

[DRAFT]

**Assessment of the own-children estimates of fertility applied to the 2011 Iran Census and the 2010 Iran-MIDHS\***

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**ABSTRACT**

The own-children method is a reverse-survival technique to estimate fertility measures using census or survey data. Although the method has been developed in the 1960s, it is still a useful method for analysing fertility measures as it provides single-year estimates of fertility for 15 years prior to a census. This paper presents the fertility trends in Iran during 1997 and 2011 derived from the 2010 Iran Multiple Indicator Demographic and Health Survey (IrMIDHS) and the 2011 Census, and examines the validity of the own-children method of fertility estimates. The results are assessed by a detailed investigation of mortality assumptions, the presence of non-own children, and age misreporting. ASFRS and TFRs are estimated for Iran by area of residence and province. The fertility estimates obtained alternatively from two matching procedures (using relationship to head of household and mothers' line number) are investigated to see the accuracy of the results. The census OCM estimates are also compared with those obtained from the IrMIDHS. The results show consistency between the own-children estimates obtained from the two data sources as well as from the two matching procedures. The TFR for 2011 is estimated to be 1.75 indicating a rather slow decline in recent years. This has implications for the newly designed pronatalist policies for Iran.

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## **INTRODUCTION**

Iran has experienced a phenomenal fall of fertility in recent decades. Total fertility rate declined from around 6.5 children per woman in the mid-1980s to around 2.0 in 2000 and further declined to 1.8 in 2006 (Abbasi-Shavazi *et al.* 2009). This decline has been pervasive as most provinces are now experiencing below-replacement level fertility (Abbasi-Shavazi *et al.* 2013). This unprecedented and universal fall of fertility has led to the concern that there is a possibility of an emergence of very low fertility in the country. Accordingly, comments have been made on the consequences of very low fertility and the possibility of reaching negative population growth within the next decade. Based on this assumption, the government and the parliament have recently focused their attention on the negative consequences of low fertility particularly on the ageing population, and have introduced pronatalist policies aiming to raise fertility to 2.5 children per woman in the foreseeable future (Parliament Research Center, 2013).

Despite the heated debate on the future of population growth and consequences of low fertility, no comprehensive study has been undertaken to thoroughly examine the current levels, trends, and patterns of fertility, and to project the future trend of fertility for Iran. Differential fertility and its impact on regional population imbalance in the country is also a concern for policy makers in the country. The main aim of this paper is to present the latest estimates of fertility in Iran and assess the accuracy and validity of the fertility measures. Although, a major part of the paper deals with the assessment of the own-children estimates, the paper will also discuss the past, current, and future direction of fertility in Iran. Policy implications of the finding are discussed.

## **THE OWN-CHILDREN METHOD**

Cross-sectional and period fertility measures estimated at the time of the census or surveys have usually been utilised by policy makers and some population experts to show the past and future trends of fertility. However, it has been established that fertility level at census year can be affected by underreporting of the children under two years of age, and they do not show fluctuations of fertility prior to the census. Thus, single-year estimates of fertility prior to a census provide a comprehensive picture of the past and future fertility trends. Such analysis is possible through the application of the own-children to census or survey data.

The own-children method is one of the techniques which can be used to estimate fertility measures where vital registration data are incomplete, or where relevant questions have not been asked in the census. This method is a reverse-survival technique for estimating age-specific fertility rates for years previous to a census or household survey. The method was first developed by Grabill and Cho (1965) to measure current fertility from population data on young children. It was then applied to the 1910, 1940, 1950 and 1960 Censuses of the United States to study differential current fertility (Cho, Grabill and Bogue 1970; Cho 1973). The technique and its application have been elaborated on in a series of publications dating back to the 1960s (Grabill and Cho 1965; Cho *et al.* 1970; Cho 1971, 1973; Rindfuss 1976, 1977; Retherford and Cho 1978; Retherford *et al.* 1979;

Retherford, Cho and kim 1984; Cho, Retherford and Choe 1986; UN 1983; Jain 1989; Dugbaza 1994; Abbasi-Shavazi 1997, 2001).

Cho et al. (1970: 18) marked three advantages of using the own-children method in studying differential fertility. First, the method involves an additional set of coding steps or matching procedure to the existing census or household survey data. Second, using available census data, the method allows the study of differential fertility for years preceding the census. Third, the technique can be applied to sample surveys with modifications and refinements, thereby enhancing the power of these surveys to study differential fertility. Furthermore, the own-children method is superior to children-ever-born data in that it provides time-associated measures of fertility. The method gives an estimation of 'current fertility', whereas children-ever-born data are useful in estimating 'cumulative fertility'. It has been argued (Cho et al. 1970) that cumulative fertility carries a lag in fertility change over time while the current fertility clearly indicates the results of the actual change in recent fertility. For example, if we compare cumulative fertility rates based on children ever born and those constructed by current fertility data for 2010, the latter would reflect the actual fertility in 2010, while the former would reflect the fertility which mostly occurred in the 1990s.

This paper examines the reliability of the own-children estimates derived from the Iran 2011 census as well as the 2010 Iran Demographic and Health Survey. The method is also applied to the three previous decennial censuses to estimate fertility measures for the period 1971 to 2006. Each of the censuses provides fertility estimates for 15 years prior the survey, i.e 1971-1986; 1981-1996; 1991-2006. Thus, in addition to the fertility measures for four decades, there are five-year overlaps in the fertility estimates in each of the census (i.e. 1981-1986; 1991-1996; and 2001-2006) and a 10-year overlap between the results derived from the 2006 and 2011 censuses. These measures provide an excellent opportunity to examine the accuracy of the results in each of the censuses. Furthermore, the 2010 IrMIDHS provides additional source of information for estimating fertility during 1996 and 2010.

The results of the own-children method using the three censuses are also compared with the results obtained from other direct and indirect methods of fertility estimation. A question on mother's line number has been included in the 2006 and 2011 censuses. Using this information, every child is directly linked with his/her mother in the household. This allows us to estimate fertility either based on matching procedure using the relationship to the head of household or based on the mother's line number. It is expected that the mother line number yields more accurate results. This additional information is valuable for investigating the accuracy of the results from the alternative matching procedure using the relationship to the head of household.

Other examinations for the accuracy of the results include a detailed investigation of mortality assumptions, the presence of non-own children, age misreporting, and under reporting. Having examined the reliability of the results of the own-children estimates, total fertility rates and age-specific fertility rates are presented for Iran for the period 1971-2011.

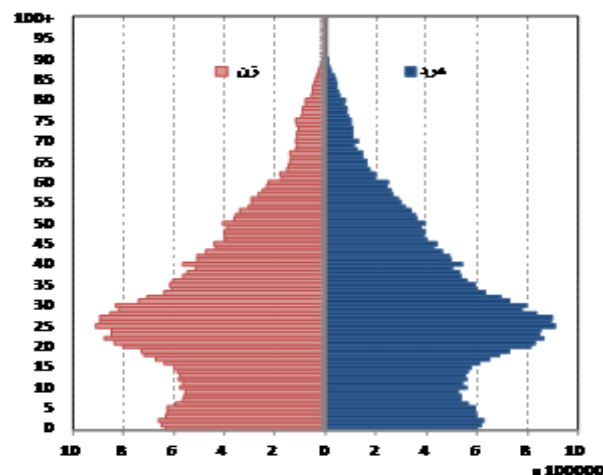
## ASSESSMENT OF THE OWN-CHILDREN RESULTS

Four implicit assumptions would be involved if own-children data were used as recorded by the census: that ages of children are correctly reported; that all children live with their mothers; that errors in the specification of mortality are negligible for women and children; and that all women and children are covered by the census (Grabill and Cho 1965; Cho et al. 1970). The results of the own-children method may be biased if these assumptions are not met and thus some adjustments should be made to overcome the problems. In using the own-children method to estimate fertility measures for sub-groups of population, another assumption should be made because the method uses the characteristics of the women at the time of the census reversing back up to 15 years before the census. This is what Rindfuss (1976, 1977) called 'constancy of group membership' in which it is assumed that the person's status at the time of the census is applicable to each of the 15 years preceding the census. Certain characteristics such as race, ethnicity and birthplace are essentially unchangeable, while other characteristics such as income and education may be subject to considerable change in the 15 years. The following is an investigation to see whether the own-children data used in this study meet the assumptions or not.

### Age reporting

The major limitation of the own-children method in developing countries has been shown to be age misreporting (Cho et al. 1986: 49), which may severely distort both the age pattern of fertility and the estimated trend of fertility. It will cause year-to-year fluctuations in own-children fertility estimates. This problem is not serious for Iran, as age reporting has been improved in the recent censuses.

Figure 1. Age Pyramid of Iran, 2011 census



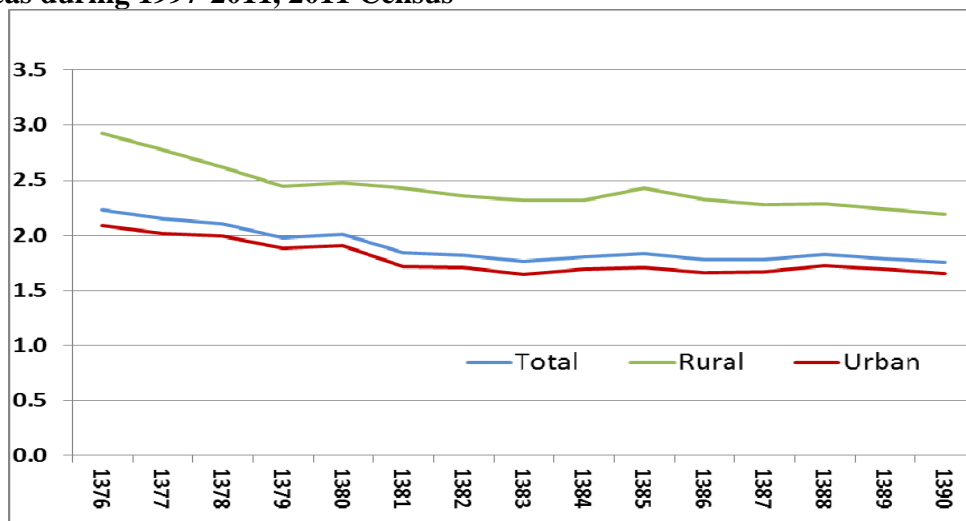
One way to ascertain the improvement in the age reporting is to look at the age pyramid plotted by single year. Single-year age distribution of population in the Iran 1986, 1996, 2006 and 2011 censuses has shown that despite minor age misreporting for some ages, in

general, the age reporting has been relatively accurate. Figure 1 shows Iran's age pyramid based on the 2011 census.

Age misreporting may not affect the age pattern of total population and thus will not impact the own-children estimates, but there are a few provinces with lower level of socio-economic development like Sistan and Baluchistna, Kohgiluyeh Boorahmad, and Ilam, where there are indications of age misreporting in the census (Abbasi-Shavazi *et al.* 2013). Own-children fertility estimates in these provinces should be treated with care.

The other way to investigate the effects of age misreporting in the own-children fertility estimates is to look at the trends of fertility in single years. Figure 2 shows trends of total fertility rates for Iran from 1996 to 2011. No major year-to-year fluctuation in total fertility rates was found.

**Figure 2 Own-children estimates of Total Fertility Rates for Iran by urban and rural areas during 1997-2011, 2011 Census**



Distortions caused by age misreporting can be lessened by aggregating estimates over several years. One way to overcome unusual single year fluctuations, fertility rates are calculated for three five-year periods, 1996-2000, 2001-2005; and 2006-2011, and thus, the effect of age-misreporting is diminished. Moreover, age-specific fertility is calculated for five-year age groups; such aggregation is particularly useful for minimising errors from age-misreporting in applications where the reporting of the ages is inaccurate. This can be applied to the provinces where there are indications of age misreporting. Overall, the problem of age misreporting in the own-children fertility estimates based on the 2011 census as well as earlier censuses appeared to be minimal.

## **Mismatching errors**

Another common source of bias in the own-children estimates of fertility arises from mismatching errors, which can be divided into three types: mismatch, misallocation of unmatched children and failure to record the existence of some children because they are living in a geographic area other than that in which their mother lives (Cho et al. 1986:7); but bias from these sources tends to be small compared with bias from age misreporting. One possible pattern is that the biological mother and her child live with the child's maternal grandmother, forming a three-generation household. Probably the biological mother is attending school and her mother is responsible for the infant's care. Under these circumstances, it is quite possible that the infant is reported as the grandmother's child rather than the mother's child (Rindfuss 1977:13).

For some families, the method may be affected by the extent to which younger children are not living with their own mothers. This phenomenon may vary not only between different societies, but also between subcategories of a population. Although some children may have left their homes, in principle their number should be small. In Iran, more than 95 per cent of household members comprised of parents and children, and less than 5 per cent of household members were other members of the family or non-relatives (Abbasi-Shavazi *et al.* 2013). Thus, the proportion of mismatched children in such circumstances tends to be very small, and thus its impact on the fertility measures is trivial.

## **Under-reporting**

Mismatch may also stem from under matching. Under-reporting of children ever born or children surviving is one of the examples of under-matching. Undercount is a much less serious source of errors than age misreporting, but it can have impact on the fertility estimates for the census year or the two years preceding the census. The own-children method permits an adjustment for the under-enumeration of children and women at the census in the calculation of fertility rates. If under-enumeration for children and women is the same, it has no effect on the own-children estimates of fertility.

Direct estimates of fertility using the number of children during the last 365 days showed that the total fertility rate for Iran dropped to around 1.6 children per woman. This was a relatively significant decline from 1.8 in 2006. A question arose as to whether the drop in fertility in 2011 was real, and if so, what are the potential explanations for this decline. Otherwise, what reasons can justify the drop of 0.2 of a child in the census year?

Tempo effect might be one reason for fertility decline in a given period. The Ahmadinejad government introduced pronatalist policy by which around IRR 10,000,000 equivalent of a gold coin would be given to every child born in 2010 onward. Had this policy been successfully implemented, fertility would have risen in 2011 slightly. Our results show the opposite. This leads to the assumption that fertility may have declined due to the economic hardship and in turn, to postponement of marriage. Though this reason seems logical, the impact of economic hardship could not be justified for only

2010 and 2011 as the economic condition was not greatly different from previous years. The third reason for this decline is the underreporting of children under two in the 2011 census.

Comparison of births registered by the Vital Registration Organization for the years 2007 to 2011 with children aged 0, 1, 2, 3, and 4 in the 2011 census is demonstrated in Table 1. The results indicate underreporting of children in the census as compared with the registration data. Based on this table, around 7.8 per cent of births (0 year old), and around five per cent of those aged one (1 year olds) were not reported in the 2011 census.

**Table 1. Number of children 0-4 registered by the Vital Registration Organization as compared with those in the 2011 Census**

Age	2011 Census	Registered Births	Registered Death	Difference (<1 years-births)	
				N	%
0	1,231,735	1,344,599	11,000	-101864	-7.58
1	1,269,029	1,335,768	925	-65814	-4.93
2	1,283,058	1,316,608	925	-32625	-2.48
3	1,231,893	1,267,308	925	-34490	-2.72
4	1,216,837	1,242,858	925	-25096	-2.02

Thus, the results confirm that the drop in total fertility in 2011 may have partly been due to the underreporting of the children under two. Adjustment for this underreporting would increase the TFR for 2011 to 1.75.

### **The presence of non-own children**

Presence of non-own children, that is those whose mother could not be identified in the household, can affect the own-children estimates. The presence of non-own children in the data does not affect the level of fertility, as these children are distributed based on the proportion of children whose mother's age has been identified in the census files. However, misallocation of non-own children to older mothers is a source of mismatching which can lead to an older age pattern in fertility. It is generally assumed that the distribution by age of mother of unmatched children aged under 15 is the same as that of those whose mothers were identified. The non-own children could come disproportionately from the younger unmatched age group, yet are assumed to be distributed by age of mother in the same proportions as own children. This would produce an effective reapplication to older maternal ages resulting in overestimation of fertility in older ages and underestimation for younger ages. However, such effects on total fertility rates are small. The own-children method has worked very well in overseas analyses where the proportion of non-own children has been very small, or no more than 5 to 10 per cent. Cho et al. (1986: 41) illustrated the effect of matching errors on own-children estimates for American Samoa and East Java. The percentage of non-own children was very high, at around 22 to 30 per cent of all children, for American Samoa, which resulted in only a small effect on the fertility estimates. The method also produced

reasonable patterns of fertility for Australian Aboriginals, for whom non-own children constituted 25 to 30 per cent of all children (Jain 1989; Dugbaza 1994).

In this study, the effects of non-own children on the own-children estimates of fertility are minor. For most of the censuses, around 3 per cent of children were considered as non-own children except for the figures based on the 2011 census and 2010 IrMIDHS using the Mother's line number (Table 2). It was expected that using mother's line number would ideally yield a more accurate result but it appeared that in both census and IrMIDHS data, fewer children were matched using this procedure. One reason may be that by using information from the question on the Relationship to Head of Household, one can make various assumptions to increase the matching of children to mothers. The other plausible reason for this is that the question on mother's line number is not considered as an important question or alternatively the instruction for recording mother's line number has not been clear for interviewers. If this is true, mother's line number could be missing for some children, and others may have been matched to other children or family members.

**Table 2. Distribution of non-own children (%) by age and type of matching procedure in various censuses, the 2000 IDHS and 2010 IrMIDHS**

Census	Age															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	0-14
<b>1986</b>	2.5	2.1	2.0	2.0	2.0	2.1	2.3	2.5	2.6	2.8	3.2	3.4	4.0	4.3	5.2	<b>2.9</b>
<b>1996</b>	2.3	2.1	2.1	2.1	2.1	2.1	2.2	2.2	2.4	2.6	2.7	3.0	3.3	3.6	4.0	<b>2.6</b>
<b>2006<sup>1</sup></b>	1.7	1.5	1.9	1.8	1.9	2.1	2.5	2.7	2.7	3.0	3.3	3.4	3.9	4.3	5.1	<b>2.9</b>
<b>2006<sup>2</sup></b>	1.2	1.8	2.0	2.0	2.1	2.5	2.9	2.9	3.1	3.5	3.8	4.1	4.6	4.9	5.8	<b>3.2</b>
<b>2011<sup>1</sup></b>	1.3	1.3	2.4	1.7	1.9	2.1	2.2	2.5	2.8	3.1	3.2	3.6	3.9	4.1	5.1	<b>2.7</b>
<b>2011<sup>2</sup></b>	5.3	5.0	5.9	5.3	5.4	5.6	5.5	5.8	6.2	6.6	5.9	6.3	6.7	6.9	7.8	<b>6.0</b>
<b>IDHS 2000</b>	1.7	1.8	2.0	1.9	2.2	2.7	2.8	3.0	3.0	3.2	3.2	3.6	4.0	4.3	5.3	<b>3.2</b>
<b>IDHS 2010<sup>1</sup></b>	1.3	0.9	0.9	1.1	1.4	1.2	1.4	2.0	1.3	2.4	1.9	2.3	2.5	3.0	3.5	<b>1.8</b>
<b>IDHS 2010<sup>2</sup></b>	5.7	4.3	5.9	4.7	5.2	5.5	6.0	6.9	6.0	7.5	7.4	6.7	7.6	7.0	9.4	<b>6.4</b>

Source: Own-children data obtained from the 1986, 1996, 2006 and 2011 censuses of Iran, and the 2000 and 2010 IDHS

<sup>1</sup> % of Non-own children obtained from the matching children by relationship to the head of household.

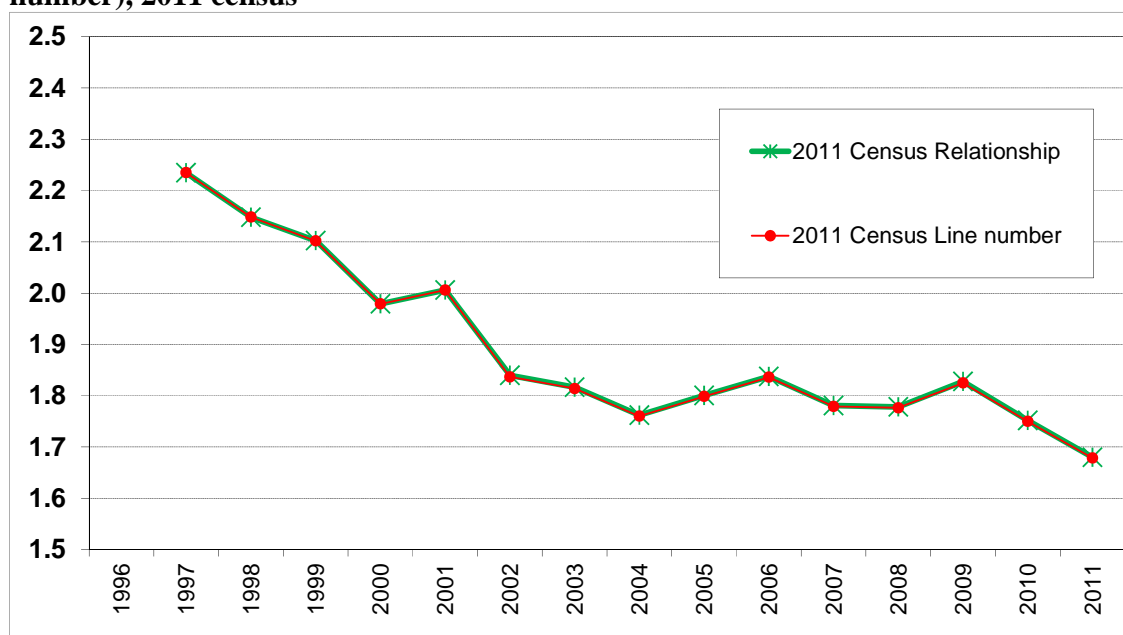
<sup>2</sup> % of Non-own children obtained from the matching children using mother's line number.

The other conclusion from the table is that percentages of the own children tend to decline by age of child. The reason may partly be due to the high proportion of children living apart from their parents. Our results indicate that, firstly, the percentage of non-own children is not high, and secondly, the age pattern of non-own children is plausible.

We examined the degree by which the presence of non-own children can affect the total fertility rates obtained from the two matching procedures. Figure 3 illustrate the total fertility rates obtained from the 2011 census alternatively by using the relationship to head of household and mother's line number.

As indicated, the level and trends of TFRS obtained by the two procedures are identical. In other words, there is no difference between the results obtained from the 2011 census using the mother's line number in which around six percentage of children were non-own as compared with those obtained from the census using relationship to head of household.

**Figure 3. Own-Children estimates of Total Fertility Rate during 1997-2011 using the two matching procedure (relationship to the Head of Household and Mother's line number), 2011 census**



Source: Abbasi-Shavazi *et al.* 2013

Including the question on mother's line number in the survey and the census allowed us to assess the quality of the data and accuracy of the matching procedure. It also made it possible to examine the impact of the non-own children on the final results which was minimal in this study.

### Mortality assumptions

The own-children measure can also be affected by the mortality of mothers, since orphaned children cannot be assigned to their own mothers and will, therefore, not be included in the computation of any averages; the problem is not serious when maternal mortality is low. Cho (1973: 270-271) employed alternative model life tables, showing a difference in life expectancy of about 10 years, reflecting two substantially different

levels of mortality; he found that the estimated total fertility rates differed by less than 5 per cent and that the differences in the age-specific fertility rates were also very small, indicating a rather low level of sensitivity to mortality estimation errors. Maternal mortality ratio has declined from around 237 per 100,000 live births in 1976 to around 37 in 1996 (Abbasi-Shavazi *et al.* 2005) and it is estimated to be around 30 in recent years. Thus, the impact of maternal mortality on the own-children fertility estimates, if at all, is negligible.

To examine the effects of mortality on the own-children estimates derived from the 2006 census, the following tests were conducted. First, the life expectancy of 69.7 for the country was used to estimate survivorship probabilities from the four Regional Model Life Tables (North, South, East and West). As the West model is more appropriate for the situation of Iran, we used two life expectancies from the highest and lowest levels. Life expectancy from Gilan province was chosen as the highest level and that of Sistan and Baluchistan was selected as the lowest level. We then applied these two life expectancies to the West Regional Model Life Table to see the impact of different level of mortality on the own-children estimates. Table 3 illustrates the results.

**Table 3. Comparison of own-children estimates of TFRs using various life expectancies and different model life tables, 2006 Census**

Model Life Table		Year														
Region	Life Expectancy	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
North	69.7	4.0	3.6	3.3	2.8	2.8	2.4	2.3	2.3	2.1	2.1	2.0	1.9	1.9	1.8	1.9
South	69.7	4.1	3.8	3.4	2.9	2.9	2.5	2.4	2.3	2.2	2.2	2.1	2.0	2.0	1.9	1.9
East	69.7	4.0	3.6	3.3	2.8	2.8	2.5	2.3	2.3	2.1	2.1	2.0	2.0	1.9	1.9	1.9
West	69.7	3.9	3.6	3.2	2.8	2.8	2.4	2.3	2.2	2.1	2.1	2.0	1.9	1.9	1.8	1.9
West	64.0	4.0	3.6	3.3	2.9	2.9	2.5	2.4	2.3	2.1	2.2	2.1	2.0	1.9	1.9	1.9
West	71.0	3.9	3.6	3.2	2.8	2.8	2.4	2.3	2.2	2.1	2.1	2.0	1.9	1.9	1.8	1.9
Ratio of TFRS using life expectancy of 71 to 69.7		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	1.00	1.00
Ratio of TFRS using life expectancy of 64 to 69.7		1.02	1.02	1.02	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.02
Difference		0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.02

Source: Abbasi-Shavazi *et al.* 2013

As indicated in Table 3, the TFR estimated for 2006 based on different life expectancies and different model life tables is 1.9. It is important to note that even using life expectancy of 64 or 71 (7 years difference) did not make any impact on the TFR for 2006 and the years preceding the census. However, there was a minor impact on the TFR for earlier period. For example, using the lowest and highest life expectancy (64.0 and 71.0 years) applied to the West model produced TFR of 4 and 3.9, respectively. This means that by using lower level of life expectancy, more children will be reverse survived than if we use higher level of life expectancy. Despite this, however, the difference between the TFR estimated based on different life expectancies and model life tables was only 3 to 4 per cent and for some years the difference was only 2 per cent. This confirms the

low sensitivity of the own-children estimates to mortality assumptions particularly in countries like Iran (Khosravi *et al.* 2007) where mortality is low.

### **The factor of migration**

Another deficiency of the own-children method is that it does not take the factor of migration into account (United Nations 1983: 183; Cho *et al.* 1986: 6). This is a major source of error in estimating fertility in areas that are faced with either high in- or out-migration. For example, if there is a high out-migration from rural areas with high fertility and high in-migration in urban areas where fertility is lower, this can influence level of fertility in both origin and destination places. This may cause overestimation of fertility for recently arrived migrants who came from high-fertility areas. Suppose that there has been a large migration to a city where fertility is low. Also, consider that these migrants have come from a place with high fertility. At the time of the census, children of these high-fertility migrant women are considered as the births that occurred in the destination place during the 15 years prior to the census. Thus, the fertility at the place of destination can be upwardly estimated, and this will not reflect the true picture of the fertility level at the place of destination. The other side of the story is that when high-fertility migrants are moving out of a place, then the fertility of the origin will be estimated downward.

The impact of migration on Iran's fertility at the national level is negligible as other nationalities in Iran who are mainly Afghans and Iraqis constitute only less than two per cent of Iran's population (Statistical Center of Iran, 2012). Although the TFR for Afghans in Iran is twice higher than the native population, the weight of Afghan population in Iran is low and thus does not affect the fertility level. Nevertheless, the situation in small areas will be different especially if they experience large in- or out-migration. As the focus of this paper is only on the national level, the discussion on the impact of migrants in different districts of Iran is irrelevant here.

### **Consistency of the 2011 census results and the 2010 IrMIDHS**

The consistency and reliability of the own-children fertility measures can be examined by comparing them with fertility estimates derived from other sources including vital statistics. Vital registration data are not affected by heaping of children's age, and the results are not subject to distortions, whereas own-children estimates of fertility show peaks and troughs in certain calendar years according to the pattern of heaping of children's ages in the census. However, estimates from births registration data are not usually available. One reason is that birth registration system in Iran produces tables on births but not the population. Thus, they should rely on projections based on censuses to calculate the number of women as denominators for fertility measures.

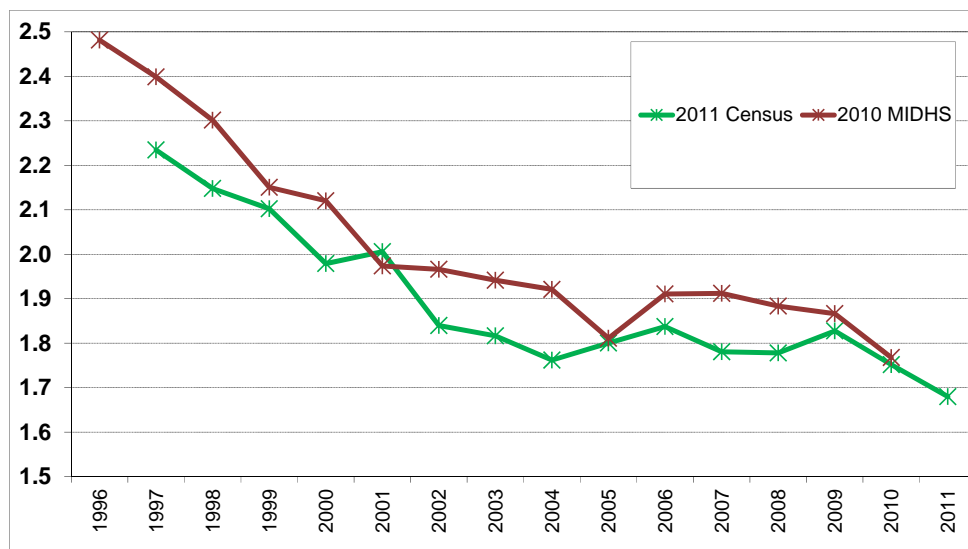
In the absence of estimates from the birth registration data, sample surveys provide useful data to compare the results with census data as alternative sources. The 2010 IrMIDHS provided an ideal opportunity to apply the own-children and compare the

results from these two sources with other estimates derived from the 2011 censuses as there were overlaps between the time of these alternative sources.

Figure 4 depicts the levels and trends of TFRs estimated alternatively from the 2010 IrMIDHS and the 2011 Census. The estimates from the IrMIDHS data are slightly higher than those estimated from the census data. The higher estimate of TFR based on the IrMIDHS is probably due to the higher proportion of single women missing from the survey while they have may have been recorded in the census data. The higher estimate of TFR based on the IrMIDHS is probably due to the higher proportion of single women missing from the survey while they have may have been recorded in the census data. Hull and Hartanto (2009) argued that higher fertility estimated from the DHS as compared to census in Indonesia was due to the significant number of single women missing from the DHS sample. This led to smaller denominator and thus fertility was overestimated.

Despite the small difference in TFRs based on the two data sources, the agreement between the two sets of TFRs is very good. The two estimates show downward trend during the 15 years preceding the census and the survey. They also show that the declining trend has been slow in recent years. The difference between the levels of TFRs from the two data sets is not large and the ratio between the two is close to unity.

**Figure 4. Own-children estimates of TFR for Iran using the 2011 census and the 2010 IrMIDHS**



Source: Abbasi-Shavazi et al. 2013

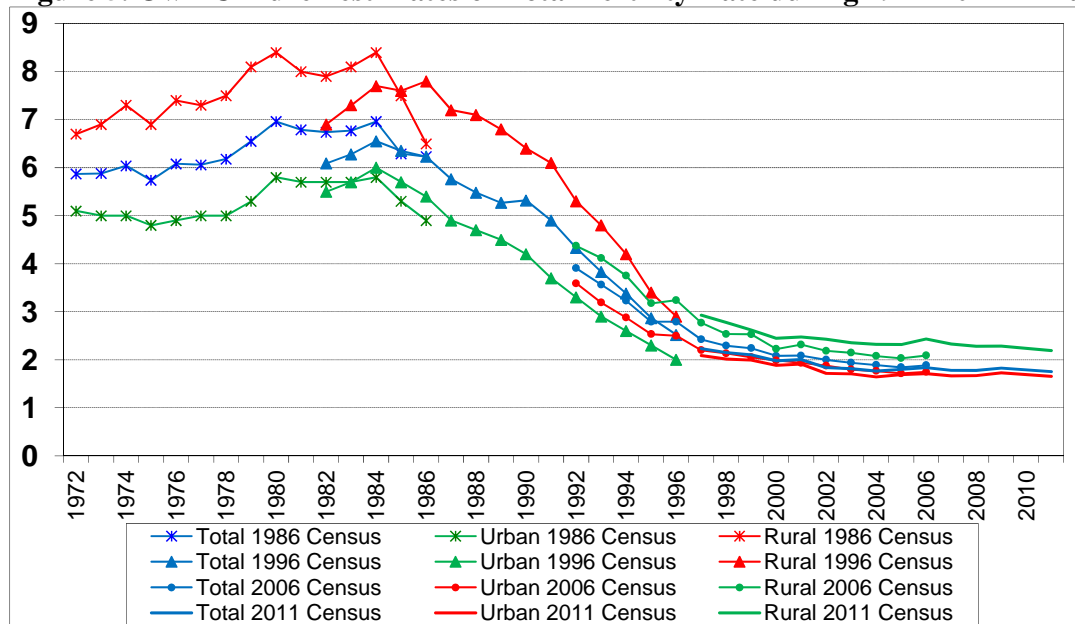
The consistency and agreement between the two TFRs calculated from the two sources is an indication of the reliability and accuracy of the own-children estimates.

## FERTILITY LEVELS AND TRENDS OF FERTILITY, 1970-2011

The accuracy of the own-children estimates has now been established, and we turn to the analysis of fertility levels, trends and patterns in Iran during 1971-2011 (Figure 5). The results show that Iran experienced modest decline in fertility during the 1970s (Amani 1970, 1996; Ladier-Fouladi 1997; Mirzaie 2005; Padidar Nia, 1977, pp. 133–136, Mirzaie 2005), followed by a rise in fertility during the 1976–1984 period, partly due to the suspension of the family planning program by the government. Studies (Salehi-Isfahani and Tandon 2000; Hosseini-Chavoshi *et al.* 2006; Erfani and McQuillan 2008) have shown that the timing of fertility shifted towards an earlier pattern of childbearing during the early years of the 1980s, and this moved the level of fertility upward.

Despite this, the high fertility regime was short lived, and fertility started to decline by the mid-1980s. TFR declined from 7.0 in 1980 to around 6.3 in 1986, and further to around 5.6 in 1988 (the estimated figure based on the 1996 census was 5.5 as compared with 5.8 based on the 2000 IDHS). The decline of fertility was slow until the government population policy was reversed and a new family planning program was officially inaugurated in 1989. TFR fell sharply from that time dropping from around 5.6 in 1988 to around 2.8 in 1996, a decline of 50 per cent in eight years. Although the fertility decline accelerated after the revival of the family planning program, the simultaneity of the decline and the population policy change in the late 1980s is indicative of the impact of other factors influencing the decline. The own-children estimates of fertility for Iran based on the 2000 IDHS showed that the TFR had reached replacement level (2.2) by 2000, and the downward trend continued and TFR declined to 1.8 in 2006 (Abbasi-Shavazi *et al.* 2009).

**Figure 5. Own-Children estimates of Total Fertility Rate during 1972-2011 in Iran**



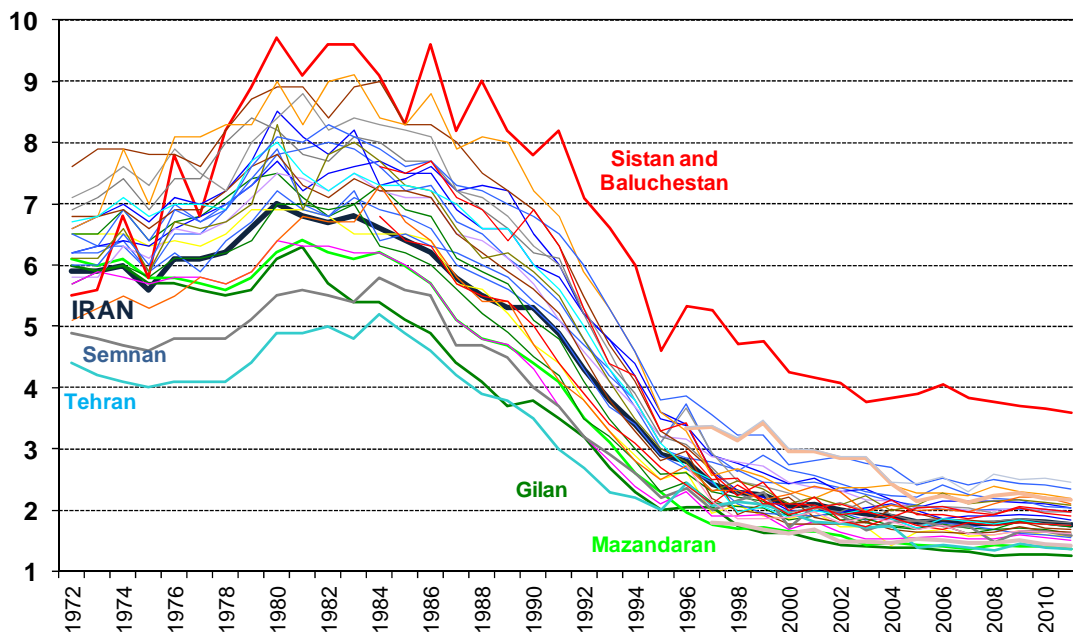
**Source:** Own-children estimates based on various censuses. See Abbasi-Shavazi *et al.* 2013

Figure 5 demonstrates that the downward trend of TFR in both rural and urban areas has slowed in recent years. The TFR for Iran in 2011 was estimated to be around 1.75. The reason for this slow decline is that fertility has already reached low level and there is not much room for further decline. Given the negative impacts of economic reform policies in recent years, a modest fertility decline is possible. However, this low level is due to tempo effects, and cohort fertility would not be as low as the level of period fertility. This has been confirmed by a thorough analysis of the 2010 IrMIDHS by Hosseini-Chavoshi, McDonald, Abbasi-Shavazi and Rashidian (2013) who showed that the real and cohort TFR in recent years have not been below 2. This is against the view of policy makers in Iran as well as other commentators who argue that fertility will continue to decline to very low level and lead to negative population growth in the foreseeable future.

### Provincial fertility trends

Our results indicate that the decline of fertility has been observed in all provinces of the country despite varying levels of socio-economic development. The majority of the provinces are now experiencing below-replacement fertility. During the three-year period of 2009-2011, 22 out of 31 provinces had fertility below 2.1. Gilan and Mazandaran provinces with a TFR of 1.3 recorded the lowest level of fertility. The TFR in Tehran was 1.4, the second lowest fertility as far as provinces are concerned. The highest fertility was recorded for Sistan and Baluchistan province with a TFR was 3.7 children per woman. Despite this low level of fertility, the trend of decline of fertility at province level has also been decelerated.

**Figure 6. Own-Children estimates of Total Fertility Rate by province during 1972-2011 in Iran**



Source: Own-children estimates based on various censuses. See Abbasi-Shavazi et al. 2013

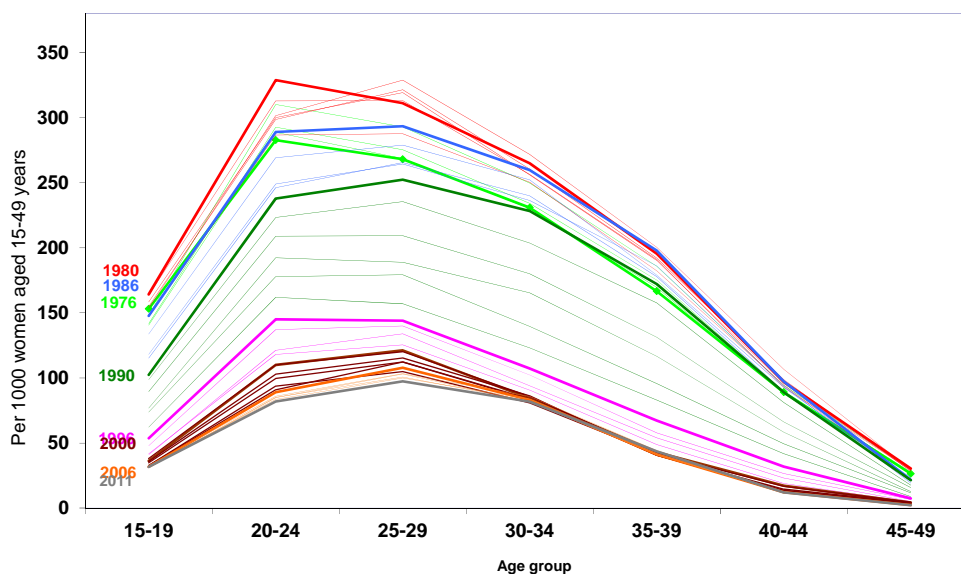
The next administrative level is district or *Shahrestan*. Our district level analysis (not shown here) revealed that out of 408 districts, 205 districts (around 50 per cent) experienced TFR below 2.0, and the rest had TFR above 2.0 during the three-year period, 2009-2011. The highest TFR (5.4) was recorded for Sib-O-Sooran District in Sistan and Baluchistan province. Taleghan District from Alborz Province, experienced the lowest TFR (0.89) in Iran (Abbasi-Shavazi *et al.* 2013).

### Age pattern of fertility

The own-children estimates of ASFRs for Iran for single years during 1972 to 2011 based on the 1986, 1996, 2006, and 2011 censuses are presented in Figure 6. The age patterns for the years 1976, 1980, 1986, 1990, 1996, 2000, 2006 and 2011 have been highlighted.

In 1976, the highest age-specific fertility rate was recorded for age group 20–24 (283 per 1000 women) followed by age groups 25–29 (268 per 1000 women) and 30–34 (231 per 1000 women). This age pattern remained in place in 1980 although fertility had risen overall. From 1976 and 1980, rises in fertility were evident for all age groups. However, during the first half of the 1980s, although the TFR remained high and nearly constant, the age pattern shifted towards later childbearing and the peak of childbearing occurred in age group 25–29. The falls in fertility at younger ages were matched by rises at older ages. Thus, Iranian women had a relatively early childbearing pattern in the first year of the revolution consistent with the pronatalist ideology adopted by the government. This behaviour did not last long however and as age at first marriage increased, fertility shifted to a relatively later childbearing pattern. This result is confirmed by an application of the synthetic parity progression ratio method to the Iran Demographic and Health Survey (Hosseini-Chavoshi *et al.* 2006).

**Figure 6. Own children estimates of age specific fertility rates for Iran, 1976 to 2011,**



**Source:** Own-children estimates based on various censuses. See Abbasi-Shavazi *et al.* 2013

The figure depicts a decline in fertility from 1986 to 1990, particularly in the young age groups, 15–19, and 20–24. Age specific fertility rates in age groups 25–29 and 30–34 were also lower in 1990 than those in 1986. However, there was a remarkable fall in fertility in all age groups during the 1990–1996 period partly due to the revival and successful implementation of the family planning program during this period. Age specific fertility rates continued to fall from 1996 to 2000, although the rate of decline was slower as there was less scope for further decline during this period. There was also an indication of a further shift towards delayed childbearing during the last period.

The trend of age-specific fertility rates since 2000 is worth noting. There has been almost no change in the age-specific fertility rates for older ages, i.e age groups 30-34 onwards. However, there has been a gradual decline in the age specific fertility rates in age groups 15-19, 20-24 and 25-29. The decline in age groups 20-29 is especially significant. This is mainly due to the fact that the post-revolutionary baby-boom generation is now continuing its education and many of them are in search of job and employment at a time when there is a large competition in the job market. This has led to the postponement of marriage and childbearing. From cohort perspective, however, it is likely that this young generation compensates some of the fertility lost during this period, and thus, their cohort fertility is likely to be higher than what is shown in this figure.

## CONCLUSION

Using the own-children method, as one of the useful indirect techniques of fertility estimation, current fertility measures for Iran by province were calculated. The results were assessed through a detailed investigation of different assumptions of the own-children method. Our results suggest that despite some of the shortcomings, due to improvement of age reporting in recent censuses, the results were not affected by age misreporting. The proportion of non-own children was not very high, except for some provinces, so that its effects on the own-children fertility estimates, too, were found to be minimal. Apart from this, control of the own-children estimates against fertility estimates using the 2010 IrMIDHS data shows the accuracy of the own-children estimates. This suggests the usefulness of the own-children method in studying differential fertility in Iran.

Although the own-children method has been developed in the 1960s to overcome the incompleteness of vital registration or the census data, it is still a useful method for estimating current differential fertility. Other indirect methods of fertility estimation are based on the assumption that fertility is constant during the years preceding the census or surveys. Using this assumption would be misleading for countries that are experiencing fertility transition. For example, Iran has experienced a rise and sharp fall of fertility over the last three decades (Abbasi-Shavazi *et al.* 2009). The examination of yearly fluctuation of fertility has only been possible through the application of the own-children method.

## DISCUSSION

The government of the Islamic Republic of Iran has recently announced its pronatalist policies aiming to increase fertility to around 2.5 in the foreseeable future. This sudden population change has been based on the assumption that fertility in Iran is low, and this will lead to negative population growth within the next two decades. As a consequence, Iran will face an ageing population in the future. While these two arguments are valid, we believe that population policies should be based on a deeper understanding of population dynamics and reproductive behaviour of the people in Iran.

Our results revealed that, first, the declining trend in Iran has decelerated and thus it will take a long time before Iran experiences negative population growth. Second, a recent study by Hosseini *et al.* (2013) showed that both real and synthetic cohort fertility in Iran have not been below two in recent years, and thus, using the period fertility for policy making is misleading. Third, experiences of other European and Asian countries with low fertility have shown that introducing pronatalist policies may not result in rising fertility in a short period of time, and even if it rises, it would be unlikely to reach TFR of 2.5 once fertility reaches below-replacement.

Pronatalist policies are expensive and require comprehensive planning, large investment, sustained implementation with well-designed management and coordination strategies. Therefore, the Iranian government should invest more time and resources in analysing available data to improve its understanding of true population dynamics and review its expectations from the policies before introducing and investing in new pronatalist policies.

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