

The Low Fertility Future? Projections Based on Different Methods Suggest Long-term Persistence of Low Fertility

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Note: Figures and tables in this version of the paper correspond to earlier UN projection scenarios from 2013 (World Population Prospects 2012). They will soon be updated to include the latest projection scenarios released in July 2015, which have already been incorporated into the text.

Short abstract

Population projections by the United Nations released in 2015 envision in their main variant that fertility rates in most countries will range between 1.75 and 2.0 by the end of this century. Are population experts in a broad agreement about the persistence of sub-replacement fertility in countries where fertility reached low levels? We compare the latest fertility projections by the UN for 2050 with two alternatives – expert assessments about the future of fertility collected by the Wittgenstein Centre for Demography and Global Human Capital in 2011 and the projections prepared by national statistical offices. We focus on countries with population above 30 million which have reached below-replacement fertility by 2012. Our analysis reveals a widespread consensus on the continuation of low fertility, combined with disagreements about how low is fertility likely to stay in the future. Specifically, the non-UN scenarios often suggest lower and more varied future fertility levels.

Extended abstract

1 Introduction

Close to a half of the world's population now lives in countries where period total fertility rates (TFR) are below the replacement level (Wilson 2004). This includes many middle- and lower-income countries in Asia and Latin America, such as Brazil, China, Iran, Thailand, Turkey and Vietnam. Parts of Europe and East Asia even experienced spells of “lowest-low fertility” (Goldstein et al. 2009) with the TFR falling below 1.3. Current low fertility is sometimes viewed as temporary, caused by the postponement of childbearing to higher ages, economic uncertainty, a passing phase in the process of human development or in the ongoing “gender revolution” (Goldstein et al. 2009, Myrskylä et al. 2009, Esping-Andersen and Billari 2015). Government concerns about low fertility may result in new policies

stimulating fertility recovery. But there is currently no consensus on this issue, as prolonged economic uncertainty, further education expansion, and other factors may act to depress future fertility (Basten et al. 2014). In parts of East Asia, especially in urban China, the spread of one-child family norms makes sizeable fertility increases unlikely. Moreover, persistent low fertility and population decline may reinforce each other (Lutz et al. 2006).

Despite this uncertainty regarding the drivers of fertility, the median variant of the widely used UN's World Population Prospects published in 2013 generally assumes fertility increases from very low levels of the TFR below 1.5. However, other available projections, mostly based on expert assessments, may envision a different future of fertility (Basten 2013), implying also different population trends and a need for stronger policy responses.

We review the most recent fertility projections for 18 low fertility countries in Europe, Asia, Latin America, and North America with a TFR below 2.1 and combined population of 2.9 billion in 2013. These countries represented 40% of the global population of 7.1 billion (Table S1). Our analysis focuses on comparing the most recent TFR with that projected for 2050. We address the following questions: Is the TFR expected to increase in the future and, if so, is it expected to reach the replacement level of 2.1? Are different projections methods giving systematically different results?

2 Projections and assessments selected for comparison

We look at three different sets of projections and expert assessments: the United Nation's 2015 World Population Prospects (Gerland et al. 2014, UN 2015), the expectations of population experts responding to an online survey conducted by the Wittgenstein Centre for Demography and Global Human Capital (WIC) in 2011 (Basten et al. 2014) and the most recent fertility scenarios published by national statistical offices.

These projections rely on contrasting methodology and thus represent different underlying paradigms in population projection-making. The UN projections are based on a Bayesian model which gives a probabilistic projection of the TFR for all countries assuming a three-stage process of global fertility change (Alkema et al. 2011, UN 2014). The WIC results stem from a structured assessment of the likely future fertility trends and their drivers by experts participating in an online survey (Basten et al. 2014). The NSO fertility scenarios are prepared for the national population projections that are produced with varying frequency and based on different methodology (Table 2).

We focus on larger countries (population 30 million or above as of 2013) with period total fertility rates (TFR) at or below the population replacement level (2.1) as of 2012 (or the latest year available). To simplify the presentation we focus on the projected TFR in 2050. To account for uncertainty about future trends, fertility projections in the past have usually been presented in scenarios, with a most typical combination featuring the main (or medium, median) scenario alongside low and high scenarios. This combination is still used by most NSOs (Table 2). The probabilistic projections by the UN are now published with projection intervals around the median scenario, focusing especially on 80% and 95% intervals (UN 2013, UN 2014). We show the 80% uncertainty intervals in Figures 1 and 4 below.

3 Projection methods and assumptions behind the analyzed scenarios

3.1 *UN World Population Prospects 2015*

UN projections are published for five-year periods. We use Median variant (50% prediction interval) for the TFR in 2045-50, ranging from 1.56 (Poland) to 1.96 (France) for the 18 countries compared (weighted mean=1.80, Table 1). These values differ very little (by 0.00-0.03 in absolute terms) from the TFR predicted for the next period, 2050-55 (UN 2015).

Since the 2010 round the UN projections are based on a Bayesian hierarchical model that takes into account three stages of fertility changes during and after the demographic transition. Five-year changes in period total fertility rates (TFR) are based on similarities in past trends and assumptions about the future TFR patterns. These are partly modelled on previous experience of Europe and Northern America with the cycle of TFR downturn driven by the postponement of childbearing and subsequent partial recovery of postponed childbearing at later childbearing ages (Alkema et al. 2011).

The current fertility projections by the UN constitute an important departure from the earlier deterministic scenarios assuming a convergence towards replacement level of fertility in the very long term (Alkema et al. 2011). Until 2008 the underlying assumptions for future trends in fertility, mortality and migration had been defined by teams of experts based on their substantive knowledge about the determinants of these trends and country-specific factors.

3.2 *The WIC survey of experts*

The WIC survey is an online survey of experts designed to provide an input for a new set of education-specific population projections for every country of the world (Lutz et al. 2014). The invitation was sent to members of major international population associations. Population researchers could choose between responding a questionnaire about the future of fertility, mortality or migration. As the survey relied on the willingness of the invited population experts to participate in the survey, there was an unequal coverage of assessments for the low-fertility countries, with the United States being evaluated by 22 experts, China by 13 experts and some important countries, including France, not being covered at all (Basten et al. 2014). We analyze all countries for which at least four assessments have been conducted. This is a low number, but corresponding to the highly specialized field of fertility analysis and similar to the number of experts often involved in producing the NSO fertility scenarios.

The ‘Low Fertility Module’ of the WIC survey sought to provide the views of experts on future fertility levels as well as the information on its underlying determinants in countries defined as having low fertility – see Basten et al. 2014, Appendix 2, for definition and country selection. These experts provided their forecasts of period total fertility rate (TFR) in 2030 and 2050, including 80% uncertainty ranges. They were also asked to assess the impact and validity of a series of qualitative statements regarding future drivers of fertility.

At least two experts provided an assessment for 17 out of 18 countries analysed here. For five countries (Canada, Poland, Republic of Korea, Ukraine, and Viet Nam) only 2-3 assessments were available; these are not analysed here. In total we used 98 assessments for 12 countries ranging from 4 for Russia, United Kingdom, and Thailand up to 12 for Italy, 13 for China and 22 for the United States (Table 1). Our analysis looks at the average TFR value projected for 2050 across all the experts assessing a given country.

3.3. NSO projections

Most NSOs produce deterministic projections rather than model-based scenarios (Keilman 2008). These are either formulated internally within each NSO and/or with the help of national and international experts (Eurostat 1999).

While the UN projections are available for all countries globally, the NSO fertility projection scenarios are not available or not formulated for some countries. We have collected NSO projections for 13 out of 18 countries analysed; no fertility projections were available for China, Iran, Thailand, Viet Nam, and Ukraine (Table 2). The most recent available projections were published between 2009 (Germany) and 2014 (Canada, Poland, Spain, and the United States). These projections typically cover the next 50 years up to around 2060. The projection for Turkey extends until 2075, whereas the projection for United Kingdom is the shortest and covers only the period until 2037. In this case, we used the data for 2037 and assumed that they also represent the period up to 2050—this assumption is justified by a stable level of the projected TFR during the whole projected period.

4 The low fertility expectations

There is a widely shared expectation of the persistence of low fertility in the future. Of all the projections examined, none suggests in its medium variant that the TFR in any of the examined countries will recover to the replacement level of 2.1 or above by the year 2050. The highest projected TFR, 1.96, comes from the UN projection for France and a NSO projection for France (1.95), followed by the UN projection for the United States (1.92).

However, the projections differ in their view on how low is fertility likely to stay and on whether countries will become more similar in their fertility (Figure 1). The median variant of the UN projection does not envision a continuation of very low fertility and the TFR in all the analyzed countries is projected to rise above 1.55, with most countries converging to a narrow TFR range of 1.71-1.90 (Table 1). In contrast, most WIC experts and NSO scenarios anticipate a lower TFR in the future. The population-weighted average projected TFR in 2050 for all the analyzed countries with available data is 1.80 for the UN projection, 1.64 for the NSO forecasts and 1.54 for the WIC projections. When only eight countries with all the three available projections are selected, the WIC average shifts, reaching 1.66.

The WIC and NSO experts appear rather skeptical about the prospects of the future TFR recovery in countries with a prolonged experience of very low fertility. They predict a TFR below 1.5 in six countries: in the NSO projections for Spain (1.23), Japan (1.35), Germany (1.40) and Korea (1.42) and by WIC experts for Japan (1.38), China (1.42) and Russia (1.48) (Table 1). These are very low values, which fall, together with the WIC projection for Russia, below the 80% prediction interval of the UN projection (Figure 1). Moreover, the UN projection's 80% interval for 2050 falls above the current TFR levels in Italy, Poland, Spain, and, probably also China, where considerable uncertainty about the current TFR level exists (Zhao and Zhang 2010).

With a few exceptions the UN projections predicted the highest TFR and the smallest cross-country variation in 2050, with 14 out of 18 analyzed countries expected to have their TFR in a range of 1.60-1.90. The WIC and NSO projections show on average lower and often similar values, with NSO projections depicting the largest variability and smallest differences from recent TFR (Figures 2 and 3). Projections for the most populous country, China, have an impact on the presented differences between projections, as the UN medium projection envisions a strong TFR increase to 1.74 whereas the WIC experts expected merely a stagnating TFR of 1.42, very close to the estimated TFR of 1.45 in 2010 (Table 1). However,

the data for China should be interpreted with caution, as even the recent fertility levels there are uncertain and debated among the experts (Basten et al, 2014; Zhao and Zhang 2010; Goodkind 2011).

The three sets of medium projections are differentiated by country groups. Countries with early fertility declines which never experienced TFR falls to very low (below 1.5) levels (United States, France, United Kingdom) are, according to all the three projections sets analysed, expected to retain similar TFR in the future as that recorded recently, between 1.83 and 1.99. The expectations are more varied for the countries with early fertility declines, mostly in Europe, which experienced TFR falls to very low levels below 1.5 (Germany, Italy, Poland, Russia, Spain, Ukraine, but also Japan). There, the UN projection mostly envisions considerable fertility recovery to the levels 1.56 (Poland) to 1.87 (Russia), whereas the WIC and NSO projections differ widely by country. For Japan, both expect a continuation of very low fertility, with the TFR just above 1.3, i.e., below the lower-bound of 80 % interval of the UN projection and slightly below the most recent TFR. For Germany, NSO projection gives a low value of 1.40, while the UN and WIC experts expect the TFR to rise above 1.6. Large contrasts between projections are found for Russia and Spain. For Russia, the WIC experts expect a TFR declining to 1.48, while the NSO and UN predict it will recover above 1.8. For Spain, an NSO projection predicts an extreme low value of 1.23, while the WIC experts as well as the UN expect a TFR by 0.4-0.5 higher. For countries that have only recently experienced a TFR decline below 2.1—Brazil, Iran, Thailand, Turkey, and Viet Nam UN projection expects further TFR declines (except for Thailand), as do most of the WIC (except for Brazil and Thailand) and NSO projections. The UN expects the lowest TFR in 2050 in Thailand (1.58), the WIC experts suggest a low value of 1.51 in Iran, and the NSO projections are particularly low for Brazil (1.50).

Overall, the UN model gives a picture of a broad convergence: it mostly predicts fertility increases in countries with a recent TFR below 1.8 and declines in those above this threshold. In contrast, the NSO projections show a wide variation, characterized by the weakest TFR recovery and a strong correlation between the current and the predicted TFR levels (Figure 2). Only for the countries with a relatively high TFR above 1.8, UN, WIC and NSO projections come to a broad agreement as they typically expect slight fertility declines in the future (Figure 3).

Most projections take into account uncertainty about future trends. Figure 1 shows the 80% prediction interval of the UN projection for 2050. Figure 4 compares for eight countries medium variants with low and high variants (NSO) and 80% uncertainty range (WIC) or 80% prediction interval (UN) of the projected TFR in 2050. For the UN and WIC datasets, a typical upper 80 % threshold of the TFR projection is around the replacement level, with a UN mean of 2.06 across the 18 analyzed countries (min. 1.92, max. 2.24). In contrast, the NSO projections often have a high variant well below 2 and as low as 1.6 in Japan and Germany. The lower boundaries are yet more varied. They are on average highest for the UN projection (average lower 80% boundary at 1.47) and lowest for the NSO low variant scenarios. In China, Italy, and Spain the lower 80% threshold in the UN projection is above the recent reported TFR levels, showing a strong confidence in the future TFR growth. Some predicted values are extremely low. The WIC experts suggest that there is a considerable chance TFR in China will be below 1 in 2050 (lower 80% at 0.93, strongly contrasting with a UN value of 1.52). The lower TFR variant in the NSO projection for Japan is 1.01 and for South Korea 1.13. Similarly, the lower 80% bound of the UN projection for Thailand and Vietnam is at 1.1.

5 Discussion and policy challenges

There is a strong persistence of the view that replacement level fertility at around 2.1 children per woman is most sustainable, optimal or desirable. Hence, governments in many low-fertility countries have increasingly expressed concerns about the sustainability of their fertility levels. Some have defined clear policy strategies intended to raise fertility (UN 2013). Russia, Iran and Turkey have adopted explicitly pronatalist rhetoric and policies, with the latter two countries aiming to keep fertility above replacement level to ensure continued population growth. Other countries which identify low fertility as a concern are designing more implicit policy approaches to family policy, work-life balance and labor market reforms.

The different projection methods analyzed here come to a broad agreement that fertility will remain below the replacement level by 2050. The main difference between the analyzed projections lies in a general convergence to moderately low fertility in the UN projection model as opposed to a higher diversity combined with the expectation of continuing very low fertility in some countries among WIC experts and in NSO projections. This difference is most pertinent for China, Japan, and Russia, where the UN expects considerable fertility increase, whereas the experts in WIC survey predict low and stagnating fertility. But the expected persistence of low fertility is also remarkable for the countries that have experienced low fertility only recently, such as Brazil and Iran. This indicates that many population experts expect that once a country reaches a (very) low fertility level, it is likely to become locked in.

The main caveat of expert-based assessments provided by WIC survey and also shaping most of the NSO projections is their tendency to expect stable patterns and trends – in most of their assessments the world of tomorrow looks very much like the world of today. But despite this drawback the possibility of long-term persistence of very low fertility in many countries should be taken seriously by policy makers. Long-term very low fertility would have more serious consequences in countries that do not experience sizeable immigration, such as China and Japan. It would not only negatively affect population growth, but also accelerate the ongoing population aging, creating challenges for families, healthcare, public finances, employers, social security systems and government policies (Smeeding 2014, Harper 2014). Low fertility will also have some positive consequences. Optimal fertility is likely to lie below the replacement threshold when environmental factors and the expansion of higher education—bringing considerable costs at young ages and enhancing productivity later in life—are considered (Striessnig and Lutz 2014). Fertility below replacement supports higher consumption and thus has a positive effect on material standard of living, especially in older age (Lee et al. 2014).

Governments often have limited ability to influence fertility beyond creating temporary baby booms. In all higher-income countries there will be a growing pressure for them to provide better conditions for young couples to have children and to support easier combination of work and family life in the form of childcare provision, leave arrangements, gender equality policies and taxation (Thévenon 2011). However, the current fertility projections also strongly indicate policy makers should take into account the predicted continuation of low fertility and pursue necessary adjustments in retirement age, public spending, social and employment policies. This is most pertinent for China, where government still imposes policies limiting number of children couples are authorized to have (Wang Feng et al. 2013). The expectations of Chinese experts of continuing very low fertility suggests that scrapping these regulations is a long overdue policy priority.

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References and Notes

To be added

Figures and Tables

Figure 1. Observed (2012 or latest available) and projected period Total Fertility Rate in 2050 according to the UN WPP 2012 (median scenario and 80 % intervals), WIC experts (2011, mean of point estimates) and national statistical offices (most recent medium scenario) – 18 low-fertility countries with population over 30 million.

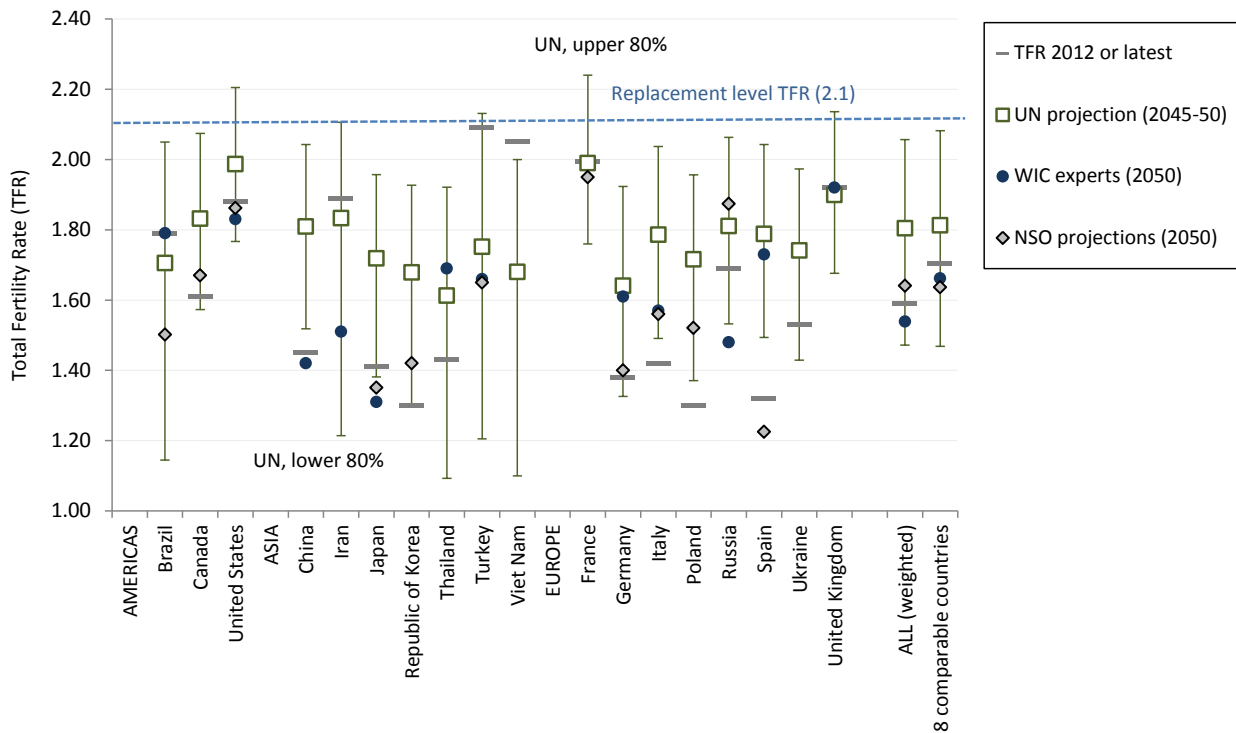


Figure 2. Observed TFR in 2012 (or latest available) and projected TFR in 2050 (medium variant). Projections by UN, WIC experts and NSO in 18 low-fertility countries with population over 30 million. The trend lines are quadratic polynomials.

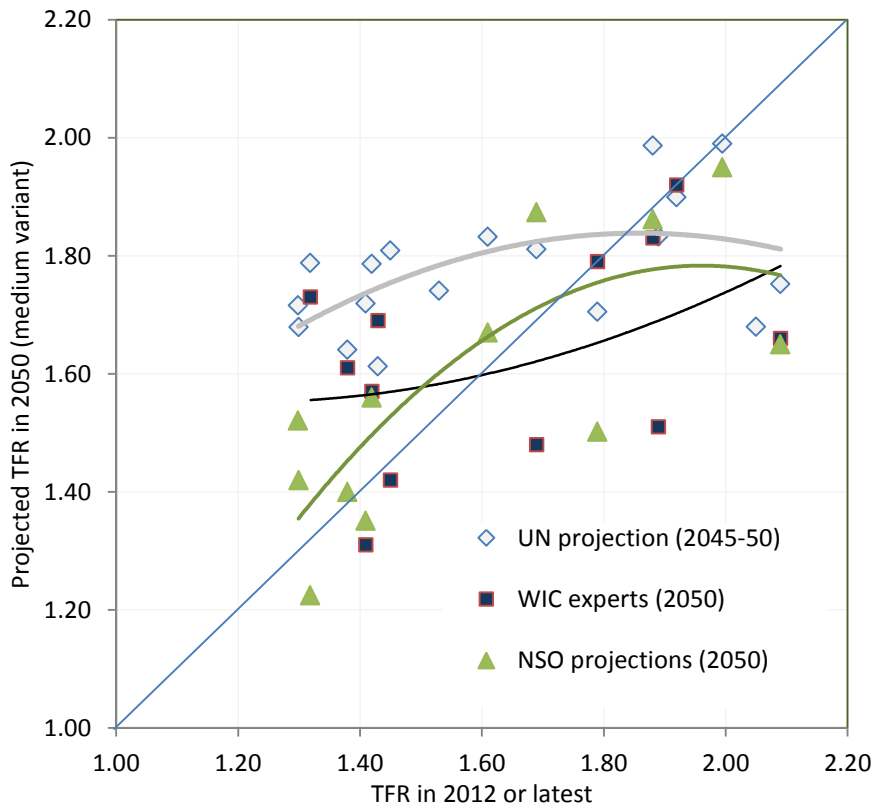


Figure 3. Observed TFR in 2012 (or latest available) and projected change in TFR in 2012-50. Projections by UN, WIC experts and NSO in 18 low-fertility countries with population over 30 million. The trend lines are quadratic polynomials.

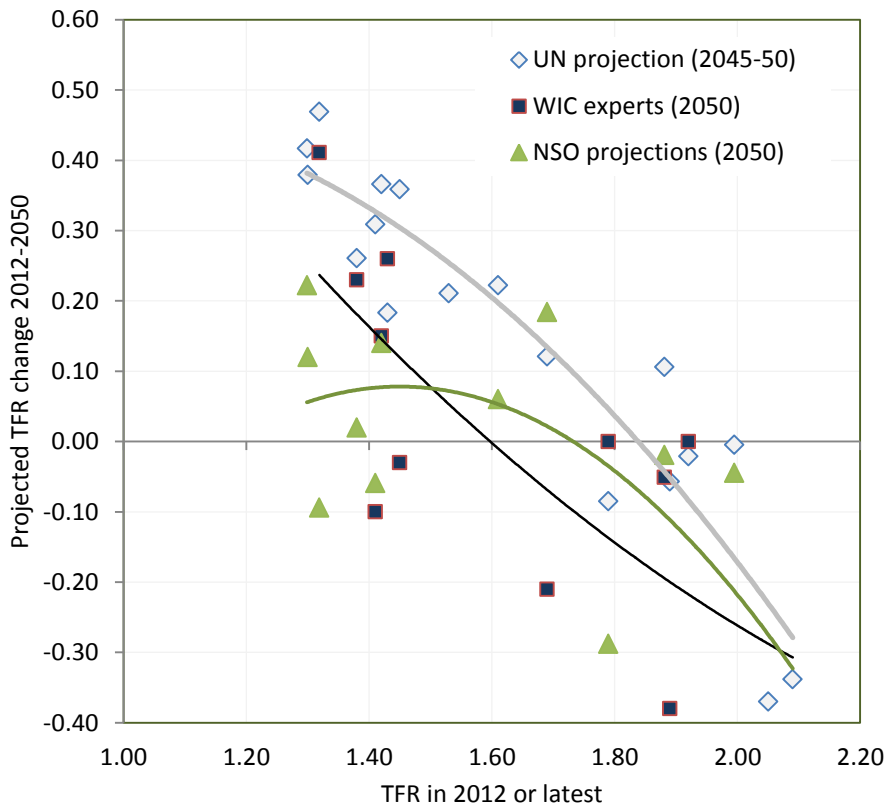


Figure 4. Observed TFR in 2012 (or latest available) and projected TFR in 2050 according to the UN (2012, median scenario and 80% prediction intervals), WIC experts (2011, mean and 80% uncertainty range) and NSO (most recent main, low and high scenario). Eight low-fertility countries with population over 30 million.

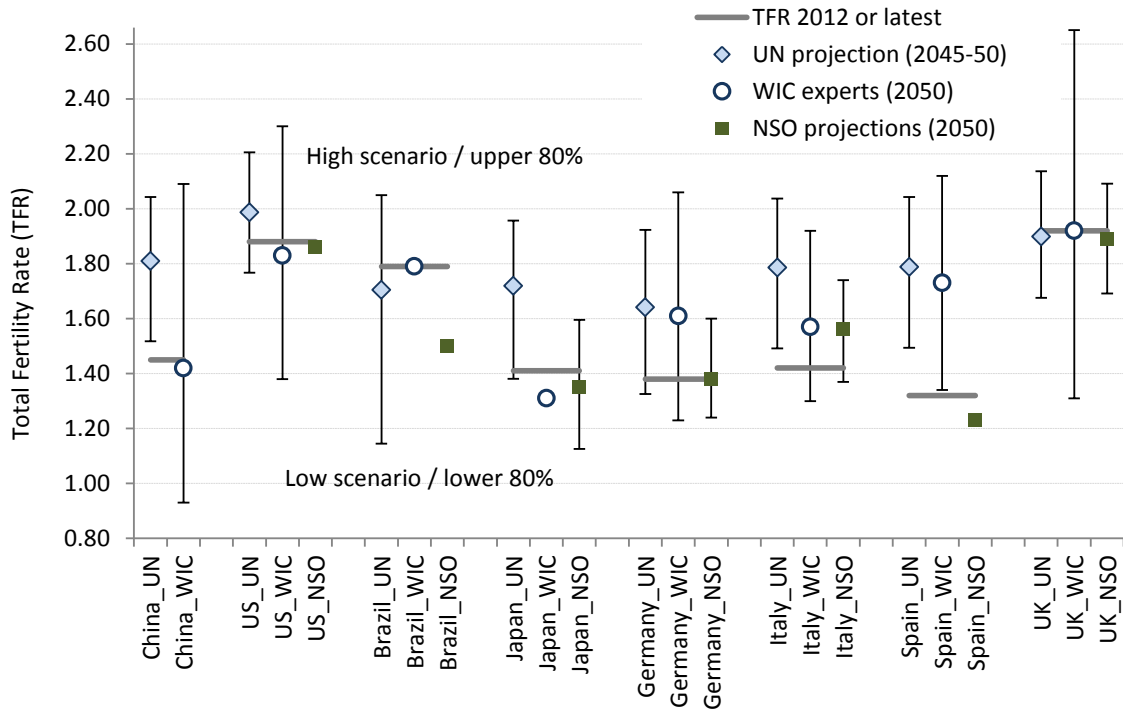


Table 1. Countries with below-replacement period TFR (2012 or latest available) and population over 30 million in 2013

Country	Population 2013, million	Period TFR, 2012 or latest	Source and reference year for TFR 2012 or latest	Projected fertility in 2050 (main, mean or medium variant)			
				UN 2012	WIC experts 2011 ¹⁾	NSO	No. of experts in WIC survey
<i>Latin & North America</i>							
Brazil	194	1.79	(38), 2011	1.71	1.79	1.50	7
Canada	35	1.61	(39), 2011	1.83	(1.68)	1.67	3
United States	314	1.88	(40), 2012	1.99	1.83	1.86	22
<i>Asia</i>							
China	1,351	1.45	(3), 2010	1.81	1.42	..	13
Iran	76	1.89	(41), 2006	1.83	1.51	..	8
Japan	128	1.41	(42), 2012	1.72	1.31	1.35	6
Republic of Korea	50	1.30	(43), 2012	1.68	(1.48)	1.42	2
Thailand	68	1.43	(41), 2009	1.61	1.69	..	4
Turkey	75	2.09	(44), 2012	1.75	1.66	1.65	5
Viet Nam	89	2.05	(45), 2012	1.68	(1.40)	..	3
<i>Europe</i>							
France	64	1.99	(37), 2012	1.99	..	1.95	0
Germany	82	1.38	(37), 2012	1.64	1.61	1.40	9
Italy	60	1.42	(37), 2012	1.79	1.57	1.56	12
Poland	39	1.30	(37), 2012	1.72	(1.73)	1.52	2
Russia	143	1.69	(46), 2012	1.81	1.48	1.87	4
Spain	47	1.32	(37), 2012	1.79	1.73	1.23	6
Ukraine	46	1.53	(37), 2012	1.74	(1.60)	..	2
United Kingdom	64	1.92	(37), 2012	1.90	1.92	1.89 (2037)	4
Total	2,922	1.59		1.80	..	..
Global	7,080	2.50	UN (2010-15, projected)	2.24			
All available countries (population-weighted) ¹⁾				1.80	1.54	1.64	100
8 comparable countries (population-weighted) ²⁾	1,042	1.70		1.81	1.66	1.64	75

Notes: More details about NSO projections are provided in Table 2

1) WIC experts' forecasts are not considered for analysis if fewer than four experts per country participated in the online survey

2) 8 comparable countries for which all three types of projections (UN, WIC with 4+ experts and NSO) were available: US, Brazil, Japan, Turkey, Germany, Italy, Russia, and Spain

Table 2. Information about fertility projections prepared by national statistical offices (NSO)

Country	Projection published	Projection period	Variants	Used variants	Institution	Reference
<i>Latin & North America</i>						
Brazil	2013	2000-2060	medium	medium	Instituto Brasileiro de Geografia e Estatística (IBGE)	(22)
Canada	2014	2011-2063	low, medium, high	low, medium, high	Statistics Canada	(23)
United States	2014	2014-2060	medium	medium	U.S. Census Bureau	(24)
<i>Asia</i>						
China	not available	----	----	----	----	----
Iran	not available	----	----	----	----	----
Japan	2012	2010-2060	low, medium, high	low, medium, high	National Institute of Population and Social Security Research in Japan	(25)
Republic of Korea	2011	2010-2060	low, medium, high, fixed	low, medium, high	Statistics Korea	(26)
Thailand	not available	----	----	----	----	----
Turkey	2013	2013-2075	medium, high, very high	medium, high	Turkish Statistical Institute	(27)
Viet Nam	not available	----	----	----	----	----
<i>Europe</i>						
France	2010	2010-2060	low, medium, high	low, medium, high	Insee	(28)
Germany	2009	2009-2060	low, medium, high	low, medium, high	DESTATIS - Statistisches Bundesamt	(29)
Italy	2011	2011-2065	low, medium, high	low, medium, high	Italian National Institute of Statistics (ISTAT)	(30)
Poland	2014	2014-2070	low, medium, high, very high	low, medium, high	Central Statistical Office	(31)
Russia	2013	2014-2050	low, medium, high	low, medium, high	Federal State Statistics Service	(32)
Spain	2014	2014-2063	medium	medium	National Statistics Institute	(33)
Ukraine	not available	----	----	----	----	----
United Kingdom	2012	2010-2037	low, medium, high	low, medium, high	Office for National Statistics (ONS)	(34)

Table 3. Main (Median), Low (or lower 80% interval) and High (or upper 80% interval) variants of fertility projections.

Country	Period TFR, 2012 or latest	Main/medium/median variant			Low / lower 80% variant			High / upper 80% variant			No. of experts in WIC survey	
		UN	WIC ¹⁾	NSO	UN	WIC ¹⁾	NSO	UN	WIC ¹⁾	NSO	Medium var.	80% CI range
<i>Latin & North America</i>												
Brazil	1.79	1.71	1.79	1.50	1.15	..	..	2.05	..	..	7	2
Canada	1.61	1.83	..	1.67	1.57	..	1.53	2.07	..	1.88	3	2
United States	1.88	1.99	1.83	1.86	1.77	1.38	..	2.21	2.30	..	22	19
<i>Asia</i>												
China	1.45	1.81	1.42	..	1.52	0.93	..	2.04	2.09	..	13	7
Iran	1.89	1.83	1.51	..	1.21	..	..	2.11	..	..	8	1
Japan	1.41	1.72	1.31	1.35	1.38	..	1.13	1.96	..	1.60	6	2
Republic of Korea	1.30	1.68	..	1.42	1.30	..	1.01	1.93	..	1.79	2	1
Thailand	1.43	1.61	1.69	..	1.09	..	..	1.92	..	..	4	2
Turkey	2.09	1.75	1.66	1.65	1.21	..	..	2.13	..	2.50	5	2
Viet Nam	2.05	1.68	..	..	1.10	..	..	2.00	..	..	3	0
<i>Europe</i>												
France	1.99	1.99	..	1.95	1.76	..	1.80	2.24	..	2.10	0	0
Germany	1.38	1.64	1.61	1.40	1.33	1.23	1.24	1.92	2.06	1.60	9	4
Italy	1.42	1.79	1.57	1.56	1.49	1.30	1.37	2.04	1.92	1.74	12	7
Poland	1.30	1.72	..	1.52	1.37	..	1.38	1.96	..	1.70	2	2
Russia	1.69	1.81	1.48	1.87	1.53	..	1.50	2.06	..	2.19	4	2
Spain	1.32	1.79	1.73	1.23	1.49	1.34	..	2.04	2.12	..	6	4
Ukraine	1.53	1.74	..	..	1.43	..	..	1.97	..	..	2	2
United Kingdom ²⁾	1.92	1.90	1.92	1.89	1.68	1.31	1.69	2.14	2.65	2.09	4	4

NOTES More details about NSO projections are provided in Table 2; more details about latest TFR data are in Table 1

- 1) WIC experts' forecasts are not considered if fewer than four experts per country participated in the online survey or if fewer than four experts per country gave assessment of the 80% interval of the TFR range in 2050
- 2) Figures for United Kingdom NSO are for 2037