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The surprising global variation in replacement fertility

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Abstract. It is frequently assumed by the general public and also by some population experts that the value of replacement-level fertility is everywhere an average of 2.1 lifetime births per woman. Nothing could be farther from the truth. The global variation in replacement fertility is substantial, ranging by almost 1.4 live births from less than 2.1 to nearly 3.5. This range is due almost entirely to cross-country differences in mortality, concentrated in the less developed world. Policy makers need to be sensitive to own-country replacement rates. Failure to do so could result in fertility levels that are below replacement and lead to long-run population decline. For example, the current replacement total fertility rate for the East Africa region is 2.94. Lowering fertility to 2.10 would, under current mortality conditions, result in a regional birthrate 29 percent below replacement.

It is frequently assumed by the general public, the media, and even by some demographers that the value of replacement-level fertility is universally 2.1. For example, in an article about recent dramatic declines in fertility in some developing countries, Crossette (2002: D8) notes, "Today, village women and slum families in some of the poorest countries are beginning to prove [the experts] wrong, as fertility rates drop faster than predicted toward the replacement level – 2.1 children for the average mother". The *2000 Revision* of the United Nations (2001) world population projections refers to "the" replacement level as a total fertility rate of 2.1. Finally, after assessing trends in total fertility rates for 143 developing countries from 1950 to 2000, John Bongaarts (2002: 2) concludes, "It is highly unlikely that developing countries will converge on replacement fertility of 2.1 children per woman as is often assumed in population projections".

The global variation in replacement-level fertility is shown in Figure 1. It is substantial, ranging from a low of 2.05 for Réunion to a high of 3.43 in Sierra Leone. A majority of the world's countries – and all of the more developed ones – have replacement-level total fertility rates within 0.1 of 2.1. But roughly 80 developing countries display replacement fertility rates higher than 2.2. This range of behaviors shows that there is not just one universal constant for replacement-level total fertility; instead, the values for replacement fertility are highly country-specific.

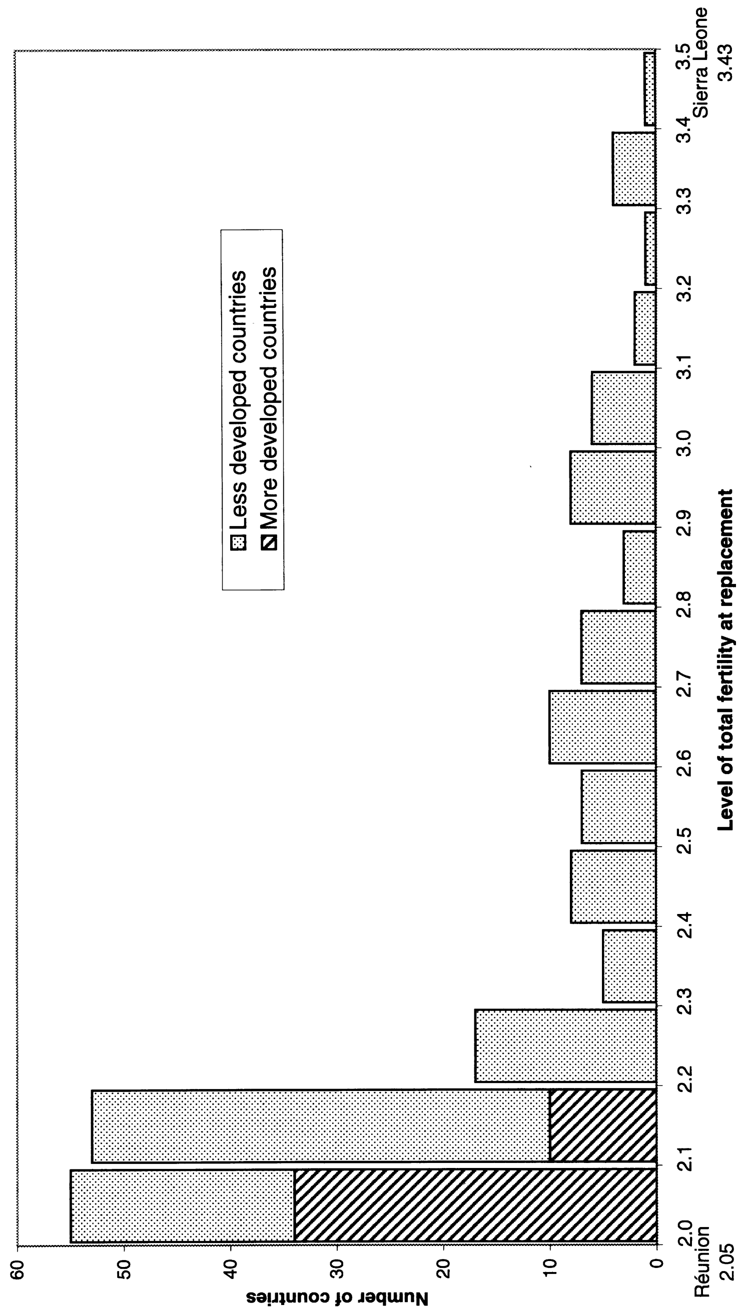

Figure 1. Distribution of replacement-level total fertility rates by country, 1995-2000 (N = 187). *Source:* Authors' calculations from data in United Nations (2001).

The numerical values for replacement fertility in Figure 1 are calculated using the approximation in Preston et al. (2001: 115):

$$\mathrm{TFR}_R \approx (1 + \mathrm{SRB})/p(A_M), \tag{1}$$

where TFR_R is the replacement value for the total fertility rate (TFR), SRB is the sex ratio at birth and equal to the ratio of the number of male to female births, and $p(A_M)$ is the probability of surviving to the mean age of the fertility schedule. The major determinant of cross-national variations in TFR_R is differences in mortality. TFR_R will be close to 2.1 when practically all women survive to the mean age of the fertility schedule (usually to age 25 or 30). However, when this survival proportion falls closer to 0.60 – as it does in Afghanistan, Burundi, and Sierra Leone – then replacement total fertility rates above 3.3 are implied.

A comparison between current total fertility rates and associated levels of replacement fertility highlights the significance of replacement fertility. In the absence of migration, a continuation of current fertility and mortality conditions leads to long-run population increase if fertility is above replacement and to eventual population decline if fertility is below replacement. The relation between actual and replacement fertility for the world's less developed countries is shown in Figure 2. Current total fertility rates are shown along the vertical axis, and replacement TFRs are measured horizontally. If replacement fertility were universally 2.1, then countries that are located above (below) the horizontal line corresponding to TFR = 2.1 would have fertility above (below) replacement. The 45-degree line traces out points where the values for current and replacement TFR are equal. Countries that lie above (below) this line have fertility above (below) replacement.

A majority of the 143 less developed countries, and especially those that the United Nations (2001) terms the least developed, have fertility rates that are substantially above replacement. This is so whether we include countries that lie above the horizontal line corresponding to TFR = 2.1 or, more appropriately, count those above the 45-degree line. The variation in current total fertility is striking, ranging from just above 1.0 for Hong Kong to 8.0 in Niger. But the cluster of data points for countries with total fertility rates above 4 or 5 also shows that the value for replacement fertility is not always 2.1 and can reach nearly 3.5. The measurement of replacement has obvious consequences for how far current fertility is from replacement. For example, in the case of Botswana in Figure 2, the current total fertility rate (4.35) is 107 percent above 2.1 but only 45 percent greater than its own replacement value of 3.01.

The corresponding situation for the world's more developed countries is shown in Figure 3. For the period 1995–2000, with the exception of Albania,

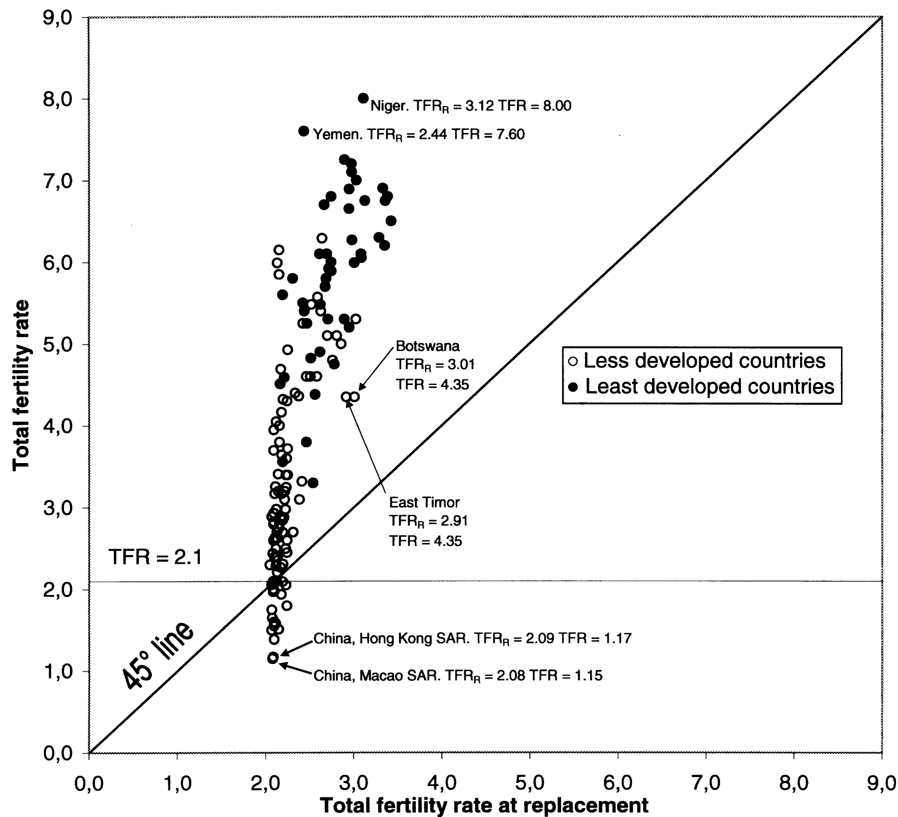

Figure 2. Total fertility rate and total fertility rate at replacement for the less and least developed countries, 1995–2000 (N = 143). *Source*: Authors' calculations from data in United Nations (2001).

fertility is below replacement in all 44 more developed countries. Figure 3 also confirms the observation from Figure 1 that all more developed countries exhibit values for replacement-level fertility that are very close to 2.1.

Failure to appreciate the significant global variation in replacement fertility is more than a demographic peccadillo. It can have important policy consequences. Table 1 shows the gap between current fertility and replacement fertility for the world and its major regions. Current levels of total fertility are shown in column 2; column 3 presents values for replacement fertility, calculated using Equation (1). Column 4 shows the deviation of actual from replacement fertility using 2.1 as the standard for replacement. World fertility by this measure is 34 percent above replacement. By contrast, column 5 derives deviations between actual and replacement fertility from own-region replacement values. Seen from this new perspective, world fer-

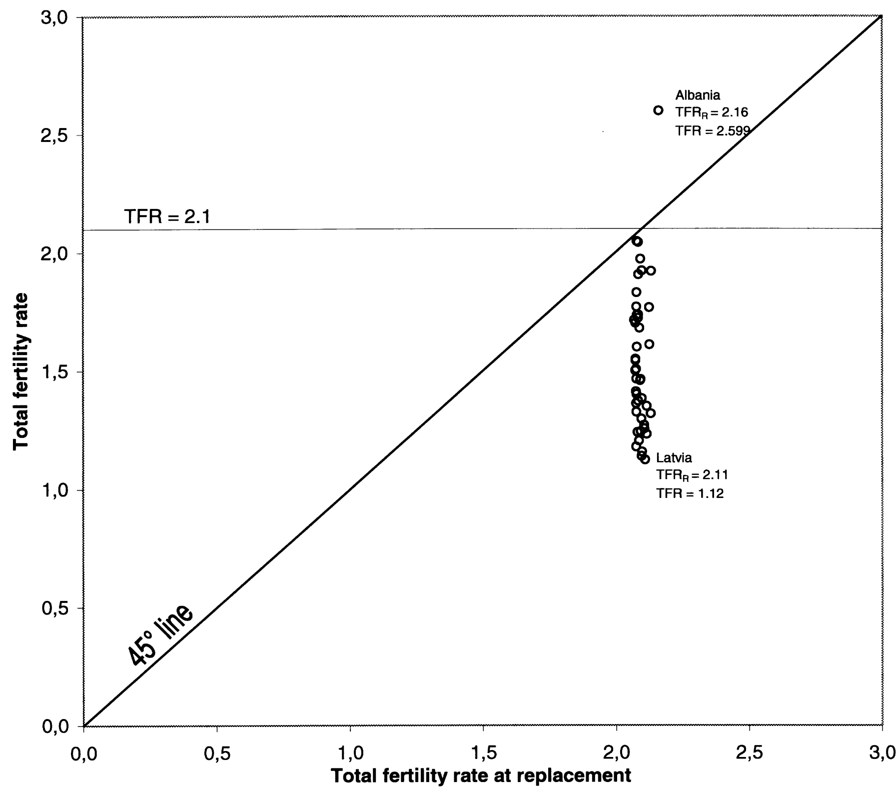

Figure 3. Total fertility rate and total fertility rate at replacement for the more developed countries, 1995-2000 (N = 44). *Source*: Authors' calculations from data in United Nations (2001).

tility is 21 percent above replacement – still high by many standards, but not as high as when judged by the conventional, though misleading, rule of thumb of 2.1. European fertility is 33 percent below replacement, regardless of which measure of replacement is used. On the other hand, fertility in Africa is 151 percent above replacement as measured by 2.1 but 95 percent above its own-region replacement level.

In many policy circles the implicit goal of population policy in high-fertility countries is a reduction to a total fertility rate of 2.1. The data in column 6 indicate that, for most regions of the world, this is a recipe for population decline. On a global scale, a TFR of 2.1 would produce a fertility level 10 percent below replacement. For the more developed regions generally, as well as for North America and Europe individually, total fertility of 2.1 is roughly equivalent to fertility at replacement. But for the least developed regions, and especially for Africa, reducing fertility to 2.1 lifetime

Table 1. The gap between actual fertility and replacement fertility for the world and major regions, 1995–2000

Region (1)	Total fertility rate (TFR) (2)	Total fertility at replacement (TFR_R) (3)	TFR/2.1 (4)	TFR/TFR_R (5)	$2.1/TFR_R$ (6)
World	2.816	2.335	1.341	1.206	0.899
More developed regions	1.567	2.091	0.746	0.749	1.004
Less developed regions	3.097	2.370	1.475	1.307	0.886
Least developed countries	5.471	2.748	2.605	1.991	0.764
Less developed regions excluding the least developed countries	2.776	2.303	1.322	1.205	0.912
Northern America	1.999	2.085	0.952	0.959	1.007
Europe	1.408	2.097	0.670	0.671	1.001
Oceania	2.411	2.176	1.148	1.108	0.965
Latin America/Caribbean	2.687	2.170	1.280	1.238	0.968
Central America	3.044	2.164	1.450	1.406	0.970
South America	2.572	2.166	1.225	1.187	0.969
Caribbean	2.500	2.234	1.190	1.119	0.940
Africa	5.273	2.699	2.511	1.954	0.778
Eastern Africa	6.093	2.944	2.901	2.069	0.713
Middle Africa	6.409	2.745	3.052	2.334	0.765
Northern Africa	3.576	2.302	1.703	1.553	0.912
Southern Africa	3.294	2.442	1.569	1.349	0.860
Western Africa	5.945	2.772	2.831	2.145	0.758
Asia	2.699	2.320	1.285	1.163	0.905
Eastern Asia	1.762	2.230	0.839	0.790	0.942
South-eastern Asia	2.826	2.251	1.346	1.256	0.933
South-central Asia	3.577	2.426	1.703	1.474	0.866
Western Asia	3.855	2.230	1.836	1.729	0.942

Source: Authors' calculations from data in United Nations (2001).

births per woman would – under current mortality conditions in these areas – lead eventually to population decline. In East Africa, the most striking example, fertility reductions of this magnitude would produce birth rates 29 percent below replacement. Much of the confusion surrounding the value for replacement fertility could be removed if demographers relied on the net reproduction rate (NRR) instead of the total fertility rate. Because the NRR

is a measure that combines fertility and mortality, fertility is unambiguously at replacement if and only if NRR = 1.0.

Discussion

One might argue that it is implausible to assume that fertility reductions in developing countries can occur in the absence of corresponding declines in mortality. While it is not unreasonable to believe that social and economic forces that promote lower fertility would in general also lead to lower mortality, there is a growing body of literature suggesting that the rising prevalence of HIV/AIDS can produce both higher mortality *and* lower fertility. Studies in rural Uganda and Tanzania and in Kinshasa, Zaire, have consistently shown that fertility rates of HIV-positive women are 20 to 30 percent below those of their uninfected counterparts (Carpenter et al. 1997; Hunter et al. 2003; Ryder et al. 1991; Sewankambo et al. 1994).

These differentials typically have both behavioral and biological components, including among infected populations higher rates of widowhood and divorce and lower remarriage, reduced coital frequency, greater use of modern contraception, increased risk of spontaneous abortions and stillbirths, increased amenorrhea, and (among infected men) reduced spermatogenesis (Hunter et al. 2003). In the many countries where HIV prevalence has the potential to climb still further, the realization of such increases is likely to mean higher mortality and morbidity as well as lower fertility as HIV-infected women make up a larger share of the adult population (Gregson et al. 1997; Heuveline 2003). Heuveline (2003) also reports that the impact of HIV-positive women on fertility has been shown to outweigh the mortality impact in terms of future population growth. This relatively greater effect of HIV on fertility would be compounded if, as Heuveline (2003) suspects, the care-giving strain on uninfected women in high-prevalence areas depresses their fertility.

Furthermore, even though the United Nations in its population projections appears not to have explicitly modeled the impact of HIV/AIDS on fertility trends, it has recognized that AIDS results in a deficit of births, not only through the premature deaths of women of childbearing age but also because of “the effect of HIV on the fertility of women living with the disease” (United Nations 2003: 10). (To estimate the effect of HIV/AIDS on child mortality in the *2000 Revision*, the United Nations (2002: 109) has assumed that the fertility of HIV-positive women is 20 percent below that of uninfected women in every age group.) Medium-variant projections in the United Nations *2000 Revision* for Botswana, Lesotho, South Africa, and Swaziland – four countries where the estimated 2001 AIDS prevalence exceeds 20 per-

cent (United Nations 2003, Annex Table 17) – show fertility dropping below replacement at TFR values 15 to 30 percent higher than 2.1 (United Nations, 2001). And in the *2002 Revision*, which by comparison with the *2000 Revision* assumes a more serious and prolonged impact of the HIV/AIDS epidemic and lower expected future fertility levels, Botswana, Lesotho, South Africa, and Swaziland are all projected to experience population loss between 2000 and 2050 (United Nations 2003). The recent experiences of many western and eastern European countries, along with several republics of the former Soviet Union, also belie the notion that fertility cannot fall substantially without concomitant improvements in mortality. There, fertility has fallen sharply below replacement – in some cases to nearly 1.0 lifetime births per woman – in the face of only gradual increases in life expectancy at birth (United Nations 2003, Annex Table 11).

How much independent variation fertility and mortality can display is a topic that requires further research. But clearly, based on the evidence already in hand, it is not unrealistic to assume that, in countries where AIDS is beginning to have an impact and where HIV prevalence may increase substantially in the future, fertility will fall faster than already projected while mortality remains high or goes even higher.

Conclusions

This brief note serves first of all as an important reminder that there is substantial worldwide variation in replacement-level total fertility rates. It is misleading and incorrect to refer to "the" replacement level as invariantly 2.1. Under current conditions, replacement fertility varies from a low of 2.05 in Réunion to a value 67 percent higher in Sierra Leone (3.43). Most of the variation occurs in the less developed countries and is due to cross-national differences in mortality. And these differences are likely to increase further with the spread of AIDS. Only among the more developed countries is the level of replacement fertility typically within 0.1 of 2.1.

Policy makers need to be sensitive to country-level variations in replacement fertility. Fertility policies should incorporate own-country replacement fertility rather than a presumed universal standard. Failure to do so, especially in the face of unusually high mortality, could lead to fertility outcomes that might actually be lower than those that were intended.

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