Analysis of Economic Determinants of Fertility in IRAN: A Multilevel Approach

Introduction

The number of children ever born per woman has important implications for public health, economic climate, and population structure. It can influence infant, child and maternal mortality, obstetric and child health services, economic growth (or decline), independency burden, labor force participation, and age structure of populations (Cleland, 2008).

According to Population Reference Bureau (2011), Iran is amongst the twenty most populated countries of the world. Nevertheless, during the last three decades, total fertility rate (TFR) in this country has fallen considerably from 6.5 for each woman in 1983 to 1.89 in 2010 which is below the replacement fertility rate (Haub & Yanagishita, 2011). it is interesting to note that Iran now has the lowest fertility rate in the Middle East (Haub & Yanagishita, 2011).

There is a rich literature about fertility transition in Iran and how expansion in education, reduction in child mortality, urbanization, wide access to family planning services and importance of quality vs. quantity of children have contributed to the recent fertility decline in this country (M. J. Abbasi-Shavazi, P. McDonald, & M. Hosseini-Chavoshi, 2009; M. J. Abbasi-Shavazi, P. F. McDonald, & M. Hosseini-Chavoshi, 2009; Abbasi-Shavazi & Torabi, 2012; Aghajanian, 1995; Aghajanian & Mehryar, 1999; Aghajanian & Merhyar, 1999; Salehi-Isfahani, Abbasi-Shavazi, & Hosseini-Chavoshi, 2010; Torabi, 2011), However, to our knowledge, the impact of economic factors on fertility behavior has not been elaborated.

In order to provide an explanation for the dramatic change in the number of children in the Iranian households, the paper applies the intra-household bargaining model framework and investigates the extent to which economic determinants at the household and provincial levels are associated with fertility behavior. The paper linked with the household data from the 2010 Household Expenditure and Income Survey (HEIS) to provincial data from the 2010 Iran Multiple-Indicator Demographic and Health survey (IrMIDHS), the National Census of Population

and Housing and the Iran statistical year books. Then, a random intercept multilevel Poisson regression function is specified based on a collective model of intra-household bargaining power in which spouses' bargaining power is measured through extra-household gender gap indices.

Theoretical background

In an economic view, children fall into several main categories such as public goods, investment goods and consumer durable goods. When children are described as consumer durable goods, they are considered to provide a flow of utility to their spouses (Cochrane, 1975; Folbre, 1994).

Some economists have tried to explore fertility behavior of individuals and households based on microeconomic theories. Malthus's classic essay is one of the primary economic studies of fertility behavior. The essay points to the conclusion that fertility would rise and drop as income increase and decrease (Malthus & Hollingsworth, 1973). Nonetheless, the Malthusian approach cannot describe fertility of developed economies for the reason that it neglects two features of these economies, including opportunity cost of parenthood and importance of educated and healthy children, which both persuade spouses to have smaller families (Gary S Becker, 1993; Galor & Weil, 2000; Robinson, 1997). Becker' theory of fertility behavior, specially the notion of "quality and quantity of children", a substantial contribution to family and household economics, suggests those spouses who give higher quality to their children choose smaller family sizes (Gary Stanley Becker & Becker, 2009; Gary S Becker, Duesenberry, & Okun, 1960; Gary S Becker, Murphy, & Tamura, 1994; Pollak, 2003). Becker (1960, 1981, 1991, 2009) and Becker and Lewis (1974) emphasize the role of economic determinants such as household income and female labor force participation, childbearing cost in addition to socioeconomic factors in household fertility (Gary Stanley Becker & Becker, 2009; Gary S Becker, et al., 1960; Gary S Becker & Lewis, 1974). A main conclusion of Becker' theory is that unlike Malthusian theory, the effect of income on fertility is ambiguous depending on the extent of offsetting income and substitution influences (Gary S Becker, et al., 1960; Pollak, 2003; Vermeulen, 2002).

Though, according to Becker's unitary model, spouses maximize one single utility function meaning that they have same preferences about quality or quantity of their children (Bourguignon & Chiappori, 1992; Browning, Chiappori, & Lechene, 2006; Pollak, 2003; Vermeulen, 2002). Samuelson also develops a household social welfare function with one joint utility function (Samuelson, 1956). In contrast, intra-household bargaining decision making models developed by Manser & Brown (1980) and McElroy & Horney (1981) advocate different utility functions for spouses. In these models, quantity of children depends on spouses bargaining power. *Non-cooperative* and *cooperative* bargaining settings are two categories of these models which are based on the game-theoretic framework. In non-cooperative games, household members maximize their utility, taking the other members' behaviors as given (Browning & Chiappori, 1998; Iyigun & Walsh, 2007; Klawon & Tiefenthaler, 2001; Manser & Brown, 1980; McElroy & Horney, 1981). One weakness of this approach is that it does not essentially have Pareto efficient intra-household allocation of welfare (Bourguignon & Chiappori, 1992; Dosman & Adamowicz, 2006; Vermeulen, 2002). In cooperative games, household members aim is to reach an agreement on how to divide the gains from living together. In this game, a Pareto efficacy of intra-household allocation of welfare is archived. Still, both cooperative and non-cooperative games depend on a particular bargaining concept which is a limitation (Manser & Brown, 1980; McElroy & Horney, 1981; Pollak, 2003). The *collective model* developed by Chiappori (1988a, 1992) and Apps and Rees (1988) has only one assumption that all intra-household decisions are Pareto efficient; thus, it has the least limitation. In this model, household allocation problem can be defined as a unique solution to the following maximization problem:

$$W = \mu U^{A} + (1-\mu)U^{B}$$

U^A and U^B are utility function of two family members *A* and *B*. μ and (1-μ) refer to welfare weights. These welfare weights are interpreted as bargaining power of family members (Apps & Rees, 1997; Bourguignon & Chiappori, 1992; Browning, et al., 2006; Pierre-André Chiappori, 1988; Pierre-Andre Chiappori, 1992).

A number of studies have recognized, at macro level, the relationship between fertility and economic determinants such as per capita income, employment rate,

inflation rate, economic uncertainty, and economic growth (Agadjanian, Dommaraju, & Glick, 2006; Billingsley, 2010, 2011; Eun, 2003; J. R. Goldstein, Sobotka, & Jasilioniene, 2009; Hashimoto & Kondo, 2010; Kohler & Kohler, 2002; Sobotka, Skirbekk, & Philipov, 2011). Other works have noted the association between fertility and economic status of household or individuals at a micro level (Billingsley, 2011; Hondroyiannis, 2004; Klawon & Tiefenthaler, 2001; Matysiak & Vignoli, 2008; Melkersson & Rooth, 2000; Schultz, 1998). Moreover, fertility behavior has been investigated, at micro level, in the framework of household bargaining power. In these research, intra-household bargain power is derived from individual determinants such as spouses 'income, wage rate, assets, age and education as well as woman empowerment (Eswaran, 2002; Jejeebhoy, 1995; Klawon & Tiefenthaler, 2001; Kodzi, Johnson, & Casterline, 2012; Sanderson & Dubrow, 2000), or from household determinants such as the age, educational and wage differences between spouses (Iyigun & Walsh, 2007; MacPhail & Dong, 2007; Rasul, 2008). Other studies have pointed out the key role of contextual factors specifically gendered institutions meaning asymmetric social norms, cultural beliefs and laws on bargaining power of household members (Mabsout & Van Staveren, 2010; McDonald, 2000; Oláh, 2003; Van Staveren & Odebode, 2007). A few dimensions of gender gap such as wage gender gap, polygamy, political participation etc., have also been used at higher levels as proxies for intra-household bargaining power (Adsera, 2005; Erosa, Fuster, & Restuccia, 2002; Iyigun & Walsh, 2007).

In this paper, the spouses' bargaining power is explained in terms of extra-household gender gap dimensions based on benchmarking tools introduced by World Economic Forum (R Hausmann, Tyson, & Zahidi, 2011; Ricardo Hausmann, Tyson, & Zahidi, 2009) We assume a negative relationship between extra-household gender gap and intra-household woman's bargaining power.

Data source and sample selection

The first level of observations consists of households and the second level contains the Iranian provenances in the year of 2010.

We apply different data sources: 1) the 2010 Household Expenditure and Income Survey (HEIS), 2) the 2010 Iran Multiple-Indicator Demographic and

Health survey, 3) the National Census of Population and Housing, 4) the Iran statistical year books provided by Statistical Center of Iran.

The HEIS operated by Statistical Center of Iran and Iranian central bank is a nationally representative survey administered to two samples of urban and rural households in all provenances. 2010 Household Expenditure and Income Survey was the main data set. The household-level variables have been constructed by extracting data from this survey. Total sample included 38950 households. We excluded following households from the sample: we dropped households being single parent families, and households in which woman aged less than fifteen when the first child had been borne as well as households in which woman aged more than forty at the time of interview. We eliminated households with twins and other multiplies births. Totally, the final sample for the analysis consisted of 13952 households with married couple living within thirty provinces.

The 2010 IrMIDHS carried out by Iranian minister of health includes a representative sample of 31350 households in all provenances. In this study, we used provincial level data of this survey.

The National Census of Population and Housing conducted by Statistical Center of Iran was started in 1956 and has been conducted each ten years until 1986 and each five years after that time. We made use of the surveys conducted in 1986, 1996, 2006 and 2011 to compile a number of provincial variables by measuring the average of data during selected years.

Other data, at the provincial level, made available from “international statistics”, “price indices” and “political statistics” parts of Iran statistical year books from 1985 to 2010.We used an average of available data during this period to construct some variables at provincial level.

Method and variables

In this paper, the data has a two-level hierarchal structure in which 13952 households nested within thirty provinces. Clustering of observations within higher-level units can result in a hierarchically structured data set in which observations are not independent. The ordinary least square method (OLS) is not suitable for observations of this type because it can give inefficient estimates of

parameters and downwardly biased estimates of standard errors (Gelman, 2007; H. Goldstein, 2011; Hank & Kreyenfeld, 2003). Besides, the dependent variable is counts of children in each household. Count data are constrained to be non negative. Fitting a normal model to these data can cause predicted negative counts (Greene & Zhang, 2009; Verbeek, 2004; Wooldridge, 2002). Therefore, we applied a multilevel count model based on extra Poisson distribution with random intercept to account for hierarchal structure of the observations and to avoid any bias resulted from fitting a linear model to count data. According to evidence (Verbeek, 2004; Wooldridge, 2002), the probability mass function of y_i conditional x_i in count data model is:

$$P\{y_i = y \mid x_i\} = \frac{\exp\{-\pi_1\}\pi^{y_i}}{y!}$$

$$\pi_i \equiv \exp\{x_i'\beta\}$$

Therefore, the regression function based on a collective household model is specified as follow:

$$Childnum_{ij} \sim Poisson\ (\pi_{ij})$$

$$\log(\pi_{ij}) = \beta_{0j} + Lfpoure_{ij} + \sum_{i=1}^{13950}\sum_{j=1}^{30} X_{1ij} + \sum_{j=1}^{30} X_{2j}$$

$$\beta_{0j} = \beta_0 + \upsilon_{0j} + \varepsilon_{ij}$$

Following similar studies (Adsera, 2005; Hondroyiannis, 2004; Klawon & Tiefenthaler, 2001), *Childnum*, the number of children in each household, used as a proximate determinant for total children ever born. The reason is that, the does not record the total number of surviving children. Still, this measure is a good estimate of the total number of children ever born because we limit our sample to households in which women are under the age forty to avoid an underestimation of total surviving children. *Lfpoure* is the offset variable to control for the "exposure time" (i.e. the years that a woman in each household is at risk of childbearing). It is defined as the natural logarithm of the age of the oldest child in the household as a proxy for marriage span because the HEIS does not record any information about the length of marriage. X_{1ij} and X_{2j} are the individual-level explanatory variable and

the provenance-level ones in which order, υ_{0j} explains the province random effects and ε_{ij} is the individual-level error.

The main Independent variables, measured either at the household or province levels, are economic determinants. To test quantity- quality hypothesis of childbearing, we enter the per capita household educational expenditure in real price based on consumer price index (CPI) of provinces in 2010 to capture the quality of children. More, we add the total household expenditure in real price based on CPI of provinces in 2010, as a proxy for household income. The other independent variable is a categorical variable which divide households into three categories: households in the first to third income deciles (low income households), households in the fourth to seventh income deciles (middle income households), and those in the eighth to tenth income deciles (high income households). One dummy variable, indicating whether or not a woman had a job was represented to measure the opportunity cost of childbearing and raising children.

Several provincial level covariates are incorporated into the model to determine the economic status, at macro level. These independent variables are average house rent, measuring the cost of living in each provenance, the average value added in manufacturing industries which is indicative of industrial and economic development, the average amount of CPI representing inflation rate of each province, and the average employment rate.

Gender gap is derived from a number of variables at provincial level including the average female employment rate, the average male to female wage ratio in manufacturing industries, the average ratio of highly educated male to female employees (i.e. employees having master or doctorial degree) in manufacturing industries from 1985 to 2010, the average ratio of male to female election onto City and Village Councils of Iran during its first, second and third periods, in addition to the polygamy rate and the percentage of unmet need for contraception which both gathered in the year of 2010.

In order to control for demographic factors, we add family level characteristics in addition to provincial level covariates; the model contains a categorical variable classified as "having only boys", "having only girls" and "having mixed-sex children" to specify sex composition of children. Two different dummies indicating whether or not either wife or husband is literate are used as independent variables, explaining variation in the fertility behavior of literate and illiterate spouses. The average percentage of urban population in each province is incorporated as a demographic covariate at second level. Further, a binary variable defined as living in provenances in which at least sixty percent of population have Shiite religion, is entered into the model. These two demographic dummy covariates are used to control for the regional and religious fertility differences in Iran. We also incorporate the average provincial household size to measure the effects of social norms related to reproductive choice on fertility behavior of families as suggested by related papers (Quesnel-Vallée & Morgan, 2003; Voas, 2003).

Data analyses are performed using MLwiN version 2.20 and Stata version 9. We use iterated generalized least square (IGLS) estimation and the 2st order predictive quasi likelihood (PQL) method.

Results

Table 1 reports the means, the standard deviations of continuous variables, and the percentage of the categorical variables and Table 2 reports distribution of the number of children in the Iranian households.

The average number of children per household is 2.71 and both the median and the mode are two children. The provinces of Gilan and Sistan & Baluchistan, with the average numbers of children equal to 2.01 and 3.86 display the lowest and the highest number of children per household, respectively. 14% of the households are childless or have one child, 39% have two children, 27% have three and 22% have four or more. While 77% of households in Gilan and 68% in Mazandaran have a maximum of two children, nearly 74% in Sistan & Baluchistan and 70% in

Kohkloye & Boyerahmad have at least three children. This suggests a considerable divergence in household size across the Iranian provenances.

Since, the variance of the number of children is 1.65, which is quite less than its mean, the dependent variable has an under-dispersion distribution; hence, we consider an extra Poisson distribution assumption in the estimation procedure. Significance level is assumed to be at 5%.

Table 3 reports the final results from the multilevel count data model. The value of the Wald test indicates the overall goodness of fit of the model. The standard deviation of the provincial random effects (σ_{υ}) is small but significantly different from zero meaning that intercepts vary slightly over provinces. Again, the caterpillar plot of the residuals reveals that fourteen provenances differ significantly from the average level of residuals (figure 1).

Because the coefficients are not presented as marginal effects, only their signs are interpreted here. The coefficient of household per capita educational expenditure is significant and negative. Spending more on the education and training of the children is related to lower probability of demand for larger number of children. The variable of total household expenditure has a significantly negative coefficient. Noticeably, the estimated parameters for either low income households or high income ones compared to the reference group (i.e. middle income households) are significantly positive. Then, ceteris paribus, both low income and high income households have higher probability of demand for more children than middle income households. The estimated parameter for the dummy variable of being an employed woman is found to be insignificant.

At the second level, the average value added in manufacturing industries has a positive coefficient and the average house rent has a significant negative coefficient. Thus, to live in provinces with higher value added in manufacturing industries is associated with a higher probability of having larger families. By contrast, to live in provinces with higher rents is related to smaller ones. The coefficients of the average CPI and the average employment rate were not significant.

Among variables addressing dimensions of gender gap, the polygamy rate and the unmet need for contraception and the average ratio of highly educated male to female employees in manufacturing industries have significantly positive signs. The other variables in that group are insignificant. This finding indicates, ceteris paribus, the probability of demand for larger number of children is significantly higher among those households living in provinces with higher rate of polygamy, higher rate of unmet need for contraception or lower rate of scholar female employees working in manufacturing industries.

All of the demographic variables except for the average percentage of urban population in each province are significant and in the expected directions. The coefficients on both dummy variables relating to literacy of wife and husband are negative indicating the lower probability of demand for larger number of children among literate spouses. Incidentally, the estimated parameter for "having only boys" compared to the reference group of "having only girl" is negative and significant but the coefficient for "having mixed-sex children" is insignificant, which reveal the demand for a larger number of children is higher only in families with no boys. The provincial average household size has a significant positive coefficient and the binary variable for living in provenances with at least sixty percent of Shiite population has significant negative coefficient. As a result, living in areas that larger household size is more common and living in provinces where the Shiite population is not dominant increase the probability of having a larger number of children.

Discussion

This paper analysis was based on a multilevel approach, as applied in earlier works (Hank, 2002; Hank & Kreyenfeld, 2003; Van Bavel, 2010). The standard deviation of the provincial effects obtained from the random part of multilevel regression function was statistically significant providing evidence that the differences in the number of children among Iranian households could in part explained by provincial effects.

The empirical results obtained from the fixed part of the regression function appear to indicate that economic determinants at both household and provincial levels are the key factors associated to fertility of Iranian households. First, the higher the educational expenditure a household spent for each member, the smaller is the number of its children. Second, the probability of having a larger number of children drops significantly as the real total expenditure (as a proxy for family income) rise The results are supported by other works (Gary Stanley Becker & Becker, 2009; Gary S Becker & Lewis, 1974; Docquier, 2004; Hondroyiannis, 2004; Jones & Tertilt, 2008). This suggests that, in total, the impact of substitution income on fertility is greater than its offsetting effect describing the other aspect of Becker's theory of fertility. These two findings support the Becker's theory of "quality and quantity of children". In general, the preferences of Iranian families have shifted toward fewer but healthier and higher educated children. Third, both low income and high income households have significantly higher probability of having more children than those of middle income households. The results are in line with some earlier research (Billingsley, 2011). We can conclude that spouses in the middle income group decide to substitute the quantity with the quality of children while high income spouses can afford more children with good quality. Then, high income spouses don't reduce the number of children as much as those of middle income spouses. However, it should be noted that as the middle income group constituted a sizeable portion of our sample, the negative effect of the real per capita expenditure on demand for more children can be related to the fertility behavior of this specific group. Still, some studies have found the reverse (Billingsley, 2011; Galor & Weil, 2000).

We found no significant association between woman's work outside home and the demand for children (Matysiak & Vignoli, 2008). Still, there is a broad evidence on the negative association between women's employment and fertility at micro level (Matysiak & Vignoli, 2008). This finding can be explained by the fact that only thirteen percent of women in our sample were employed. Then, the opportunity cost of childbearing for women in our sample is not as much important as women in samples with high percentage of women in the labor market.

living in provenances with higher house rent and less value added in manufacturing industries is associated with a lower probability of having larger

number of children, suggesting the direct relation between the macro-level economic problems and the smaller size of household in our sample. The results are parallel to some earlier research finding that economic crisis is associated with lower fertility or childbearing postponement (Agadjanian, et al., 2006; Billingsley, 2010, 2011; J. R. Goldstein, et al., 2009; Hondroyiannis & Papapetrou, 2005; Kodzi, et al., 2012; Kohler & Kohler, 2002; Simon & Tamura, 2009). However, there are other works supporting the reverse (Gertler & Molyneaux, 1994; Hondroyiannis & Papapetrou, 2005).

As discussed earlier, we utilized gender gap dimensions measured at provincial level as indicators of intra-household bargaining power. Three of all variables referring to gender gap were significant with the anticipated effects. Higher rates of the polygamy and unmet need for contraception and a lower rate of scholar female employees working in industries as indicators for higher level of gender gap causing women to lose their bargaining power over household decision making such as quantity of children. The lower the woman's bargaining power, the more is the number of her children confirming a negative relation between woman's bargaining power and the number of her children which is well established in the literature (Adsera, 2005; Erosa, et al., 2002; Iyigun & Walsh, 2007). We can conclude Iranian women would prefer to have fewer children but of better quality than would their husbands.

As expected, almost all of the demographic variables were statistically significant meaning that, as evidenced by earlier research, demographic determinants including sex preference especially son preference (Arokiasamy, 2002; Billingsley, 2011; Poston Jr, 2002; Yamaguchi & Ferguson, 1995; Yount, Langsten, & Hill, 2000), education (Bhargava, 2007; Klawon & Tiefenthaler, 2001; Salehi-Isfahani, et al., 2010; Van Bavel, 2010), religion (Frejka & Westoff, 2008; McQuillan, 2004; Salehi-Isfahani, et al., 2010; Voas, 2007; Westoff & Frejka, 2007) and social norms of household size (Kalwij, 2010; Quesnel-Vallée & Morgan, 2003; Voas, 2003) exert prominent influences over fertility behavior.

According to our results, urbanization had no significant influence on demand for children (Abadian, 1996; Billingsley, 2011; Hank, 2002) meaning that variation between urban and household sizes has been diminished in Iran. Still, it is in

contrast with some earlier studies (Bhargava, 2007; Billingsley, 2011; Klawon & Tiefenthaler, 2001; White, et al., 2008; White, Tagoe, Stiff, Adazu, & Smith, 2005).

Conclusion

This investigation of the determinants of the demand for the number of children among a sample of 13952 Iranian households with married couple is relied on a collective model of household decision makings and uses a multilevel extra Poisson regression function.

The empirical results of the analysis derived us to conclude that three groups of determinants influence fertility behavior of Iranian households. The first group consists of economic factors either at micro or macro levels. Especially the findings show that (1) spouses' childbearing behavior has shifted towards fewer but more qualified children, which confirms the Becker's theory of "quality and quantity of children", and (2) economic conditions at macro level such as house rent and value added in manufacturing industries influence demand for the number of children. Second, distribution of intra-household bargaining power has a strong influence on fertility in Iran. Spouses exercise their power, measured through extra-household gender gap to achieve their desired number of children. As gender gap at provincial level increases, women's power in household decision making falls resulting in larger number of children; thus, Iranian women have the stronger preferences for fewer children than their husbands .Finally, although there was no difference between the number of children in urban and rural areas, the findings yield a support for the role of other demographic determinants such as literacy, social norms of household size, and religion on fertility behavior of Iranian families.

Conflict of interest

There was no conflict of interest in this study.

Acknowledgements

This study was supported by Statistical Research and Training Center. The authors are very grateful to all the staff of this center.

table1: Descriptive statistics of household's characteristics

Variable	household	woman	man
Number of children in each household	2.7 (1.29)	-	-
age		33.1 (5.03)	38.6 (6.83)
Years at risk of fertility	12.25 (5.69)	-	-
Literate	-	.81	.87
Both spouses are literate	.77		
Employed	-	.13	.96
Sex composition of children			
	.18		
Girl	.22		
Boy	.60		
Mixed-sex children			
Income deciles:			
	.29		
Low income households	.45		
Middle income households	.26		
High income households			

Note: Standard deviations are in parentheses

Table2: Observed distribution of the number of children

Count	Frequency	Proportion
0-1	4150	.14
2	11414	.39
3	7902	.27
4	3912	.14
5	1545	.052
6	720	.024
7-9	389	.0122
total	81250	1

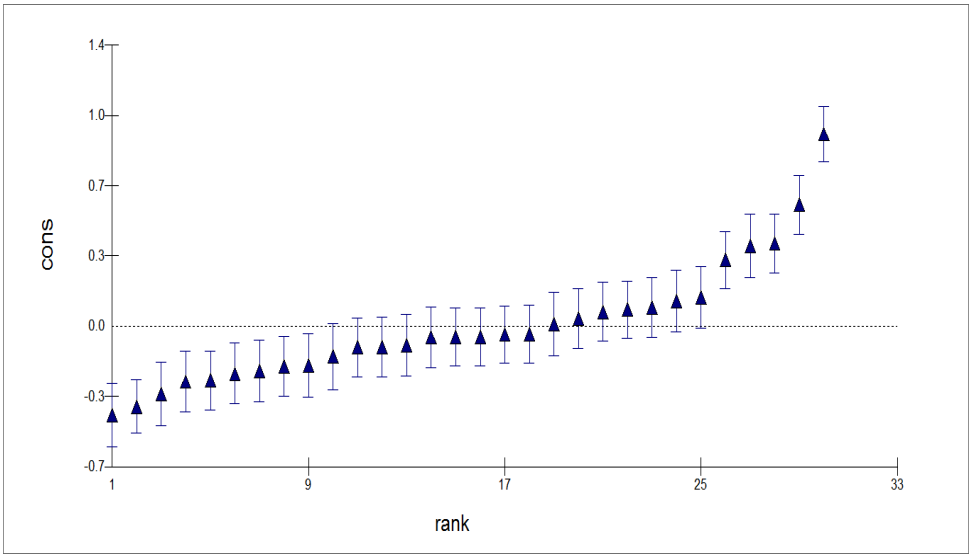
Table3: Random intercept model for number of children in household

Parameters	**Coefficient**	**SE**
Fixed:		
Household level variables		
Constant	-1.87554312	0.19676235
Total expenditure (in real price)	-0.00000001**	0.00000000
Per capita educational expenditure (in real price)	-0.00000005**	0.00000000
Income deciles ranks		
Low income households	0.03381026**	0.00629572
Middle income households	-	
High income households	0.03126070**	0.00793064
woman is literate	-0.06320526**	0.00673651
Man is literate	-0.00055862**	0.00772305
Sex composition of children		
Girl	-	
Boy	-0.10633624**	0.00918037
Mixed-sex children	0.00931823	0.00757126
provincial level variables		
Average value added in manufacturing industries	0.00000001*	0.00000000
Average amount of house rent	-0.00107305*	0.00041694
Average amount of CPI	-0.000029230	0.00029334
Average of employment rate	0.0014756	0.00554136
Percentage of unmet need for contraception (in the year of 2010)	0.01799823**	0.00577209
Polygamy rate (in the year of 2010)	0.02572139**	0.00523151
Average highly educated male to female workers ratio in manufacturing industries	00350597*	0.0014234
Average of female employment rate	-0.00949443	0.01378525

Average ratio of male to female election onto City and Village Councils	0.0001053	0.00019486
Average male to female wage ratio in manufacturing industries	0.01323182	0.02999019
Average Household size	0.06925783**	0.0151
Provenances with at least sixty percent of Shiite religion population	-0.07170510**	0.02456726
Average percentage of urbanization	-0.00071694	(0.00107305)
Random:		
σ_{υ} (between provenances)	0.0010328**	0.00032094
σ_{ε} (between households)	0.49475229**	0.00404336
Wald chi2(5) Probability > chi2	1579.07322 0.000	

Note: *p< 5%, **p< 1%

Figure 1: caterpillar plot of estimated provincial level residuals



Refrences

Abadian, S. (1996). Women's autonomy and its impact on fertility. *World Development, 24*(12), 1793-1809.

Abbasi-Shavazi, M. J., McDonald, P., & Hosseini-Chavoshi, M. (2009). *National and Provincial Level Fertility Trends in Iran, 1972–2006*: Springer.

Abbasi-Shavazi, M. J., McDonald, P. F., & Hosseini-Chavoshi, M. (2009). *The fertility transition in Iran: Revolution and reproduction*: Springer.

Abbasi-Shavazi, M. J., & Torabi, F. (2012). Women's Education and Fertility in Islamic Countries *Population Dynamics in Muslim Countries* (pp. 43-62): Springer.

Adsera, A. (2005). Vanishing children: From high unemployment to low fertility in developed countries. *The American Economic Review, 95*(2), 189-193.

Agadjanian, V., Dommaraju, P., & Glick, J. (2006). *Reproduction in upheaval: ethnicity fertility and societal transformations in Kazakhstan*.

Aghajanian, A. (1995). A new direction in population policy and family planning in the Islamic Republic of Iran. *Asia-Pacific population journal/United Nations, 10*(1), 3.

Aghajanian, A., & Mehryar, A. H. (1999). Fertility transition in the Islamic Republic of Iran: 1976-1996. *Asia-Pacific population journal/United Nations, 14*(1), 21.

Aghajanian, A., & Merhyar, A. H. (1999). Fertility, contraceptive use and family planning program activity in the Islamic Republic of Iran. *International Family Planning Perspectives, 25*(2), 98-102.

Apps, P. F., & Rees, R. (1997). Collective labor supply and household production. *The Journal of Political Economy, 105*(1), 178-190.

Arokiasamy, P. (2002). Gender preference, contraceptive use and fertility in India: regional and development influences. *International Journal of Population Geography, 8*(1), 49-67.

Becker, G. S. (1993). Nobel lecture: The economic way of looking at behavior. *Journal of Political Economy*, 385-409.

Becker, G. S., & Becker, G. S. (2009). *A Treatise on the Family*: Harvard university press.

Becker, G. S., Duesenberry, J. S., & Okun, B. (1960). An economic analysis of fertility *Demographic and economic change in developed countries* (pp. 209-240): Columbia University Press.

Becker, G. S., & Lewis, H. G. (1974). Interaction between quantity and quality of children *Economics of the family: Marriage, children, and human capital* (pp. 81-90): UMI.

Becker, G. S., Murphy, K. M., & Tamura, R. (1994). Human capital, fertility, and economic growth *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education (3rd Edition)* (pp. 323-350): The University of Chicago Press.

Bhargava, A. (2007). Desired family size, family planning and fertility in Ethiopia. *Journal of biosocial science, 39*(03), 367-381.

Billingsley, S. (2010). The post-communist fertility puzzle. *Population Research and Policy Review, 29*(2), 193-231.

Billingsley, S. (2011). Second and third births in Armenia and Moldova: An economic perspective of recent behaviour and current preferences. *European Journal of Population/Revue européenne de Démographie, 27*(2), 125-155.

Bourguignon, F., & Chiappori, P.-A. (1992). Collective models of household behavior. *European Economic Review, 36*, 355-364.

Browning, M., & Chiappori, P.-A. (1998). Efficient intra-household allocations: A general characterization and empirical tests. *Econometrica*, 1241-1278.

Browning, M., Chiappori, P.-A., & Lechene, V. (2006). Collective and unitary models: A clarification. *Review of Economics of the Household, 4*(1), 5-14.

Chiappori, P.-A. (1988). Rational household labor supply. *Econometrica: Journal of the Econometric Society*, 63-90.

Chiappori, P.-A. (1992). Collective labor supply and welfare. *Journal of Political Economy*, 437-467.

Cleland, J. G. (2008). Trends in Human Fertility. In H. K. Heggenhougen (Ed.), *International Encyclopedia of Public Health* (pp. 364-371). Oxford: Academic Press.

Cochrane, S. H. (1975). Children as by-products, investment goods and consumer goods: a review of some micro-economic models of fertility. *Population Studies, 29*(3), 373-390.

Docquier, F. (2004). Income Distribution, Non-convexities and the Fertility–Income Relationship. *Economica, 71*(282), 261-273.
Dosman, D., & Adamowicz, W. (2006). Combining stated and revealed preference data to construct an empirical examination of intrahousehold bargaining. *Review of Economics of the Household, 4*(1), 15-34.
Erosa, A., Fuster, L., & Restuccia, D. (2002). Fertility decisions and gender differences in labor turnover, employment, and wages. *Review of Economic Dynamics, 5*(4), 856-891.
Eswaran, M. (2002). The empowerment of women, fertility, and child mortality: Towards a theoretical analysis. *Journal of Population Economics, 15*(3), 433-454.
Eun, K.-S. (2003). Understanding recent fertility decline in Korea. *Journal of Population and Social Security (Population), 1*, 574-595.
Folbre, N. (1994). Children as public goods. *The American Economic Review, 84*(2), 86-90.
Frejka, T., & Westoff, C. F. (2008). Religion, religiousness and fertility in the US and in Europe. *European Journal of Population/Revue européenne de Démographie, 24*(1), 5-31.
Galor, O., & Weil, D. N. (2000). Population, technology, and growth: From Malthusian stagnation to the demographic transition and beyond. *American economic review*, 806-828.
Gelman, A. (2007). *Data analysis using regression and multilevel/hierarchical models*: Cambridge University Press.
Gertler, P. J., & Molyneaux, J. W. (1994). How economic development and family planning programs combined to reduce Indonesian fertility. *Demography, 31*(1), 33-63.
Goldstein, H. (2011). *Multilevel statistical models* (Vol. 922): Wiley. com.
Goldstein, J. R., Sobotka, T., & Jasilioniene, A. (2009). The End of "Lowest-Low" Fertility? *Population and Development Review, 35*(4), 663-699.
Greene, W. H., & Zhang, C. (2009). *Econometric analysis* (Vol. 5): prentice Hall Upper Saddle River, NJ.
Hank, K. (2002). Regional social contexts and individual fertility decisions: A multilevel analysis of first and second births in western Germany. *European Journal of Population/Revue européenne de Démographie, 18*(3), 281-299.
Hank, K., & Kreyenfeld, M. (2003). A multilevel analysis of child care and women's fertility decisions in Western Germany. *Journal of Marriage and Family, 65*(3), 584-596.
Hashimoto, Y., & Kondo, A. (2010). *Long-term effects of labor market conditions on family formation for Japanese youth*: Institute of Social and Economic Research, Osaka University.
Haub, C., & Yanagishita, M. (2011). world population data sheet. Population Reference Bureau, Washington, DC.
Hausmann, R., Tyson, L., & Zahidi, S. (2011). Global gender gap report. Geneva, Switzerland: World Economic Forum.
Hausmann, R., Tyson, L. D., & Zahidi, S. (2009). The Global Gender Gap Report (Geneva: World Economic Forum).
Hondroyiannis, G. (2004). Modeling household fertility decisions in Greece. *The Social Science Journal, 41*(3), 477-483.
Hondroyiannis, G., & Papapetrou, E. (2005). Fertility and output in Europe: new evidence from panel cointegration analysis. *Journal of Policy Modeling, 27*(2), 143-156.
Iyigun, M., & Walsh, R. P. (2007). Endogenous gender power, household labor supply and the demographic transition. *Journal of Development Economics, 82*(1), 138-155.
Jejeebhoy, S. J. (1995). Women's education, autonomy, and reproductive behaviour: Experience from developing countries. *OUP Catalogue*.
Jones, L. E., & Tertilt, M. (2008). *An economic history of fertility in the United States: 1826–1960* (Vol. 1): Emerald Group Publishing Limited.
Kalwij, A. (2010). The impact of family policy expenditure on fertility in western Europe. *Demography, 47*(2), 503-519.
Klawon, E., & Tiefenthaler, J. (2001). Bargaining over family size: the determinants of fertility in Brazil. *Population Research and Policy Review, 20*(5), 423-440.
Kodzi, I. A., Johnson, D. R., & Casterline, J. B. (2012). To have or not to have another child: Life cycle, health and cost considerations of Ghanaian women. *Social Science & Medicine, 74*(7), 966-972.
Kohler, H.-P., & Kohler, I. (2002). Fertility decline in Russia in the early and mid 1990s: The role of economic uncertainty and labour market crises. *European Journal of Population/Revue européenne de Démographie, 18*(3), 233-262.
Mabsout, R., & Van Staveren, I. (2010). Disentangling bargaining power from individual and household level to institutions: Evidence on women's position in Ethiopia. *World Development, 38*(5), 783-796.

MacPhail, F., & Dong, X.-y. (2007). Women's market work and household status in rural China: Evidence from Jiangsu and Shandong in the late 1990s. *Feminist Economics, 13*(3-4), 93-124.
Malthus, T. R., & Hollingsworth, T. (1973). *An essay on the principle of population*: Dent London.
Manser, M., & Brown, M. (1980). Marriage and household decision-making: A bargaining analysis. *International Economic Review, 21*(1), 31-44.
Matysiak, A., & Vignoli, D. (2008). Fertility and women's employment: A meta-analysis. *European Journal of Population/Revue européenne de Démographie, 24*(4), 363-384.
McDonald, P. (2000). Gender equity, social institutions and the future of fertility. *Journal of Population Research, 17*(1), 1-16.
McElroy, M. B., & Horney, M. J. (1981). Nash-bargained household decisions: Toward a generalization of the theory of demand. *International Economic Review, 22*(2), 333-349.
McQuillan, K. (2004). When does religion influence fertility? *Population and Development Review, 30*(1), 25-56.
Melkersson, M., & Rooth, D.-O. (2000). Modeling female fertility using inflated count data models. *Journal of Population Economics, 13*(2), 189-203.
Oláh, L. S. (2003). Gendering fertility: Second births in Sweden and Hungary. *Population Research and Policy Review, 22*(2), 171-200.
Pollak, R. A. (2003). Gary Becker's contributions to family and household economics. *Review of Economics of the Household, 1*(1-2), 111-141.
Poston Jr, D. L. (2002). Son preference and fertility in China. *Journal of biosocial science, 34*(3), 333-347.
Quesnel-Vallée, A., & Morgan, S. P. (2003). Missing the target? Correspondence of fertility intentions and behavior in the US. *Population Research and Policy Review, 22*(5-6), 497-525.
Rasul, I. (2008). Household bargaining over fertility: Theory and evidence from Malaysia. *Journal of Development Economics, 86*(2), 215-241.
Robinson, W. C. (1997). The economic theory of fertility over three decades. *Population Studies, 51*(1), 63-74.
Salehi-Isfahani, D., Abbasi-Shavazi, M. J., & Hosseini-Chavoshi, M. (2010). Family planning and fertility decline in rural Iran: the impact of rural health clinics. *Health Economics, 19*(S1), 159-180.
Samuelson, P. A. (1956). Social indifference curves. *The Quarterly Journal of Economics, 70*(1), 1-22.
Sanderson, S. K., & Dubrow, J. (2000). Fertility decline in the modern world and in the original demographic transition: Testing three theories with cross-national data. *Population and Environment, 21*(6), 511-537.
Schultz, T. P. (1998). Eroding the economic foundations of marriage and fertility in the United States. *Structural Change and Economic Dynamics, 9*(4), 391-413.
Simon, C. J., & Tamura, R. (2009). Do higher rents discourage fertility? Evidence from US cities, 1940–2000. *Regional Science and Urban Economics, 39*(1), 33-42.
Sobotka, T., Skirbekk, V., & Philipov, D. (2011). Economic recession and fertility in the developed world. *Population and Development Review, 37*(2), 267-306.
Torabi, F. (2011). *Marriage postponement and fertility decline in Iran.* London School of Hygiene and Tropical Medicine (University of London).
Van Bavel, J. (2010). Choice of study discipline and the postponement of motherhood in Europe: The impact of expected earnings, gender composition, and family attitudes. *Demography, 47*(2), 439-458.
Van Staveren, I., & Odebode, O. (2007). Gender norms as asymmetric institutions: A case study of Yoruba women in Nigeria. *Journal of Economic Issues, 41*(4), 903-925.
Verbeek, M. (2004). *A guide to modern econometrics*: Wiley.
Vermeulen, F. (2002). Collective household models: principles and main results. *Journal of Economic Surveys, 16*(4), 533-564.
Voas, D. (2003). Conflicting preferences: a reason fertility tends to be too high or too low. *Population and Development Review, 29*(4), 627-646.
Voas, D. (2007). Does religion belong in population studies? *Environment and Planning A, 39*(5), 1166.
Westoff, C. F., & Frejka, T. (2007). Religiousness and fertility among European Muslims. *Population and Development Review, 33*(4), 785-809.
White, M. J., Muhidin, S., Andrzejewski, C., Tagoe, E., Knight, R., & Reed, H. (2008). Urbanization and fertility: An event-history analysis of coastal Ghana. *Demography, 45*(4), 803-816.
White, M. J., Tagoe, E., Stiff, C., Adazu, K., & Smith, D. J. (2005). Urbanization and the fertility transition in Ghana. *Population Research and Policy Review, 24*(1), 59-83.
Wooldridge, J. M. (2002). *Econometric analysis of cross section and panel data*: The MIT press.

Yamaguchi, K., & Ferguson, L. R. (1995). The stopping and spacing of childbirths and their birth-history predictors: rational-choice theory and event-history analysis. *American Sociological Review*, 272-298.

Yount, K. M., Langsten, R., & Hill, K. (2000). The effect of gender preference on contraceptive use and fertility in rural Egypt. *Studies in family planning*, *31*(4), 290-300.