POPULATION GROWTH, THE NATURAL RATE OF INTEREST, AND INFLATION

Sebastian Weiske (Goethe University Frankfurt)

## ECB Forum on Central Banking 2016

Introduction

In the end it is clear that the tools of modern growth theory lead to an ambiguous answer about how population growth affects the return to capital. One can write down textbook models in which the two variables move together (the Solow model), and one can write down models in which they do not (the Ramsey model). The natural response to this theoretical ambiguity is to muster evidence, either from time-series data or from the international cross section, about the actual effect of population growth. (Mankiw, 2005, 317-18)

Research Questions

- Is there a link between population growth and the natural rate of interest?
- What are the implications for monetary policy?

Postwar Fertility Shocks in the US

- Collect monthly data on live births from the *National Center of Health Statistics*.
- Focus on the civilian noninstituional population, 16 years and older.
- Calculate the "natural" population growth rate, i.e. the growth rate due to live births 16 years ago.
- US population growth rate, 16+ (dashed line) vs natural population growth rate, 16+ (solid line):
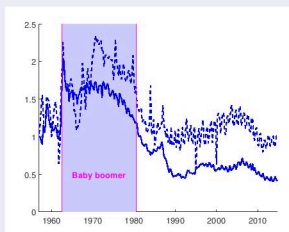
Macroeconomic Effects of Fertility Shocks

- Estimate a VAR including: fertility shocks, output, consumption, investment, hours worked, real wage, inflation, federal funds rate (FFR).
- Identification of fertility shocks: fertility decisions 16 years ago unaffected by today's business cycle conditions (Jaimovich and Siu, 2009) ⇒ recursive identification with fertility shocks ordered first.
- Impulse responses: no significant effect on most variables. But, inflation increases after a positive fertility shock, while the FFR increases with a delay.
- Forecast error variance decomposition: fertility shocks account for 10-15% of the inflation variance at horizons of 5 years and more.
- Historical decomposition: baby bust accounts for two pp of the decline in inflation during the 1980s and 1990s.

References

CARVALHO, C. AND A. FERRERO (2014): "What Explains Japan's Persistent Deflation?" Working paper, PUC Rio de Janeiro and University of Oxford.

JAIMOVICH, N. AND H. E. SIU (2009): "The Young, the Old, and the Restless: Demographics and Business Cycle Volatility," *American Economic Review*, 99, 804–26.

MANKIW, G. N. (2005): "Asset Returns and Economic Growth: Comment," *Brookings Papers on Economic Activity*, 36, 316–321.

Fertility Shocks in a DSGE Model

- Include stochastic population growth in a standard DSGE model featuring
  - investment adjustment costs
  - variable capital utilization
  - price and nominal wage rigidities
- Preferences of the representative household:

$$\mathbb{E}_0\left[\sum_{t=0}^{\infty}\beta^t N_t^{1-\theta} u(c_t, h_t)\right], \quad \beta \in (0,1), \quad (1)$$

where c_t is (per-capita) consumption and h_t are (per-capita) hours worked. N_t is the size of the household.

- Degree of "imperfect altruism": θ
  - $\theta = 0$: *Benthamite* preferences / *classical* utilitarianism
  - $\theta = 1$: *Millian* preferences / *average* utilitarianism
- Population growth:

$$\ln(N_t/N_{t-1}) = \bar{\nu} + \nu_t \quad (2)$$

  - Deterministic component: $\bar{\nu}$
  - Stochastic component: ν_t
- Consumption Euler equation (linearized):

$$\hat{c}_t = \mathbb{E}_t[\hat{c}_{t+1}] - (\hat{r}_t - \mathbb{E}_t[\hat{\pi}_{t+1}] - \theta\nu_t) \quad (3)$$

- Model responses to fertility shocks depend on θ.
- Interpretation of θ: if population growth ↑ by 1 pp in steady state then the natural rate of interest increases by θ pp in steady state.

Estimating θ

- The parameter θ is estimated by matching the empirical and the theoretical impulse responses from the DSGE model with fertility shocks:

$$\hat{\theta} = 0.59 \quad (4)$$

- Estimated model-IRFs to a fertility shock:
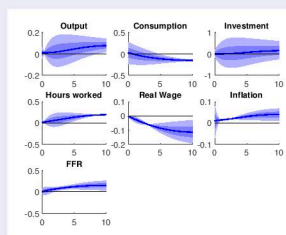
- Natural rate channel accounts for 0.5 pp of the fall in inflation in recent decades and 1 pp of the fall in the FFR.

Policy Implications

- According to the estimate of θ, there is a positive link between population growth and the natural rate of interest.
- Implications:
  1. In the presence of price rigidities only, the optimal monetary policy response to a negative fertility shock is to lower the nominal interest rate.
  2. Failure to do so may lead to deflation ⇒ Japan (Carvalho and Ferrero, 2014)