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Tempo and Quantum of Fertility in Iran:

An Application of the Synthetic Parity Progression Ratio Method

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Abstract

After a sharp fall in the 1990s, Iran's fertility decline slowed down during the 2000s and TFR has fallen to around replacement level. Following two decades of fertility control policies, more recently, the Iranian Government has been concerned that fertility will fall to a very low level and a draft pronatalist policy has been designed and is being put to the parliament. The concern has been based on estimates that Iran's current fertility is as low as 1.6 births per woman but there are questions about the reliability of estimates of fertility. There is a near-to-complete birth registration system but how near-to-complete is unknown. Own children estimates are possible but they too may not be sufficiently reliable. Furthermore, cross-sectional fertility measures can be confounded by changes in the timing of births across women's lifetimes (tempo) as well as by changes in the numbers of children that they have by the time they end their childbearing (quantum). When the age-based TFR is used, tempo and quantum can be assessed a long time after the fact by comparing the TFR for real birth cohorts with the cross-sectional or synthetic TFR. This is normally done by an offset or lag between the two series that is equivalent to the mean age of childbearing. The problems involved in assessing tempo and quantum using the age-based TFR can be overcome to a very large extent as we show in this paper by using parity progression ratios.

The findings suggest that the Iran TFR is levelling off around replacement level and that tempo effects evident particularly in the 1990s are no longer evident.

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Introduction

Iran has experienced one of the most rapid falls in fertility ever recorded. The observed pattern is one in which fertility has fallen simultaneously in all age groups, in all geographic settings and in all social groups, hence accounting for the rapidity of the decline at the national level. While fertility began to fall before the introduction of the family planning program in 1989, the precipitous decline occurred in the 1990s. The total fertility rate reportedly declined from around 7.7 in 1966 (Amani, 1970) to around 6.5 in 1976 (Aghajanian and Mehryar, 1999). Although no formal population policy was introduced after the revolution, the general pronatalist messages, unexpected war with Iraq, and substantial economic incentives based on family size produced a cross-sectional rise in TFR to around seven birth per woman (Abbasi-Shavazi et al., 2002).

Despite the post-revolutionary pronatalist ideology, the high fertility regime was short lived and fertility fell to around 5.5 in 1988. After the government population policy was reversed and a new family planning program was officially inaugurated in December 1989, again in apparent response, the total fertility rate fell sharply to around 2.8 by mid 1990s. The 2000 Iran Demographic and Health Survey (IDHS) indicated that the fertility rate had declined further reaching near-replacement level by 2000. Since 2000 the trend in the total fertility has flattened around replacement level (Abbasi-Shavazi, McDonald and Hosseini-Chavoshi 2009).

The general trend for age specific fertility rates during the period 1976-2006 was that they moved in the same direction as the total fertility rate at all ages. When the rate of fertility rose, it rose at all ages; when it fell, it fell at all ages (Abbasi-Shavazi, McDonald and Hosseini-Chavoshi 2009). Thus, overall, the trends in age specific fertility rates also tend to focus interpretation of the changes in fertility upon the impact of cross-sectional social and political changes. However, the age-based model is not informative in relation to changes in the timing of successive births. Age specific fertility rates and their sum the total fertility rate use age as a controlling or standardizing factor because the age structure of the population changes from year to year. However, age is not the only structural feature of a population that may influence the number of births in a given year. The other important structural features are the distribution of women according to the number of children that they already have, that is, their parity and the time since the most recent birth.

To better assess the impact on period fertility of changes in the timing of births, the synthetic parity progression method provides an alternative to the conventional age-based approach to the study of fertility. In this method, the control used is not age but the number of children that a woman has already had in association with the time since the most recent birth (Feeney, 1983; Feeney and Yu, 1987; Ni Bhrolchain, 1987; Rallu and Toulemon, 1994; Hinde, 1998, Chapter 9). It is argued that analysis by parity and duration since last birth facilitates interpretation of fertility trends because people make their decisions about having a child on the basis of the number of children that they already have rather than simply upon how old they are. Duration since the last birth is a much better predictor of whether and when a woman will have her next birth than is her age (McDonald and Kippen 2011). The synthetic parity progression method has been applied successfully to a number of Asian countries including our previous study of Iran (Hosseini-Chavoshi et al. 2006; Spoorenberg 2010, 2013; Spoorenberg and Dommaraju 2012). The limitations of the age-based TFR and the superiority of using parity-based measures have been described by Sobotka and Lutz (2009). The

innovation in this paper is that we demonstrate the value of comparing results from synthetic and real cohorts using the parity progression approach.

Parity progression ratios in this study

In broad historical terms, analysis of period fertility trends by parity provides similar conclusions to analysis of trends by age. However, the parity-specific analysis provides more detailed insights that cannot be observed using age analysis. More importantly, parity analysis provides measures that can be related more directly to behavioural responses than is the case with age specific fertility rates. Using these measures facilitates inferences about changes that are long-term (quantum) and changes that are temporal (tempo). In the literature, three main approaches to the analysis of fertility using parity have been utilised (Ni Bhrolchain 1987; Hinde 1998, Chapter 9), parity progression for birth or marriage cohorts, true parity cohorts and synthetic parity progression. The current paper aims to explore the patterns and the quantum and tempo of fertility over the last two decades using parity progression ratios by duration since marriage or since the previous birth for both real and synthetic cohorts. As fertility outside marriage is negligible in Iran, the date of first marriage is a reliable starting point for analysis.

In the calculation of synthetic parity progression ratios, we bring together all those who had a birth of a given parity in a particular year and measure the probability that they would do this given the time since their previous birth. These probabilities are then combined into a summary synthetic measure for all durations since the previous birth. In relation to the first birth, the interval from first marriage is used. Finally, to obtain a summary measure analogous to the age-based total fertility rate, a further component, progression from birth to first marriage is required. To derive lifetime parity progression rates, based on the literature (Feeney and Yu, 1987, Ni Bhrolchain, 1987), we assume that cumulated experience by the end of the 10th year after the previous birth is sufficient to approximate a lifetime. An examination of our data confirms that the number of births occurring ten or more years after the previous birth is negligible.

If a birth parity cohort completes its progression in ten years, the real and the synthetic cohorts can be compared using a much shorter gap or lag than is the case for the age-based TFR. The appropriate gap or lag will be the mean duration to the next birth or the mean length of the birth interval. Usually this will be in the order of 3-4 years, considerably less than the 27 year gap required for the age-based TFR. We consider that this paper demonstrates that this can be a massive advantage in attempting to disassociate tempo effects from the current period fertility estimate of TFR.

Source of data

The source of data for this paper is the 2010 Iran Multiple-indicators Demographic and Health Survey (IDHS). Conducted in 2010, the survey is composed of a representative sample of households throughout the country (MOHME 2010). The sample included 31,350 households with 94.4% response rate (optimized for proportion of households in urban and rural areas). Systematic cluster sampling was utilized to randomly select 10 households in each cluster. A systematic supervision program and vertical training were undertaken to guarantee the quality of the data collection. Interviewers contacted 35,305 women aged 15-54 and were able to complete interviews with 98% of eligible women (34,438). Three cases were dropped from the analysis due to inconsistent

information in the birth history. Overall, 62,189 births were included in our analysis. After weighting, the cases available for analysis numbered 35,839.

Household data, including date of birth and marital status are available for all members of each household. Information on reproductive behaviour is obtained for all ever-married women aged 15-54 including the timing of all live births. This information and the very large size of the sample allowed us to calculate parity progression probabilities for each calendar year from 1980 to 2010 by parity and single year of duration from the previous birth.

Table 1. Sample size of women aged 15-54 years by provinces – IDHS 2010

Province	Unweighted		Weighted	
	Frequency	Percent	Frequency	Percent
East Azarbaijan	1741	5.1	1856	5.2
West Azarbaijan	1334	3.9	1439	4.0
Ardebil	579	1.7	622	1.7
Esfahan	2448	7.1	2417	6.7
Ilam	512	1.5	258	.7
Booshehr	449	1.3	398	1.1
Tehran	5271	15.3	6176	17.2
Chaharmahal	492	1.4	420	1.2
Sout Khorasan	423	1.2	323	.9
Razavi Khorasan	2474	7.2	2707	7.5
North Khorasan	425	1.2	414	1.2
Khoozestan	2055	6.0	2184	6.1
Zanjan	436	1.3	470	1.3
Semnan	427	1.2	303	.8
Sistan	964	2.8	1027	2.9
Fars	2098	6.1	2268	6.3
Qazvin	542	1.6	609	1.7
Qom	479	1.4	530	1.5
Kogilooyeh	660	1.9	689	1.9
Kordestan	1167	3.4	1255	3.5
Kerman	928	2.7	976	2.7
Kermanshah	544	1.6	318	.9
Golestan	797	2.3	856	2.4
Gilan	1125	3.3	1207	3.4
Lorestan	797	2.3	853	2.4
Mazandaran	1718	5.0	1518	4.2
Markazi	628	1.8	660	1.8
Hormozgan	667	1.9	717	2.0
Hamedan	787	2.3	826	2.3
Yazd	475	1.4	490	1.4
Alborz	993	2.9	1090	3.0
Total	34435	100.0	35874	100.0

Presentation of results

For each birth interval, we show the synthetic parity progression ratio for the years, 1990-2009. This is compared with the real parity progression ratio for those who had their previous birth m years before the synthetic year where m is the mean duration of the birth interval. For example, for the progression from the first to the second birth, we compare the period (synthetic) measure with the real cohort measure for the cohort that had their first birth four years beforehand (1886-2005). We also compare the mean duration of the birth interval for both real and synthetic cohorts with the same lag or gap. In fact, the analysis shows that the mean duration widens for most birth intervals across the years of comparison due to changes in the spacing of births in Iran. However, with the exception of the interval between marriage and first birth for which the average interval for the 20 years is about three years, all the other Iran birth intervals average out across time at about four years.

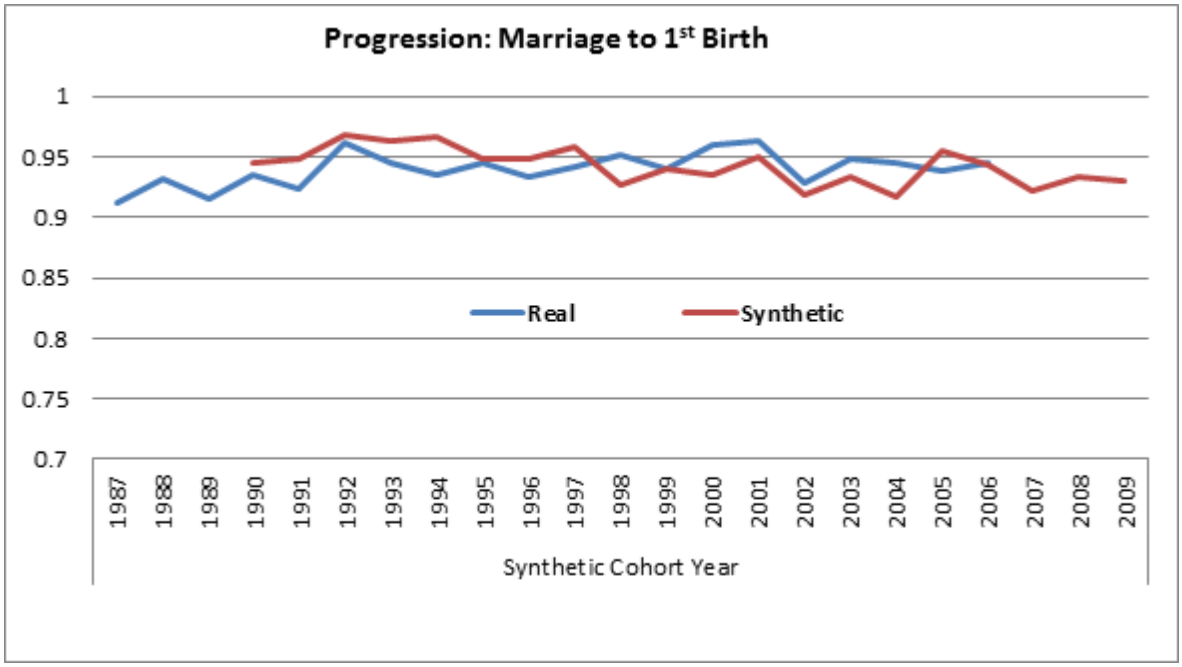
Where the real and the synthetic progressions overlap, we conclude there is little or no tempo effect. In these circumstances, we expect to also see that the mean duration curves for the synthetic and real cohorts also overlap. In the period when birth spacing widened, the 1990s, we expect to see a tempo effect due to the delay of births. This will mean that the synthetic parity progression ratio should be lower than the real parity progression ratio. The reverse is implied for the mean durations: we expect that the real mean duration between births will be lower than the synthetic mean duration.

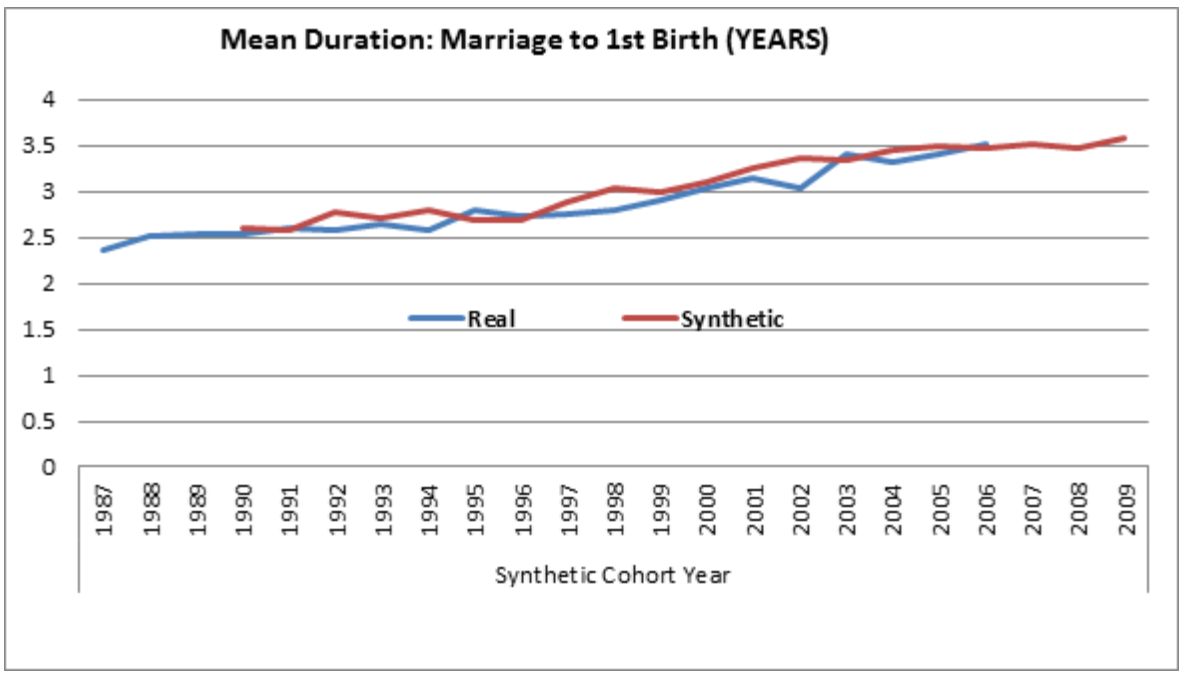
Analysis was carried out for progressions up to and including the progression from the seventh to the eighth birth. In the following pages we show the results from the progression from marriage to first birth to the progression from the fifth to the sixth birth. The story for the progressions from the sixth to the seventh birth and the seventh to the eighth birth are very similar to that for the progression from fifth to sixth.

We use progressions up to the eighth birth to calculate the implied Total Fertility Rate based on parity progressions. The estimate will be very slightly on the low side through ignoring births of parity nine and above. To calculate the Total Fertility Rate, we also need to include a progression from the respondent's own birth to marriage (the proportion who ever marry). This progression is analysed after the inter-birth intervals have been discussed.

Progression from marriage to 1st birth

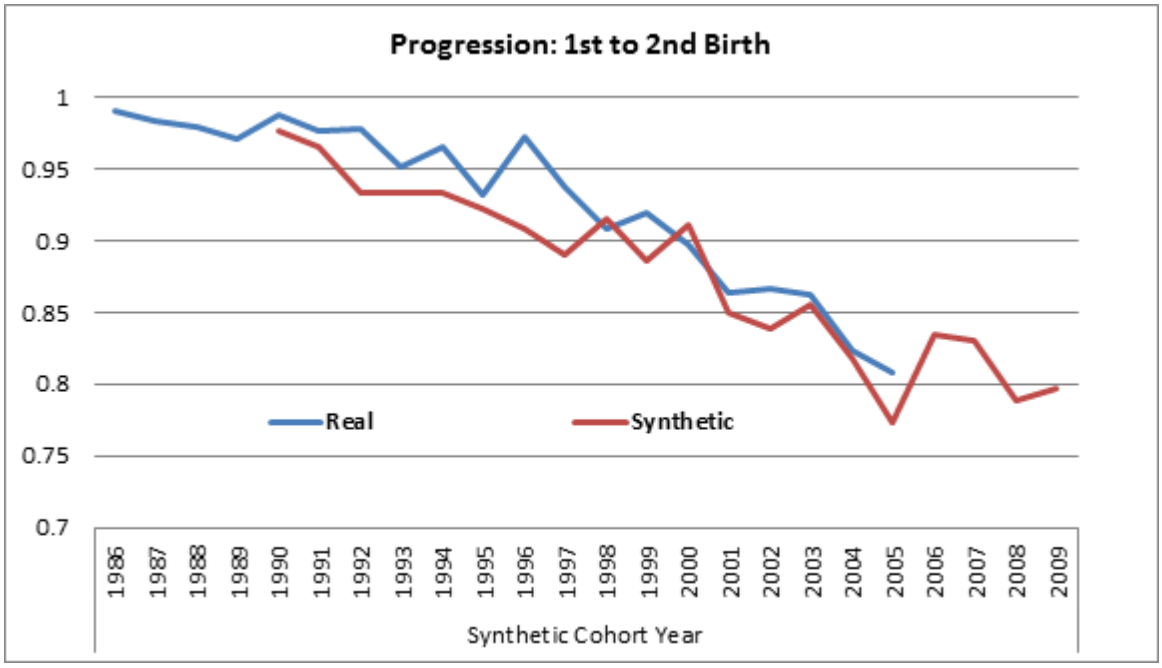
A three-year lag between the real and synthetic cohorts is used for this interval. The mean duration of the marriage to first birth interval increases gradually by about three-quarters of a year between 1996 and 2004. This small and gradual increase seems to produce very little tempo effect as the real and synthetic parity progressions overlap during the full 20-year period. Based on the real cohort, the progression has remained at about 0.95 throughout the period, although the recent synthetic progression is a little lower at about 0.93.

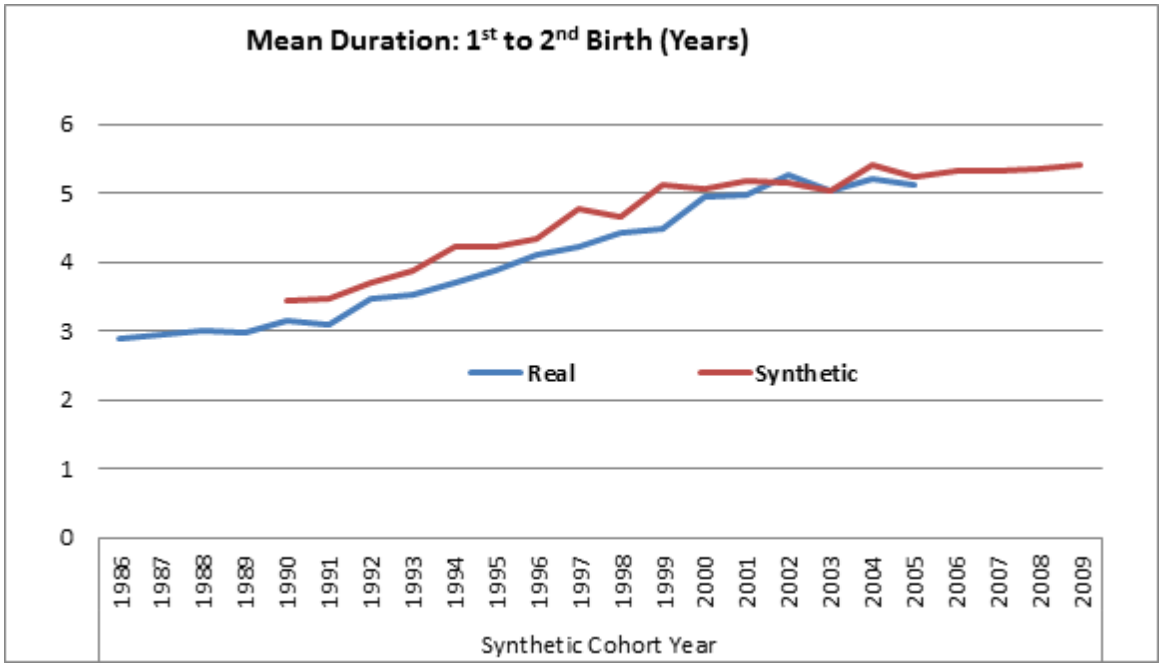




Progression from 1st to 2nd birth

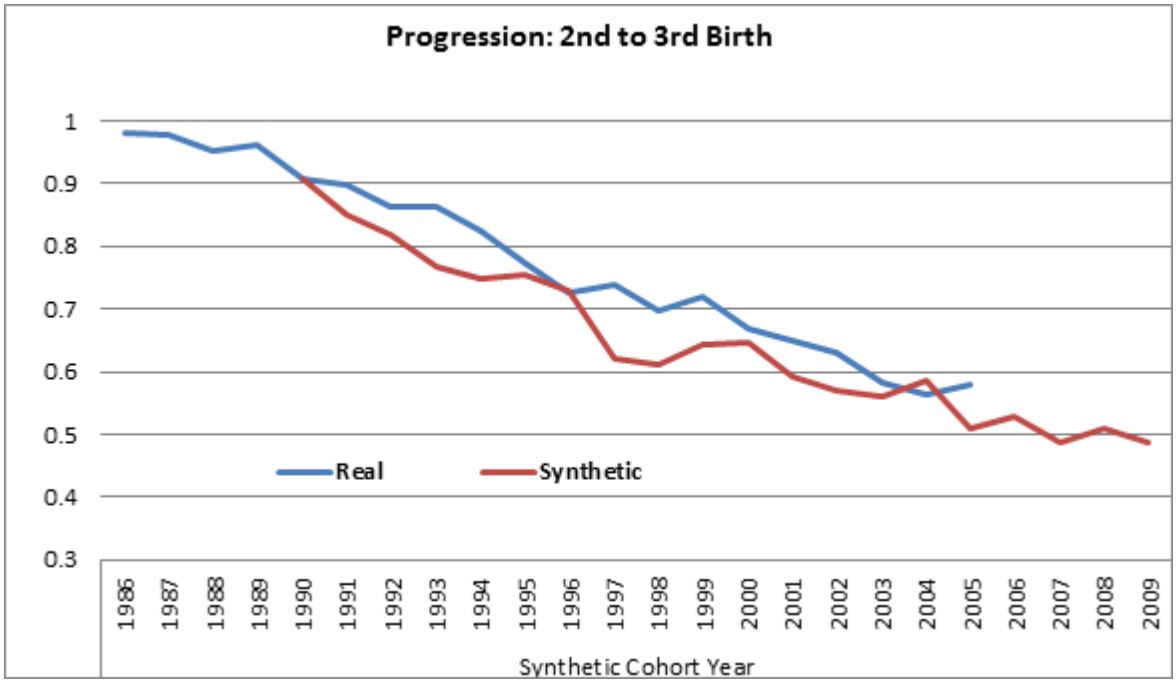
For this progression and all subsequent progressions we use a four-year lag based on the average duration across the 20 years. The progression falls from close to one for the first real cohort (first birth in 1982) to close to 0.8 for the 2005 real cohort. The mean birth interval widened considerably in the 1990s (from three to five years). This produced a tempo effect with the progression for the synthetic parity being lower than that for the real cohort during the 1990s. The spacing increase ceased around the beginning of the 2000s and, as a result, the tempo effect ended and the synthetic and real progressions overlapped. From 2005 onwards, the synthetic progression seems to have flattened out and the expectation is that the real progression will do likewise in the near future.

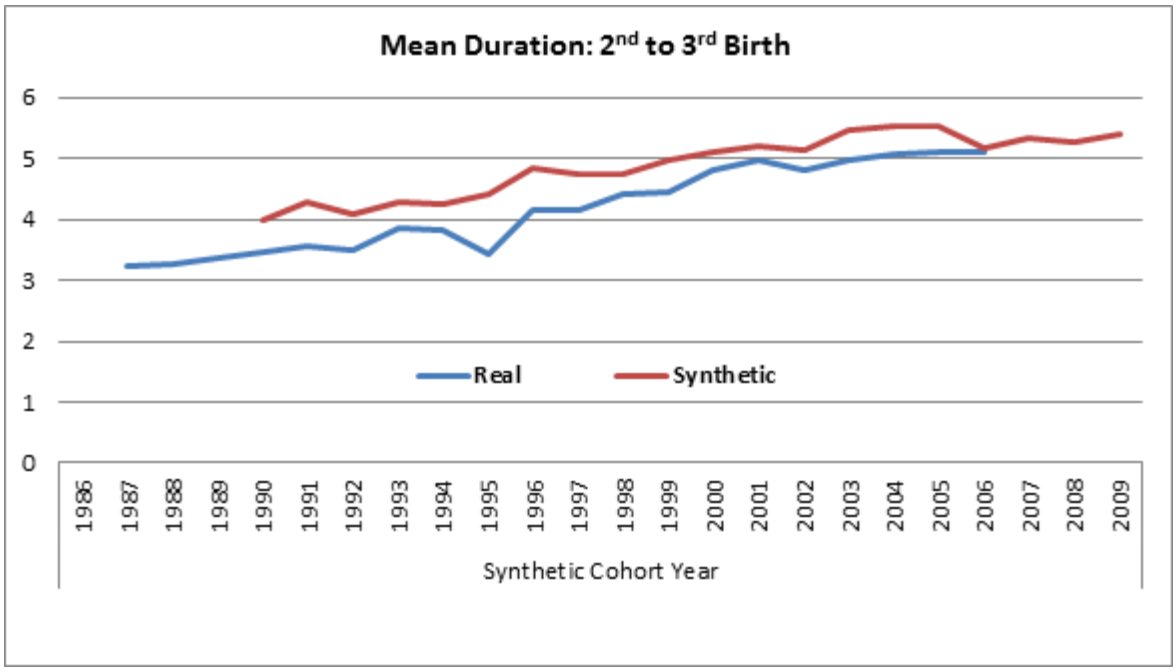




Progression from 2nd to 3rd birth

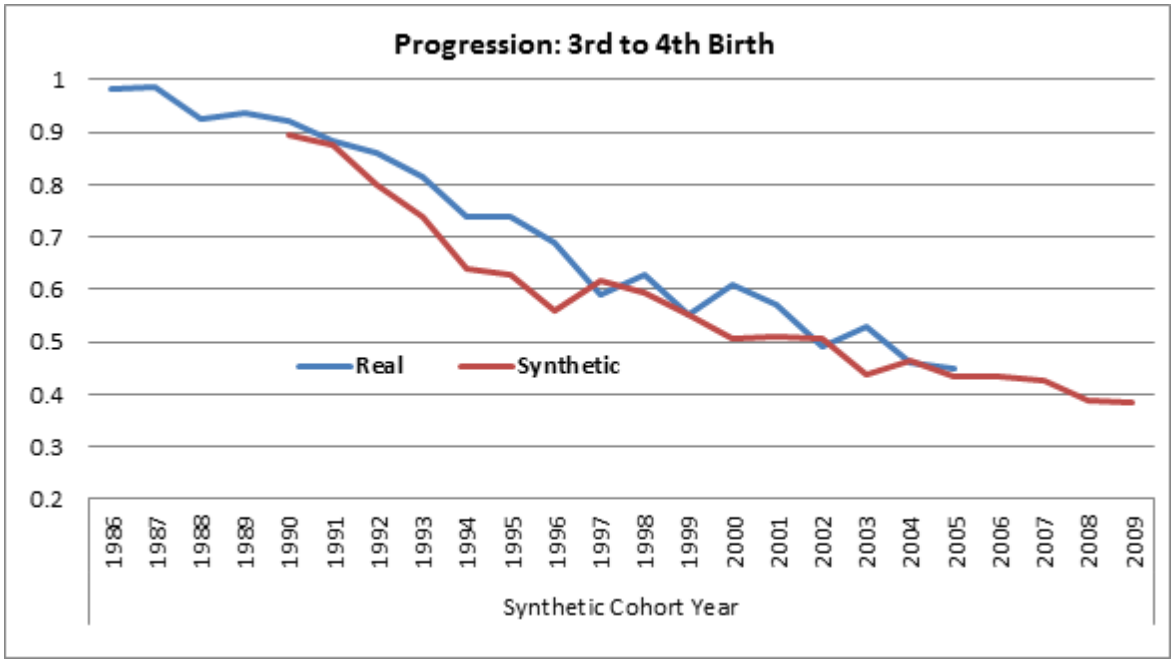
The second to third progression falls from close to one for the first real cohort (second birth in 1982) and is probably heading in the direction of the 0.5 where the real cohort seems to have stabilised in the last few years. Again, there is a sizeable increase in the mean birth interval (close to two years) which commences from the beginning of the series and continues to the early 2000s. This has a tempo effect in the 1990s and early 2000s with the real cohort progression lying above the synthetic progression in those years. The synthetic progression has been stable for the most recent period.

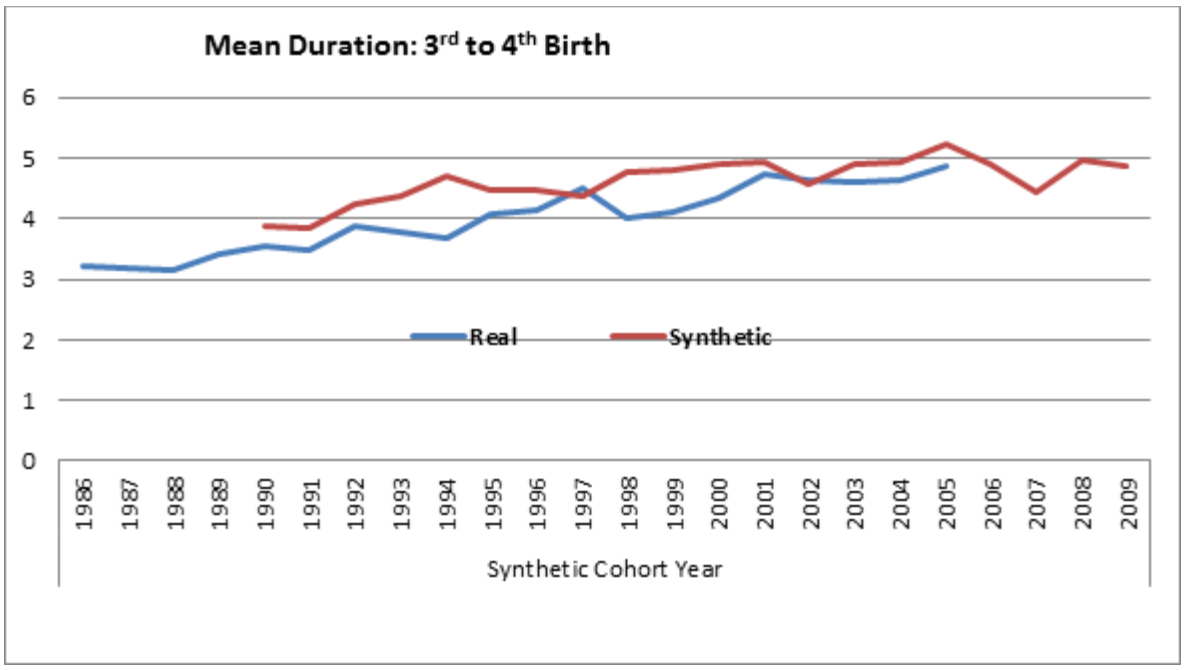




Progression from 3rd to 4th birth

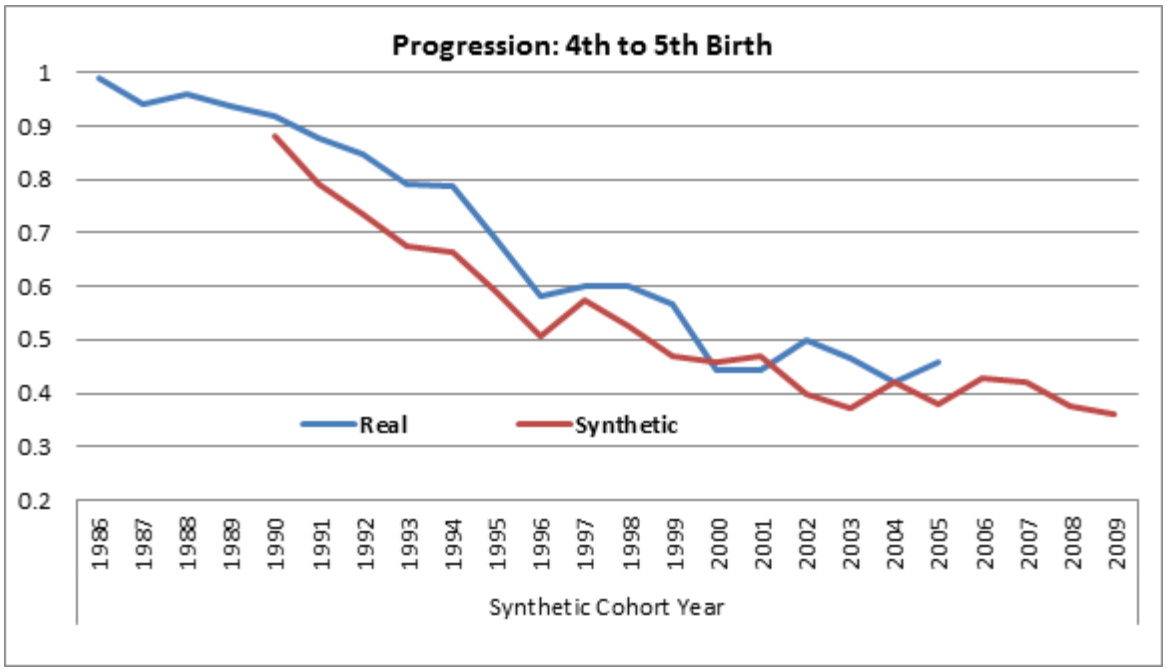
The fall in the parity progression is even larger for the third to fourth birth progression, from close to one for the 1982 real cohort to 0.4 for the most recent synthetic cohort (2009). Once more, the mean duration increases by almost two years between the late 1980s and the early 2000s. Thus, there is some evidence of a tempo effect with the synthetic progression being lower than the real progression, mainly in the first part of the 1990s. The fall in the parity progression seemed to have ceased by 2009.

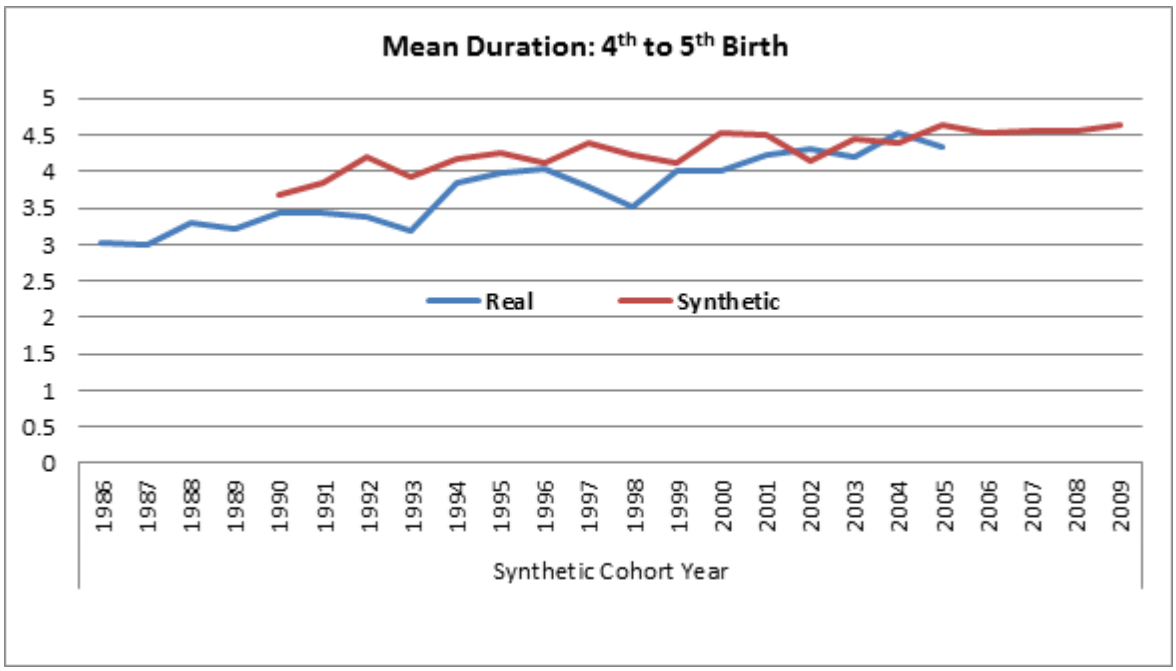




Progression 4th to 5th birth

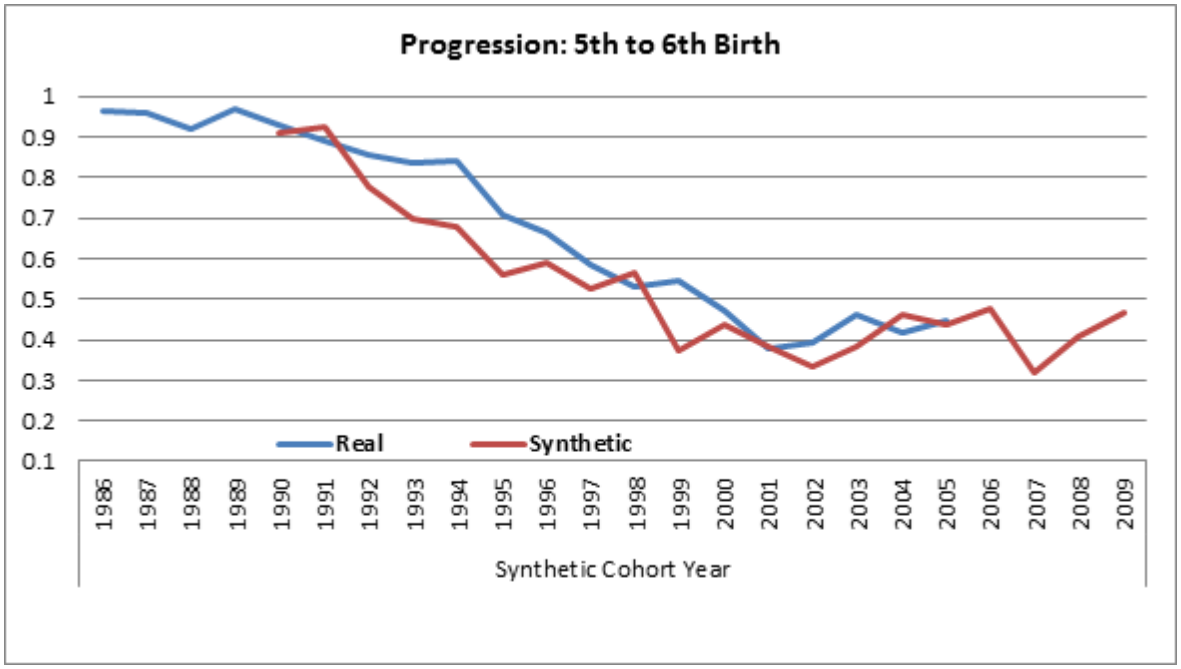
The progression from the fourth to the fifth birth falls from close to one for the 1982 real cohort but stabilised around 0.4 for the synthetic cohort from about 2002 onwards. The progression for the real cohort has also levelled off in the most recent years available. The mean duration has increased continually for the real cohort from about three years to 4.5 years over the 20-year period. This seems to have led to a tempo effect over most of the period with the synthetic cohort progression being lower than the real cohort progression. Once more, however a distinct levelling off is evident for the mean duration for the synthetic cohort in recent years.

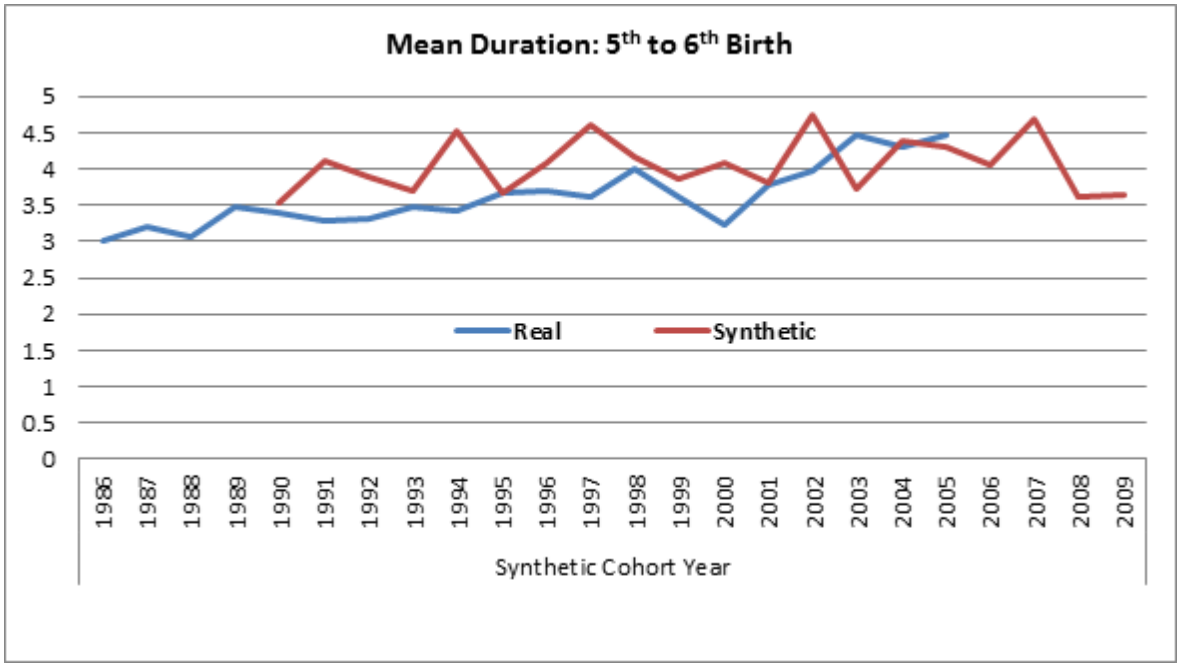




Progression from 5th to 6th birth

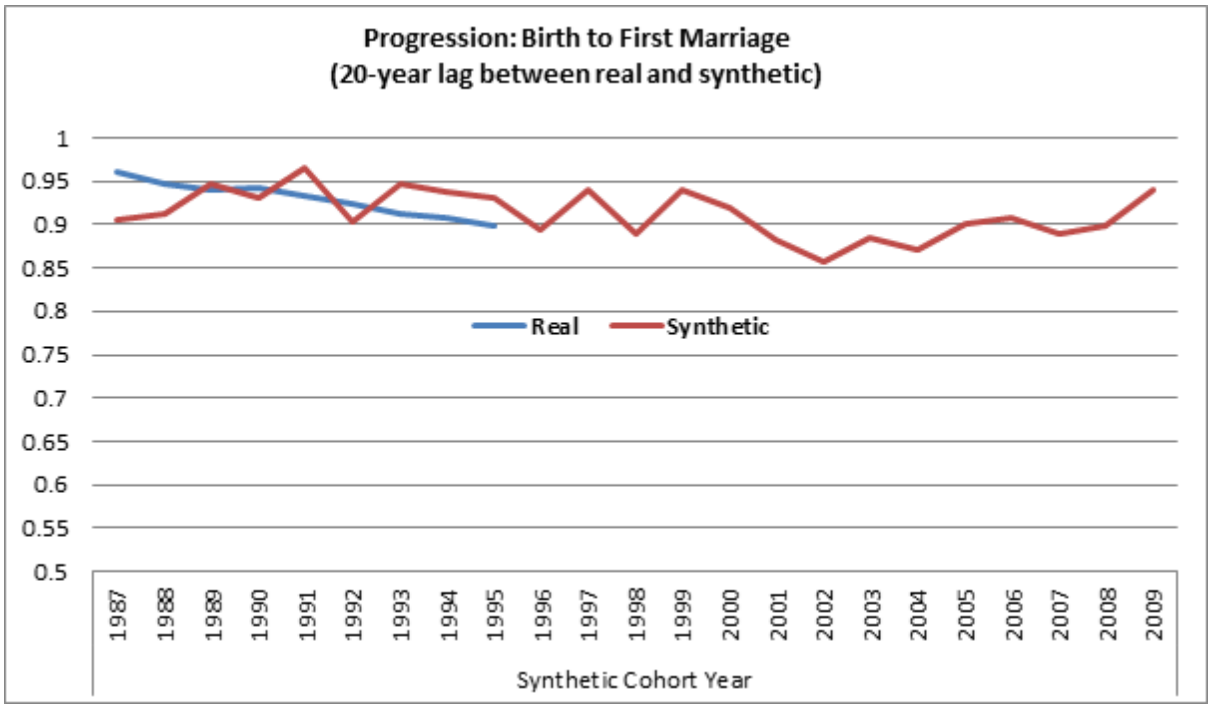
The progression from the 5th to the 6th birth fell from close to one to 0.4 by the latter part of the 1990s and has remained unchanged for about the past 10 years of synthetic cohorts and the last five years of real cohorts. For the synthetic cohort, there is little evidence of change in the mean duration across the full 20 years, perhaps a slight increase. But the mean duration seems to have risen somewhat recently. There is some evidence of a tempo effect in the early 1990s.

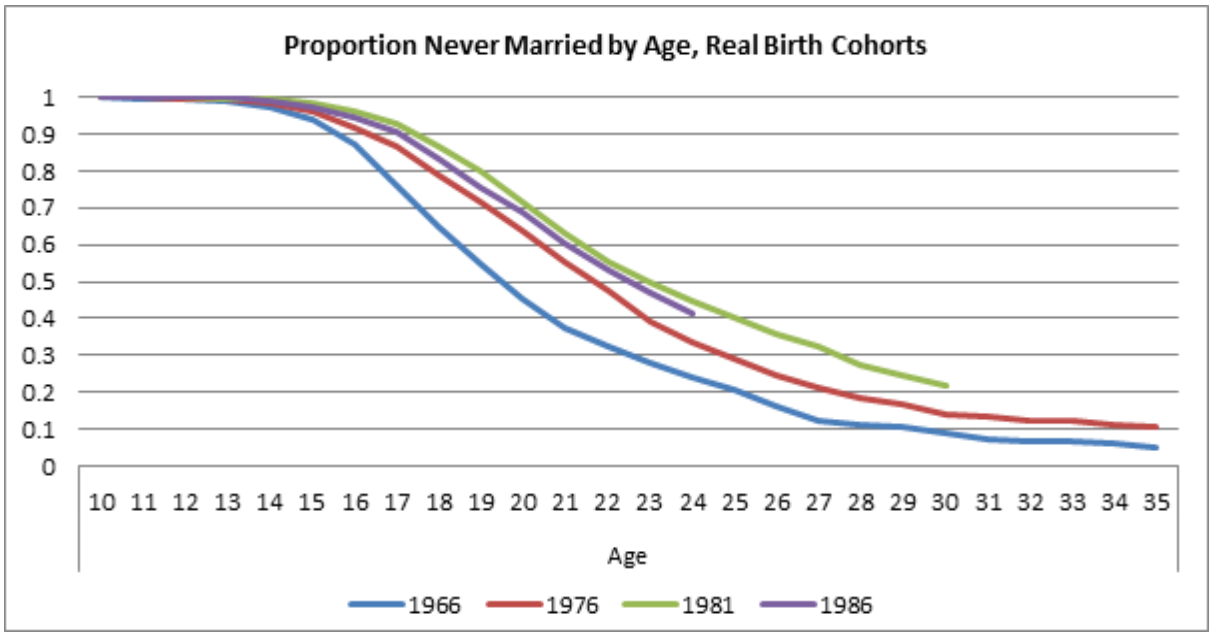




The proportion who ever marry

Interpretation of the trend in the proportion who ever marry is more difficult because, like the age-based TFR, the real and the synthetic cohorts are separated by a long period of time, the mean age at marriage, or, in this about 20 years. The synthetic measure has been relatively flat, around 90 per cent for more than 20 years, but with fluctuations between 85 and 95 per cent. The real cohort measure shows a declining trend, falling from about 96 per cent for the cohort born in 1967 to 90 per cent for the cohort born in 1975. The real cohort percentages never married by age suggest relative stability in age at first marriage for cohorts born from 1981 onwards.



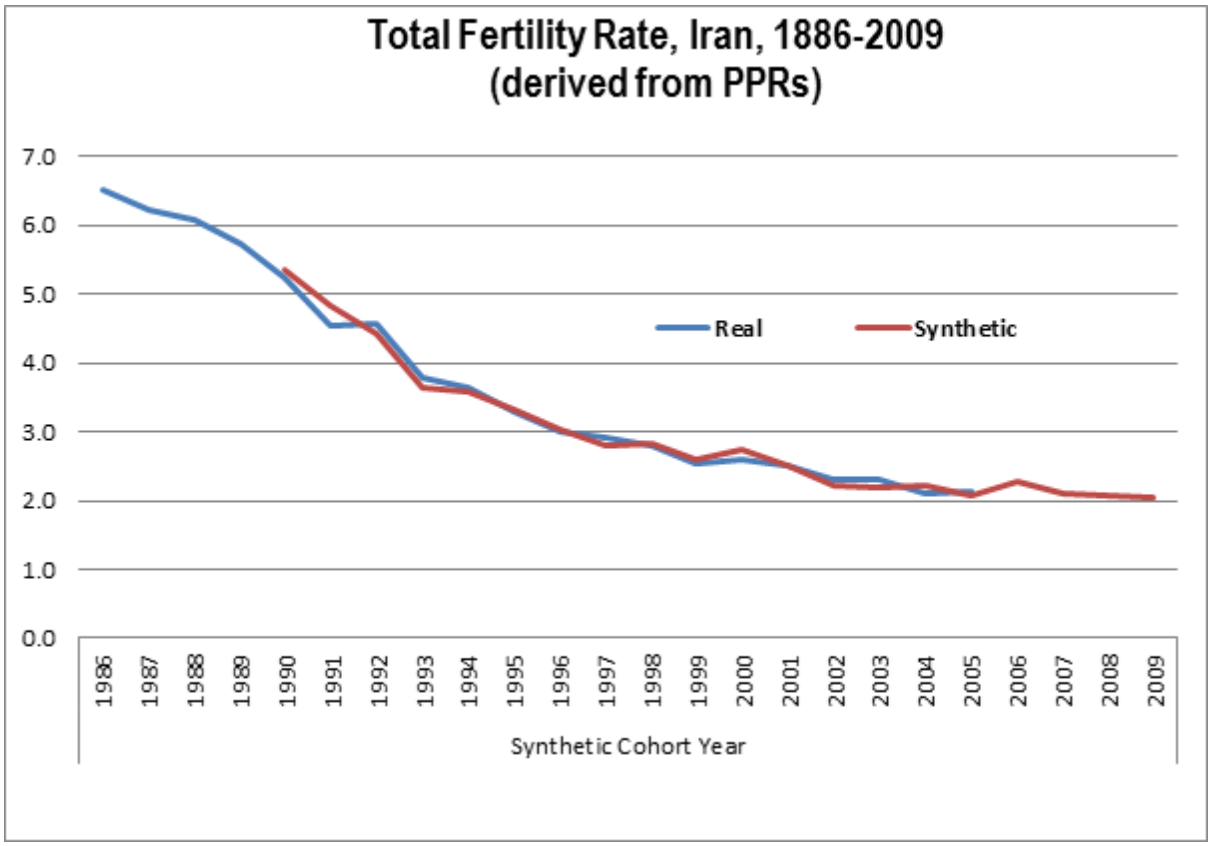


The Total Fertility Rate

For any synthetic cohort or for any real marriage cohort, the Total Fertility Rate can be calculated from the combination of the progression ratios for that cohort and an estimate of the proportion of the cohort who never married. For all cohorts, synthetic or real, we have assumed that 10 per cent never married and never had children. This is consistent with the estimate across time found in the synthetic percentages ever marrying just discussed. As explained above, progressions to the ninth and higher order births were not included so that the calculated Total Fertility Ratesmay be slightly underestimated.

The Synthetic and real Total Fertility Rates are graphed below with a four-year interval between them, the mean of all birth intervals. This very short lag indicates the considerable advantage that comparison of real and synthetic parity-based measures has over the same comparison being made for the age-based measures with a 27-year lag. The broad conclusion to be drawn from the comparison is that while individual parity progressions may have been influenced a little by tempo effects, the summary measure is hardly affected at all. The synthetic cohort Total Fertility Rate is an excellent predictor of the real cohort rate (lagged by four years) right across the time frame of the study.

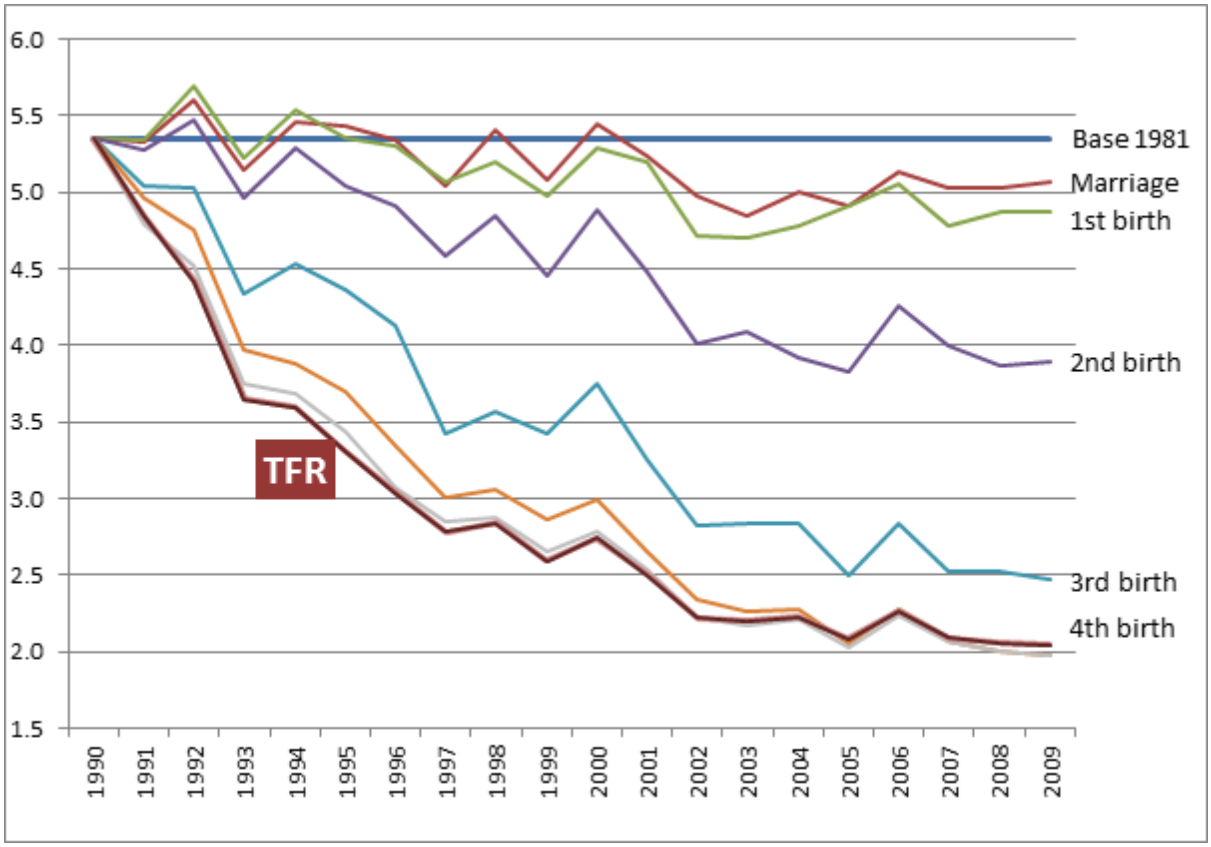
The graph also shows that the synthetic or period Total Fertility Rate levelled off at about 2.1 births per woman over the years, 2005-2009. As all the components (the progression ratios) had also levelled off in this period, the best prediction of future fertility in Iran is that it will hover around 2.1 births per woman into the immediate future.



Historical description of the Iranian fertility decline

Another conclusion to be drawn from the above analysis is that the synthetic parity progression ratios provide a good basis for describing the decline in fertility in Iran in terms of parity progressions. Progressions to marriage and the first birth played little part in the spectacular Iranian fertility decline accounting for a fall of only about 0.5 of a birth between 1990 and 2009. Changes in progressions from the fourth birth onwards played almost no role. Almost all of the decline is accounted for by changes in the progressions from the first, second and third births which together account for a fall of about 2.7 births per woman. For the most recent real cohort (married in 2009), the distribution across completed parities is quite wide: 30.6% had fewer than two births, 29.6% had two births and 39.8% had three or more births. The new policy approach in Iran is being directed at the 30.6 per cent having fewer than two births.

Decomposition of the fall in fertility in Iran from 1990 to 2009 into components due to each parity progression, based on synthetic cohort parity analysis.



Parity distribution for 1999 real marriage cohort

	Never Married	Ever Married with Parity:							
		0	1	2	3	4	5	6+	Total
%	10.2	4.0	16.4	29.6	22.1	9.4	4.5	3.8	100.0

Conclusion

The analysis has shown how comparison of real and synthetic parity progression ratios can enhance understanding of a society's fertility history in terms of tempo and quantum and how it can clarify the most recent trends in fertility. The approach capitalises on the argument that parity in combination with the duration since the previous birth are much better predictors of when and whether a woman will give birth than is her current age. Of course, adding age as a third component would further enhance the accuracy but this requires an exceptionally large sample in order to avoid small cell sizes. In application to Iran, the method is also enhanced by the fact that the number of births outside marriage is negligible and that the progression from marriage to the first birth is near universal and relatively rapid. In the absence of change in age at marriage as seems to be the case in recent years, this means that the age distribution at first birth and its incidence is near-to constant. Variations in fertility are then dependent only on the well-measured inter-birth parity progression ratios. In these circumstances, the Total Fertility Rates for real and synthetic marriage cohorts can be compared conveniently and the most recent synthetic rate provides an excellent predictor of the future real rate.

Interestingly, there was some evidence of tempo effects influencing various parity progressions particularly in the 1990s but when cumulated into the Total Fertility Rate, these effects became negligible. This was despite the fact that birth intervals often changed substantially and in a single direction (upwards). This perhaps supports the argument made by McDonald and Kippen (2011) relating to the case of Australia that tempo effects are dominated by any changes that occur in the age at first birth. In the Iran case, at least in recent times, there has been very little change in the age at first birth.

From the policy perspective, the analysis gives no support to the concern that fertility in Iran is about to tumble to very low levels (below 1.5 births per woman). This suggests that the Iranian Government should avoid punitive pronatalist measures such as discrimination against single people or women in the labour market as is proposed by the draft law. Indeed, there are strong arguments that these approaches will lead to lower rather than higher fertility. Research in Europe has shown that employment insecurity for young people has a negative effect upon their fertility and upon couple formation. The Iranian Government should be looking for policy measures that enhance the incomes of young people, including young women. With a greater sense of security, young people are more likely to marry and have children. Discrimination against single people and women in the labour market supports older men who are not particularly relevant to enhancing the fertility of the nation. Rather than discriminatory policies, the focus of policy should be upon family support measures, several of which are included in the draft law.

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