Fertility Choice under Child Mortality and Social Norms

Joydeep Bhattacharya
Iowa State University
joydeep@iastate.edu

Shankha Chakraborty
University of Oregon
shankhac@uoregon.edu

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Abstract

A cornerstone of demographic transition theory is that declines in infant and child mortality plausibly explain the onset of fertility decline in most countries. Simple versions of the Barro-Becker model of fertility choice have trouble delivering this link. We propose an extension, the inclusion of societal norms regarding family size, which, even with logarithmic preference over surviving children, can generate this link.

KEYWORDS: child mortality, fertility, demographic transition, social norms
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1 Introduction

The relation between fertility and child mortality is at the core of historical and modern demographic transitions. In several demographic transitions, such as those in England, Germany and Sweden in the nineteenth century and India and many other developing countries more recently, child mortality declines have preceded the transition to smaller family size (Angeles, 2010; Lee, 2003, Figure 3). In such transitions, the evidence points to a decline in both total and net fertility rates.[1] Yet simple versions of the Barro and Becker (1989) model – the dominant paradigm in the economics of fertility choice – have trouble delivering declines in the total *and* net fertility rates when child mortality rates decline (Doepke, 2005). Under the standard assumption of logarithmic preference for the number of surviving children, a fall in the child mortality rate is absorbed as a fall in the total fertility rate with the net fertility rate remaining unchanged. As discussed in the in-depth survey by Galor (2011), for the latter to move, one has to appeal to other assumptions, such as non-logarithmic preferences (Jones, 2001) or a precautionary demand for children (Kalemli-Ozcan, 2008).

We propose a static version of the standard Barro-Becker model under logarithmic preferences that is capable of generating the desired effect in both the total and net fertility rates. The modification is

[1] The total fertility rate (TFR) is the number of children the average woman bears. The number of surviving children per woman of child-bearing age is the net fertility rate (NFR).

the inclusion of social norms regarding family size, whereby families partly base their fertility choice on a family-size ideal or norm that exists in their social environment.[2] Our formulation of fertility norms is adapted from the conformist norms studied by Akerlof (1997). Multiple fertility equilibria emerge naturally in our setting. At the highest fertility equilibrium, a fall in the child mortality rate leads to a decline in both the total and net fertility rates.

Social norms have been known to affect fertility behavior. In his overview of England's population in the late nineteenth century Hinde (2003) observes: "Of course, once economic pressure led to smaller families becoming more common, it is also likely that they became more fashionable ... Evidence from the 1911 census data also suggests that the low fertility behaviour of the middle classes spread to other groups within the population who were closely associated with the middle classes – for example, those employed in domestic service". More recently, Munshi and Myaux (2006) present evidence that reproductive social norms can explain the inertia of fertility behavior and contraceptive adoption in rural Bangladesh. La Ferrera *et al.* (2008) find that the typically smaller family size depicted in Brazilian *telenovelas* significantly affected actual fertility behavior and especially so among women who were of similar age to the main characters.

Two theoretical contributions in the literature are related to this note. Palivos (2001) demonstrates how high fertility can result from a coordination failure when the interaction between agents takes the form of norms about family size. He then extends it to a dynamic general equilibrium model to establish value and belief driven non-ergodic development outcomes across nations.[3] In Munshi and Myaux's (2006) theory, a fertility transition occurs through Bayesian updating as families learn about the social acceptability of contraceptive use. Neither paper studies the relation between child mortality and fertility.

2 The Model

Suppose social norms partially dictate fertility behavior and, in particular, assume people are conformists. This means even though prospective parents balance their private economic trade-offs in making fertility choices, they also respond to social norms about "appropriate" family size. They do so by minimizing their fertility distance from others as best as they can (Akerlof, 1997). Let n denote a household's fertility, n_s denote the family-size ideal or norm, and $d_n \equiv |n - n_s|$ be the aforementioned distance. Suppose there is a continuum of identical households each of whom takes n_s as given and faces the optimization problem

$$\max_{c,n} \; \beta u(c) + (1-\beta)\, v(\phi n) - \gamma \omega(d_n)$$

[2] David and Sanderson (1987) is a classic treatment of the emergence of the "two-child norm" and how it came to be reflected in the behavior of many married couples who practiced deliberate fertility control in nineteenth century United States.

[3] Goto (2008) extends the Palivos model to study the effect of human capital heterogeneity.

subject to the budget constraint

$$c + p_n n = y,$$
$$c \geq 0,\ n \geq 0.$$

Here u and v are increasing and strictly concave in their arguments, ω is an increasing and (weakly) convex function, and $\beta, \gamma \in (0,1)$ are parameters.[4] The child survival rate is ϕ and parents are assumed to care only about the expected number of surviving children. Household consumption c subsumes childrens' and income y is exogenously given. The (expected) cost of raising children consists of δ units of resources spent on each surviving child, so that the expected cost per child born is $p_n \equiv \phi\delta$. Non-negativity of parental consumption places an upper bound on fertility at y/p_n.[5]

The role played by social norms is easiest to highlight with some simple functional choices:

$$u(c) = \ln c$$
$$v(\phi n) = \ln(\phi n) = \ln\phi + \ln n$$
$$\omega(d_n) = |n - n_s|$$

Our choice of the modulus norm suggests that deviations of fertility from the social norm in either direction (too few or too many children) are equally chastised.

3 No-Norms Equilibrium

As a benchmark, first consider fertility choice when $\gamma = 0$. In this case the decision problem is

$$\max_{n\in[0,y/p_n]} V(n) \equiv \beta\ln(y - p_n n) + (1-\beta)\ln(\phi n),$$

the first-order condition for which is

$$-\frac{\beta p_n}{y - p_n n} + \frac{1-\beta}{n} = 0.$$

The household's optimal fertility (TFR) is computed to be $n^* = \left(1-\beta\right) y/\phi\delta$ from where it is clear that

$$\frac{\partial n^*}{\partial \phi} = -\frac{(1-\beta)\delta y}{p_n^2} < 0.$$

An increase in child survival, raises the expected cost per child born, and hence, reduces the fertility rate. The more empirically relevant question is what happens to the net fertility rate (NFR), q, which equals

[4] The standard logarithmic Barro-Becker preferences are of the form $\beta\ln(c) + (1-\beta)\epsilon\ln n + \ln V$ where $\epsilon \in (0,1)$ and V is welfare of surviving children. In our static reformulation with no parental altruism, for $\gamma = 0$, our preferences reduce to Barro-Becker's or the one adopted in Galor (2011).

[5] Modeling child-rearing costs as time costs gives qualitatively similar results. The formulation defines norms over childbirths not survivors. An integer constraint on n is not imposed and the sequential nature of childbirths is also ignored.

the expected number of surviving children. Since $q = \phi n^* = (1-\beta)\, y/\delta$, the NFR remains unaffected by changes in child mortality, a result analogous to Proposition 1 in Doepke (2005) or Section 3 in Galor (2011). This is why researchers have employed additional mechanisms, such as a precautionary motive or non-logarithmic preferences to obtain a reduction in the NFR from better child survival.

4 Social Norms Equilibrium

As noted above, a higher child-survival rate induces a first-order reduction, albeit proportionate, in fertility; as such, the product of the two – the NFR – stays unchanged. Why might societal norms carry with it the potential to bring down the NFR? The basic intuition is that the presence of conformist social norms would provide a second-order impetus to *further* restrict fertility. It stands to reason that it may be possible for n^* to fall more than proportionately so that the NFR falls.

Assuming $\gamma > 0$, rewrite the penalty function as

$$\omega(d_n) = \begin{cases} (n - n_s), & \text{when } n \geq n_s \\ (n_s - n), & \text{when } n < n_s \end{cases}.$$

Define

$$U_1(n) \equiv V(n) - \gamma(n - n_s),\ U_2(n) \equiv V(n) - \gamma(n_s - n)$$

with $U_1(n_s) = U_2(n_s)$. Let $n_1^* = \arg\max U_1(n)$ and $n_2^* = \arg\max U_2(n)$ where

$$\begin{aligned} n_1^* &= \frac{(\gamma y + p_n) - \sqrt{(\gamma y + p_n)^2 - 4(1-\beta)\gamma p_n y}}{2\gamma p_n}, \\ n_2^* &= \frac{(\gamma y - p_n) + \sqrt{(\gamma y - p_n)^2 + 4(1-\beta)\gamma p_n y}}{2\gamma p_n}. \end{aligned}$$

From the utility functions, it is evident that $n_1^* < n^* < n_2^*$. Also, because of the piecewise linearity of the penalty function, neither n_1^* nor n_2^* directly depend (i.e., in partial equilibrium) on the norm, n_s. For n_1^* to be a valid optimal choice, $n_1^* \geq n_s$ must hold. Similarly, $n_2^* \leq n_s$ is necessary for n_2^* to be a valid optimum.

The household's objective function is simply $U(n) = \min\{U_1(n), U_2(n)\}$ which is non-differentiable at n_s. Hence, we rely on Figure 1 to establish optimal choices. Three cases, depending on the size of the social norm, are presented with the objective function identified in bold and a kink occurring at n_s. In the first panel, since $n_s < n_1^* < n_2^*$, U reaches a maximum at n_1^* which is the only valid optimal choice. In fact, this is the optimal choice for all $n_s \leq n_1^*$. In the second panel, $n_1^* < n_s < n_2^*$, and household utility is maximized at the kink, n_s. In the third panel, the household chooses a fertility of n_2^* for all $n_s \geq n_2^*$.

Thus a typical household's fertility choice responds to the social norm according to the following

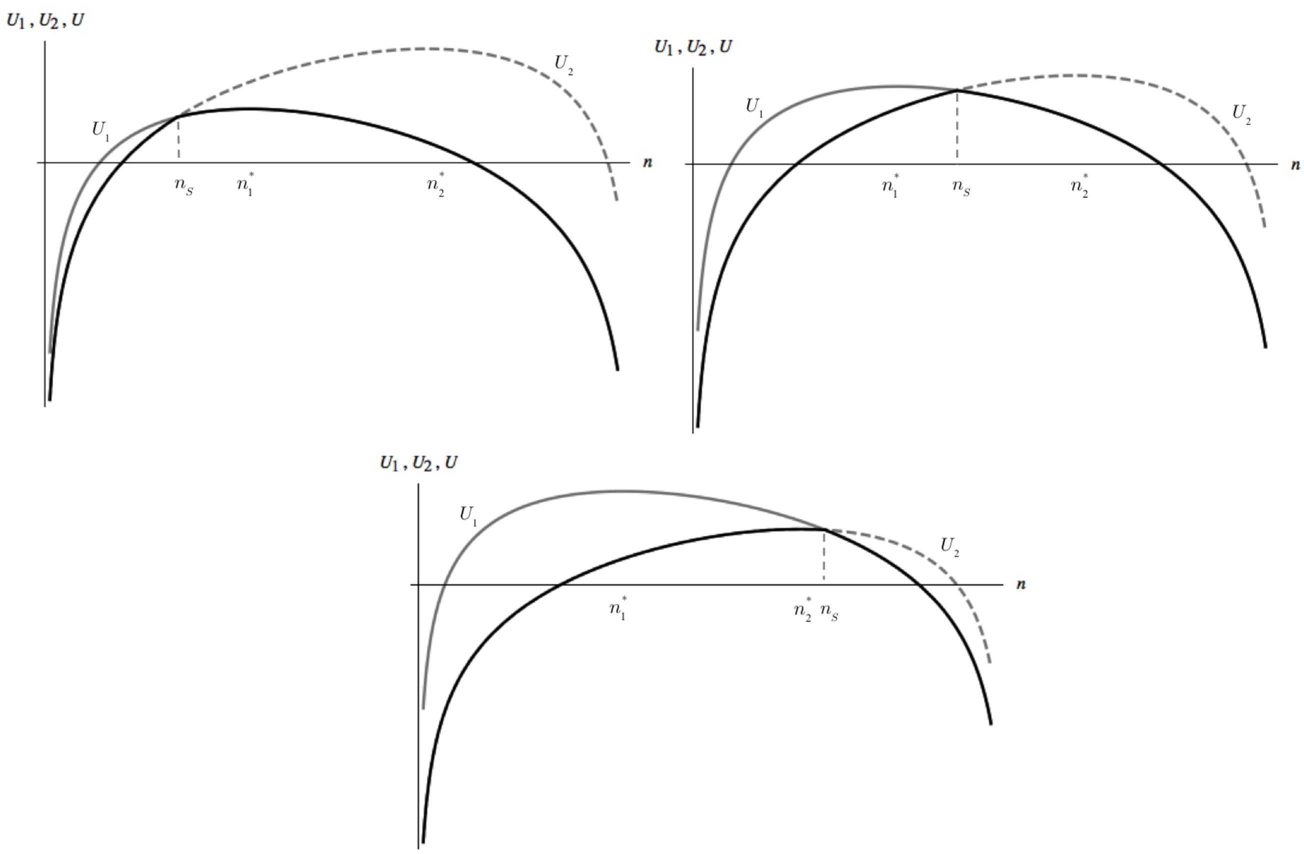

Figure 1: Fertility Equilibria under Social Norms

map:

$$n_i = f(n_s) \equiv \begin{cases} n_1^*, & \text{for } n_s \le n_1^* \\ n_s, & \text{for } n_s \in [n_1^*, n_2^*] \\ n_2^* & \text{for } n_s \ge n_2^* \end{cases} . \tag{1}$$

Intermediate values of the norm completely subjugate the household's own fertility calculus, driving its fertility choice away from the no-norms equilibrium, n^*, except in the knife-edge case of $n_s = n^*$. More extreme values push that choice in the direction of the norm, further away from n^*.

Following Easterlin *et al.* (1980) and Palivos (2001), let $n_s = \bar{n}$, the cross-sectional average fertility rate. That is, suppose households operate under a fertility norm that coincides with the mean level of fertility in the economy. Then, (1) is rewritten as

$$n_i = f(\bar{n}) \equiv \begin{cases} n_1^*, & \text{for } \bar{n} \le n_1^* \\ \bar{n}, & \text{for } \bar{n} \in [n_1^*, n_2^*] \\ n_2^* & \text{for } \bar{n} \ge n_2^* \end{cases} . \tag{2}$$

4.1 General Equilibrium

Fertility decisions by other households influence household i's fertility choice only through the social norm. We seek a symmetric Nash equilibrium assuming identical households. Such an equilibrium occurs when $n_i = \bar{n}\ \forall i$. Then the general equilibrium fertility level in the economy is described as the fixed point to $\bar{n} = f(\bar{n})$ where $f(\bar{n})$ is defined in (2). Henceforth, the equilibrium corresponding to n_2^* is called the high-fertility equilibrium. It is clear that equilibrium fertility is indeterminate – a continuum of equilibrium levels of fertility are possible – in the interval $[n_1^*, n_2^*]$. This multiplicity of equilibria is a direct consequence of conformist behavior.

Which of these equilibria is selected depends on households' expectation of others as well as history. History may be especially important since the survival of societies in pre-industrial times depended on population growth: faced with high and fluctuating rates of child mortality, high enough rates of childbirth would have been necessary to avoid the risk of dying out (Retherford, 1985). This would have been reinforced by the economic value of child labor in traditional agriculture and small-scale manufacturing. It is natural to expect that such a society would have evolved to be pronatalist and coordinated to the high-fertility equilibrium n_2^*.

4.2 Effect of Child Survival on Net Fertility

At the high-fertility equilibrium, families choose to have fewer children than what the societal norm suggests. And yet, they respond to a social pressure of not wanting to fall behind others. Such conformist behavior leads to excess fertility relative to the no-norms choice, n^*. *Ceteris paribus,* when child mortality declines, households reduce their fertility bringing it closer to the no-norms choice. In general equilibrium, the norm adjusts downwards, providing a second impetus to fertility reduction.

To see this, recall that $n_2^* > n^* = (1-\beta)y/(\phi\delta)$. At n_2^*, write the relevant first order condition in terms of the NFR q as

$$-\frac{\beta\phi\delta}{y-\delta q} + \frac{(1-\beta)\phi}{q} = -\gamma.$$

Totally differentiating this, we get

$$\left[-\frac{\beta\delta}{y-\delta q} + \frac{1-\beta}{q}\right] d\phi - \left[\frac{\beta\phi\delta^2}{(y-\delta q)^2} + \frac{(1-\beta)\phi}{q^2}\right] dq = 0.$$

The second term inside brackets on the left hand side of this expression is always positive. Hence, clearly $dq/d\phi < 0$ (i.e., the NFR falls) if the first term inside the brackets on the left hand side is negative, that is, if

$$\frac{1-\beta}{q} < \frac{\beta\delta}{y-\delta q} \Rightarrow n > n^*$$

which is true at n_2^*. In other words, at the high-fertility equilibrium not only does the TFR decline from better child survival, the NFR does too.[6]

5 Conclusion

Multiple equilibrium levels of fertility inevitably open the door for population control policies. If it reasonable to expect high-fertility societies have historically coordinated on the high-fertility equilibrium, then the model suggests (with the usual caveats) that targeting child survival may be an effective policy instrument.

Whether or not social norms about family size can explain observed declines in fertility behavior is, ultimately, a quantitative issue. While the empirical evidence suggests so, it remains to be explored if this mechanism is a substantive explanation of the demographic transition. We also leave to future work the issue of how social norms evolved towards pronatalism in pre-industrial times.

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