HAS U.S. FERTILITY DECLINED?

THE ANSWER DEPENDS ON USE OF A

PERIOD VS. COHORT MEASURE OF FERTILITY

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September 2018

Submitted for consideration for "Recent Trends in Fertility and Contraception," Session 125, 2019 Annual Meetings of the Population Association of American. Direct all correspondence to Lawrence L. Wu, Department of Sociology, New York University, Puck Building 4th floor, 295 Lafayette Street, New York, NY 10012-9605, lawrence.wu@nyu.edu.

ABSTRACT

(133 words)

In this paper, we show that period and cohort fertility measures yield strikingly different pictures of trends in U.S. fertility. Trends using the total fertility rate (TFR) and data from vital birth registers, the standard measure reported in widely publicized NCHS publications, suggest sharp declines in U.S. fertility, from an above-replacement level of 2.48 in 1970 to a below-replacement level of 1.76 in 2017. Using the same birth register data, we show that the cumulative number of births for successive birth cohorts of U.S. women suggest far more modest trends, with cohorts that have completed their fertility at or above replacement levels. We conclude that both TFR and cohort measures should be used to describe U.S. fertility trends, with our findings also reemphasizing well-known quantum and tempo distortions that can bias TFR-based analyses.

Has U.S. fertility declined? The answer, based on vital registers of births and the total fertility rate (TFR), is an unambiguous "yes", with TFR declining from an above-replacement level of 2.48 in 1970 to a below-replacement level of 1.76 in 2017. Such stylized facts are now widely publicized, with headlines such as "U.S. Births Dip To 30-Year Low; Fertility Rate Sinks Further Below Replacement Level" (National Public Radio, May 18, 2018) and "U.S. Fertility Fell to a Record Low, for a Second Straight Year" (New York Times, May 16, 2018).

In this paper, we show that a markedly different picture of trends in fertility emerges when a cohort measure—the cumulative number of births observed for successive birth cohorts of U.S. women—is used to track fertility trends. This cohort measure, which we calculated from precisely the same age-specific fertility rates used in official estimates of TFR published annually by the National Center for Health Statistics (NCHS), thus provides a very different answer to the question, "Has U.S. fertility declined?" As shown in Tables 2–4 below, this cohort-based measure reveals at- or above- replacement levels for birth cohorts of U.S. women who are currently aged 45–49 or older and who have thus completed their fertility. This holds as well for birth cohorts U.S. women who are currently 35–39 and 40–45, and who will thus complete their fertility within the next five to ten years. Cumulative fertility for those aged 30–34 in 2015, 2016, and 2017 ranges between 1.86 and 1.9, suggesting that these birth cohorts of women will likely achieve completed levels at or near replacement over the next fifteen years. These findings document how known increases in fertility at later ages have affected the average number of births for U.S. women who are currently in their 30s and 40s.

Our cohort-based measure also documents how known decreases in fertility at earlier ages have affected successive birth cohorts of U.S. women. Our estimates show that the cumulative number of births by age 25–29 was around 1.42 in the early 1970s, declining to 1.29 in 2017, for a decrease of 0.13 births. Whether current levels of 1.29 births at ages 25–29 will lead to replacement levels of completed fertility will depend on the behaviors of this cohort of women over the next 20 years. Observed patterns for adjacent birth cohorts reveal a clear trend of increased fertility at ages 30 and older. Thus, completed fertility for those currently aged 25–29 could reach levels at or near replacement were fertility at ages 30+ to remain high. Conversely, below replacement levels would require a reversal of the 25+ year trend of increased fertility for women aged 30 and older.

More generally, the discipline of demography has long provided critical data used to track trends in vital events such as mortality and fertility. Demographers have likewise placed great emphasis on obtaining

accurate answers to these and other questions. It is thus highly troubling that the same set of age-specific rates can lead to such markedly different answers to core questions such as "Has fertility declined?"

Because our cohort-based estimates below rely on published age-specific estimates, the cohort trends reported in Tables 2–4 below provide cohort trends for overlapping five-year birth cohorts of U.S. women. For our PAA paper, we will also present analyses of the micro-data in publicly available natality data, which we will use to construct one- or two-year birth cohorts. In these analyses, we will also provide breakdowns of our cohort measure (cumulative births through age t for a given birth cohort) by standard demographic variables available in these data—marital status at birth, race and ethnicity, and education. These analyses will provide a finer-grained picture of recent trends in fertility. But we suspect that the main takeaway of this paper will be the markedly different descriptive accounts of fertility trends when relying on TFR vs. cohort measures of fertility.

To sketch ideas, Table 1 reproduces published estimates of TFR and age-specific fertility rates for the calendar years 1970, 1975, 1980, . . ., 2015 (Martin et al. 2017; Table 4). The estimate of TFR for the calendar year 1970 is constructed from estimates of age-specific fertility rates (ages 10–14, 15–19, . . ., 45–49) using as the numerator the number of 1970 births in each these age ranges and as the denominator the number of women in each age range. Data on births in the numerator are obtained from vital register data as recorded on U.S. birth certificates; data on denominators are (for 1970) obtained from the decennial census, with non-decennial census year denominators obtained by interpolation. Estimates of age-specific rates give birth rates per year; hence, the calculation of TFR in 1970 involves summing the 1970 age-specific rates and multiplying the resulting sum by five.

[Table 1 about here]

To obtain Table 2, we first rearranged the age-specific fertility rates in Table 1 in a Lexis manner relying on the fact that those aged 10–14 in 1970 will be 15–19 in 1975, 20–24 in 1980, . . ., and 45–49 in 2005. (This requires the assumption that mortality is negligible and thus can be ignored for U.S. women during these ages.) The first row of Table 2 refers to those 10–14 in 1970 and hence those born 1956–1960. We then assigned this birth cohort the estimated age-specific fertility rates for ages 10–14 from 1970, the 15–19 estimates from 1975, . . ., and the 45–49 estimates from 2005. Table 2 then reports estimates of the cumulative number of births for each five-year age group for the birth cohorts of U.S. women born 1956–60, 1961–65. . . ., 1996–2000.

[Table 2 about here]

In Table 2, we have also reported two columns for TFR, the first of which gives the official TFR from standard NCHS annual reports on births and the second of which we calculated from the period age-specific fertility rates reproduced in Table 1. As Table 2 shows, the two columns for TFR are in exact agreement.

Tables 1 and 2 provide strikingly different depictions of trends in fertility, with Table 1 giving the standard TFR-based account of fertility trends from 1970 to 2015 and Table 2, relying on the exact same set of estimates, providing a cohort-based account of fertility trends. The TFR-based account of fertility in Table 1 suggests large and rapid swings in fertility, for example, from 2.480 in 1970 to 1.774 in 1975, a decline of .706 births per women during this five-year period, and from 2.057 in 2005 to 1.8435 in 2015, a decline of over .2 births per women over this ten-year period.

The cohort estimates in Table 2 provide a strikingly different picture of fertility trends, suggesting a far more gradual and modest pace of change. Thus for those who were 10–14 in 1970 and 1975, the average number of births by ages 45–49 were 2.0315 and 2.0670. This small increase of .0355 births per woman for those born 1956-60 and 1961–65 is in stark contrast, in both sign and magnitude, with the large decreasing TFR-based trend of 2.480 and 1.774 for 1970 and 1975

Table 2 also documents trends that have been widely discussed in the literature, with modest decreases in the cumulative numbers of births at ages 10–14 and 15–19. We also see somewhat larger declines in cumulative fertility at ages 20–24 and 25–29 that were offset by increases at ages 30+ that took place for the older cohorts in these data, all of whom had cumulative fertility at or near replacement levels.

Note also that the lower diagonal in Table 2 refers (roughly speaking) to the calendar years following the Great Recession. Comparing estimates just before and just after the Great Recession (for example, the .0030 and .0020 estimates for ages 10–14, the .2030 and .1740 estimates for ages 15–19, . . ., and the 2.0315 and 2.0670 estimates for ages 45–49) could be naively interpreted as suggesting a cyclical response to the Great Recession at early ages and a counter-cyclical response at later ages. Such an interpretation is complicated, however, by the decreasing fertility trend at early and the increasing fertility trend at later ages. What is perhaps clearer, however, is that the cohort-based estimates in Table 2 suggest a far smaller effect of the Great Recession than do the TFR-based analyses conducted by Morgan et al. (2011).

Table 3 repeats the above exercise using published age-specific fertility rates for the calendar years 1971, 1976, . . ., 2016 (Martin et al. 2017; Martin et al. 2018). Table 4 does the same for calendar years 1972, 1977, . . ., 2017 (Martin et al. 2017; Hamilton et al. 2018). Note in particular that this yields a

series of overlapping birth cohorts in Tables 2–4, which results from our reliance on published estimates of age-specific fertility for five-year age intervals. As noted above, for PAA we will analyze natality micro-data, which will let us report estimates for one- and two-year birth cohorts and which will provide a more fine-grained account of cohort trends.

TFR's, by construction, look backward and refer to synthetic cohorts, while the cohort-based estimates in Tables 2–4, by construction, look forward and thus refer to the cumulative number of births experienced by actual birth cohorts. An advantage of period measures such as TFR is that they provide a single numerical summary of fertility trends. By contrast, the cohort-based measures in Tables 2–4 provide estimates of the mean number of births at differing ages for different birth cohorts, thus yielding no single numerical summary of trends in fertility.

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Table 1: Period estimates of the total fertility rate and age-specific fertility rate.

		Age-specific fertility rate							
Year	TFR	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49
1970	2.4800	1.2	68.3	167.8	145.1	73.3	31.7	8.1	0.5
1975	1.7740	1.3	55.6	113.0	108.2	52.3	19.5	4.6	0.3
1980	1.8395	1.1	53.0	115.1	112.9	61.9	19.8	3.9	0.2
1985	1.8440	1.2	51.0	108.3	111.0	69.1	24.0	4.0	0.2
1990	2.0810	1.4	59.9	116.5	120.2	80.8	31.7	5.5	0.2
1995	1.9780	1.3	56.0	107.5	108.8	81.1	34.0	6.6	0.3
2000	2.0560	0.9	47.7	109.7	113.5	91.2	39.7	8.0	0.5
2005	2.0570	0.6	39.7	101.8	116.5	96.7	46.4	9.1	0.6
2010	1.9310	0.4	34.2	90.0	108.3	96.5	45.9	10.2	0.7
2015	1.8435	0.2	22.3	76.8	104.3	101.5	51.8	11.0	0.8

Source: Table 4, Hamilton et al. (2017), *Births: Final Data for 2015.*

Table 2: Cumulative fertility by birth cohort and age. U.S. women born 1956–60, 1961–65, . . ., 1996–2000.

	TFR			Cumulative births by age							
Year	NVSR	Repl.	Cohort	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49
1970	2.4800	2.4800	1956–1960	0.0060	0.2840	0.8595	1.4145	1.8185	1.9885	2.0285	2.0315
1975	1.7740	1.7740	1961–1965	0.0065	0.2715	0.8130	1.4140	1.8195	2.0180	2.0635	2.0670
1980	1.8395	1.8395	1966–1970	0.0055	0.2605	0.8430	1.3870	1.8430	2.0750	2.1260	
1985	1.8440	1.8440	1971–1975	0.0060	0.3055	0.8430	1.4105	1.8940	2.1235		
1990	2.0810	2.0810	1976–1980	0.0070	0.2870	0.8355	1.4180	1.9005			
1995	1.9780	1.9780	1981–1985	0.0065	0.2450	0.7540	1.2955				
2000	2.0560	2.0560	1986–1990	0.0045	0.2030	0.6530					
2005	2.0570	2.0570	1991–1995	0.0030	0.1740						
2010	1.9310	1.9310	1996–2000	0.0020							
2015	1.8435	1.8435	2001–2005								

Table 3: Cumulative fertility by birth cohort and age. U.S. women born 1957–61, 1962–66, . . ., 1997–2001.

	TFR			Cumulative births by age							
Year	NVSR	Repl.	Cohort	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49
1971	2.2665	2.2665	1957–1961	0.0055	0.2695	0.8305	1.3795	1.7755	1.9500	1.9905	1.9935
1976	1.7380	1.7380	1962–1966	0.0060	0.2670	0.8040	1.3900	1.8005	2.0030	2.0500	2.0535
1981	1.8120	1.8120	1967–1971	0.0055	0.2565	0.8330	1.3760	1.8350	2.0725	2.1240	
1986	1.8375	1.8375	1972–1976	0.0065	0.3155	0.8545	1.4235	1.9180	2.1540		
1991	2.0625	2.0625	1977–1981	0.0070	0.2745	0.8025	1.3925	1.8750			
1996	1.9760	1.9760	1982–1986	0.0060	0.2310	0.7585	1.2945				
2001	2.0305	2.0305	1987–1991	0.0040	0.2095	0.6360					
2006	2.1080	2.1080	1992–1996	0.0030	0.1595						
2011	1.8945	1.8945	1997–2001	0.0020							
2016	1.8205	1.8205	2002–2006								

Table 4: Cumulative fertility by birth cohort and age. U.S. women born 1958–62, 1963–67, . . ., 1998–2002.

	TFR			Cumulative births by age							
Year	NVSR	Repl.	Cohort	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49
1972	2.0100	2.0100	1958–1962	0.0060	0.2700	0.8280	1.3860	1.7835	1.9620	2.0035	2.0065
1977	1.7895	1.7895	1963–1967	0.0060	0.2680	0.8075	1.3860	1.8010	2.0090	2.0570	2.0605
1982	1.8275	1.8275	1968–1972	0.0055	0.2585	0.8270	1.3685	1.8315	2.0695	2.1215	
1987	1.8720	1.8720	1973–1977	0.0065	0.3080	0.8445	1.4180	1.9210	2.1625		
1992	2.0460	2.0455	1978–1982	0.0070	0.2635	0.7790	1.3695	1.8560			
1997	1.9710	1.9710	1983–1987	0.0055	0.2185	0.7455	1.2780				
2002	2.0205	2.0205	1988–1992	0.0035	0.2110	0.6265					
2007	2.1200	2.1200	1993–1997	0.0030	0.1500						
2012	1.8805	1.8805	1998–2002	0.0020							
2017	1.7645	1.7645	2003–2007								