Identifying the Opportunity Costs of Childbearing

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Aims and Objectives

For many demographic or economic analyses it's reasonable to take age-specific fertility rates, or functionals of those rates (e.g. TFR) as given. However,

- understanding *why* labor market conditions or family policies affect fertility rates requires a theory
- one also needs a theory of fertility choice to evaluate family policies normatively
  - e.g. two recent reviews of fertility policies - Pörtner (2018) and Silva and Tenreyro (2017) - focus entirely on the "positive" questions of whether certain policies are effective at altering behavior
  - how can we tell whether these policies are *desirable*?

Here, I partially characterize a forward-looking model of human capital accumulation and birth timing.

The key forces in the model that determine birth timing are:

- parenting imposes time costs
  - this makes it hard to build up human capital
  - so, it creates an incentive to delay births
- However, discounting creates an incentive to have children early.

Rationale and Background

Such models have been proposed before:

- Adda, Dustmann, and Stevens (2017) is a recent example
- Francesconi (2002), Rosenzweig and Wolpin (1980) even earlier

However, these models have been much used for applied welfare evaluation:

- estimation tends to be very computationally demanding
- appears to rely heavily on economic theory

Compare this situation with the widespread use of the "value of a statistical life" (VSL), which is frequently estimated and used in applied cost-benefit analysis (e.g. Viscusi (2003)).

My innovation here is to use continuous time, and to impose a convenient assumption about how the time costs of children decline with age. Both tricks help to simplify the computation of the model's predictions.

Model

I construct a variation on a canonical model (Ben-Porath (1967)) of human capital accumulation over the life cycle, modified to include time costs of childcare and the option to choose the timing of a birth.

Preferences

Consider the forward-looking decisions of a woman who lives forever and discounts the future at rate ρ. She cares about the paths of her consumption (c_t) and parity (k_t) over time, ordered by the utility functional

$$\mathcal{U} = \int_0^\infty e^{-\rho t} u(c_t, k_t) dt \qquad (1)$$

where $u(c, k)$ is increasing and weakly concave in both arguments. She can have at most one child; let T be the time (mother's age) at which this occurs. She can allocate her time to one of three mutually exclusive activities: working, investing in human capital, or childcare.

Time Costs of Childcare

Childcare takes less time for older children. If a newborn requires a fraction $\psi_0 < 1$ of her time, a child of age a requires only $\psi_0 e^{-\gamma a}$. Of course, before the first birth, no childcare is required ($\psi_t = 0$).

Investing in Human Capital

This woman can choose to spend a fraction s_t of her time investing in human capital, h_t. The gross gain in human capital is $\phi(h_t s_t)$, where ϕ is strictly increasing and strictly concave. Human capital also depreciates at rate δ, so its law of motion is

$$\dot{h}_t = \phi(h_t s_t) - \delta h_t. \qquad (2)$$

Borrowing and Saving

She finances consumption by borrowing and saving in a capital market where the (net) interest rate is r. Her net holding of physical capital is y_t, with the intertemporal budget constraint

$$\dot{y}_t = r y_t + w h_t [1 - s_t - \psi_t] - c_t. \qquad (3)$$

Results

A Separation Theorem

Given this setup, a "separation theorem" applies - meaning that the optimal path for consumption can be found independently of the optimal time allocation. One can compute of the solution in two steps:

- given a choice of age at first birth T, choose the path of human capital h_t to maximize lifetime wealth, say $\widehat{W}(T)$;
- given lifetime wealth, choose the path of consumption c_t and the timing of first birth T to maximize lifetime utility.

Let h_T be her level of human capital at the moment of first birth. The wealth-maximization problem is:

$$\widehat{W}(T) = \max_{h_T, (s_t, h_t)_t} \int_0^T e^{-\rho t} h_t [1 - s_t] dt + \int_T^\infty e^{-\rho t} h_t [1 - s_t - \psi_t] dt$$

Optimal Birth Timing and the Marginal Cost of a Birth

Given the assumption of perfect capital markets, and given the solution to the wealth-maximization problem, we can reduce her problem to the choice of T, the age at first birth. If the instantaneous utility function is separable in consumption and parity, the optimal path of consumption over the life cycle will simply be a constant $\bar{c}$ such that

$$\int_0^\infty e^{-\rho t} \bar{c} \, dt = y_0 + \widehat{W}(T),$$

i.e. the present value of consumption exhausts lifetime wealth.

For simplicity suppose $u(c, k) = c + \beta k$, so there are no income effects. Here, β is the flow value of parenthood. Then the optimal timing of the first birth trades off the possible wealth gains from delaying a birth against the foregone utility of parenthood:

$$T^* = \arg\max_T \widehat{W}(T) + \beta \rho^{-1} e^{-\rho T} \qquad (4)$$

Thus, the marginal benefit of delaying a birth is $\widehat{W}'(T)$, while the marginal cost of delay is $\beta e^{-\rho T}$. At the optimum, these will be equal. Thus, if one can estimate $\widehat{W}'(T)$, one can learn something about parents' willingness to pay for marginal changes in birth timing.

Since lifetime wealth is hard to observe, one can instead look for the effects of birth timing on consumption, since consumption will be proportional to wealth (i.e. "permanent income").

Summary

The highly simplified model I have sketched makes the following predictions:

- human capital investment will occur more rapidly before the first birth, then slow down afterwards;
- earnings will drop discontinuously at the time of a first birth and slowly rise afterwards; and
- women who have first births later will have built up more human capital by the time they become mothers.

Further, the model suggests that the marginal cost of delaying a birth can be estimated by computing the effect of birth timing on consumption.

References

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