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Bequeathed tastes and fertility in an endogenous growth model

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Abstract

In this paper, we incorporate an endogenous fertility decision into De la Croix's (1996) bequeathed tastes model under a log-linear utility function and an -type production function, following Romer (1989). We show that the presence of bequeathed tastes can explain the decline of the fertility rate that has occurred in developed economies.

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1. Introduction

It is generally accepted that economies experience a steady and continuous decline in fertility rates as they develop. According to the World Bank's (2015) World Databank, between 1960 and 2009, the total fertility rate fell from 2.00 to 1.37 in Japan, from 3.65 to 2.00 in the U.S., from 5.2 to 1.1 in Hong Kong, from 2.4 to 1.4 in Germany, and from 2.9 to 2.0 in France. This paper develops an overlapping generations (OLG) model with de la Croix-type (1996) bequeathed tastes to help explain recent downward trends in the fertility rate that have accompanied the development of economies.[1]

As is well known, in the absence of bequeathed tastes, consumption and expenditures on children would be fixed shares of income under a log-linear utility function, so that fertility would be constant. When bequeathed tastes are added, as the economy develops, the increase in wages raises consumption and therefore aspiration for consumption goes up because of the bequeathed tastes. When the level of aspiration increases but the wage level is held constant, individuals lower their fertility rate to reduce spending on child rearing in their youth. If wage levels increase, ceteris paribus, the fertility rate increases, because an increase in the relative price suppresses the reduction in the number of children born for a given level of bequeathed tastes. For any initial level of capital, if the initial level of aspirations is low enough, then the capital-aspirations ratio needs to decrease to reach its steady state. As it does, aspirations grow faster than capital so that less is spent on children and fertility decreases.

The remainder of the paper is organized as follows. Section 2 describes the model; Section 3 examines the determinants of the fertility rate in the transition process and the long run; and Section 4 concludes the paper.

2. The model

This section presents an OLG model incorporating endogenous fertility into the AK-type endogenous growth framework with bequeathed tastes. de la Croix (1996) originally developed the type of aspiration applied in this framework, referred to as bequeathed tastes. In this framework, children inherit their aspiration for consumption from their parents.

2.1. Individuals

Individuals live for three periods: childhood, the young period and the old period. In their childhood, they make no decisions on economic activity. They only inherit tastes from their parents. When young, each individual bears children, n_t (therefore, n_t represents the fertility rate in period t, $n_t \equiv N_{t+1}/N_t$, where N_t is the number of the young in period t or the number of children in period $t-1$) and allocates time to work and to rearing children.

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[1] There are many explanations of the decline of fertility, such as increase in the opportunity cost of children, preference for quality of children and improvements in contraception techniques. See Doepke (2015) and Lee (2015).

By working in the young period, individuals earn wages for consumption and savings. Therefore, the budget constraint of the young in period t is:

$$c_t = (1 - \theta n_t)w_t - s_t, \tag{1}$$

where w_t, c_t and s_t are wages, consumption in the young period, and savings in period t, respectively, and θ is the constant time required for rearing one child.

When individuals become old, they retire from work and consume using the returns from their savings. Therefore, the budget constraint of the old in period $t+1$ is:

$$d_{t+1} = (1 + r_{t+1})s_t, \tag{2}$$

where d_{t+1} and r_{t+1} are consumption in the old period and the interest rate in period $t+1$, respectively.

We assume that individuals obtain utility from consumption in both the young and the old periods and from the number of their children. Regarding the utility gained from consumption in the young period, individuals will be bequeathed aspirations, a_t, via the consumption activity of their parents. That is, they take into account the level of consumption of their parents such that $a_t = c_{t-1}$. The utility function of the young in period t is given in log-linear form as:

$$U_t \equiv \ln(c_t - \gamma a_t) + \alpha \ln d_{t+1} + \beta \ln n_t, \quad \alpha, \beta \textit{ and } \gamma > 0, \tag{3}$$

where α, β, and γ are the time discount factor, the rate of preference for the number of children, and individuals' degree of reference to the consumption of their parents, respectively.

Maximizing utility function (3) subject to the budget constraints (1) and (2) yields the following functions:

$$n_t = \frac{\beta w_t}{(1+\alpha+\beta)\theta w_t} - \frac{\beta \gamma a_t}{(1+\alpha+\beta)\theta w_t}, \tag{4}$$

$$s_t = \frac{\alpha w_t}{1+\alpha+\beta} - \frac{\alpha \gamma a_t}{1+\alpha+\beta}, \tag{5}$$

$$c_t = \frac{w_t}{1+\alpha+\beta} + \frac{(\alpha+\beta)\gamma a_t}{1+\alpha+\beta}, \tag{6}$$

From equation (4), we can clearly see how the existence of bequeathed taste affects the determination of the fertility rate. If $\gamma = 0$, the model is reduced to the standard OLG model with endogenous fertility and the fertility rate becomes a constant, regardless of the level of the wage rate. This property arises because of the assumption of a log-linear utility function.

However, with bequeathed tastes, there emerges another channel of influence on the fertility rate. As bequeathed tastes set the standard of living, the household raises its level of consumption by a portion, $(\alpha+\beta)\gamma a_t/(1+\alpha+\beta)$, of their income (see the second term on the right-hand side of equation (6)). This consumption expansion decreases spending on child rearing by $\beta\gamma a_t/(1+\alpha+\beta)$, which results in a reduction in the number of children by $\beta\gamma a_t/\{(1+\alpha+\beta)\theta w_t\}$, as θw_t is the relative price of rearing one child in terms of consumption. The second term on the right-hand side of equation (4) represents this channel.

From the above, we see that this channel consists of two kinds of effects on fertility. The first is the *spending reduction effect*. When the level of aspiration, a_t, increases, but the wage level is held constant, individuals lower their fertility rate to reduce spending on child rearing in their young period. The second effect on fertility is the *relative price effect*. If wages increase, ceteris paribus, the fertility rate increases. This is because an increase in the relative price suppresses the reduction in the number of children for the reduced level of the spending on children by bequeathed tastes, $-\gamma a_t$.

To investigate the general equilibrium effect of bequeathed tastes and the wage rate, we shall specify firms' behavior and the market equilibrium conditions.

2.2. Firms

There exits an infinite number of homogeneous firms in the economy. These firms compete in perfectly competitive markets and maximize their profits subject to the production function. The production function of firm j is represented by:

$$Y_t^j = A\left(K_t^j\right)^{\epsilon}\left(L_t^j\right)^{1-\epsilon} E_t^{1-\epsilon}, 0<\epsilon<1 \tag{7}$$

where A and ϵ represent the technology parameter (which is positive) and the capital intensity. K_t^j L_t^j and E_t are capital employed by firm j, labor employed by firm j, and the production externality in period t, respectively. According to Romer (1989), the production externality comes from the level of capital. Specifically, to avoid a scale effect, we assume that E_t is equal to the capital-labor ratio of the whole economy; that is, $E_t = K_t/L_t$, where K_t is aggregate capital and L_t is the total amount of labor in period t. Firms regard the externality, E_t, as given; however, at the level of the whole economy, this externality can be realized. Under the assumption of symmetry among firms, the profit maximization yields the following:

$$r_t = A\epsilon, \tag{8}$$

$$w_t = A(1-\epsilon)k_t, \tag{9}$$

where $k_t \equiv K_t/L_t$.

2.3. General equilibrium

Finally, we describe the equilibrium. The capital market equilibrium condition can be expressed as:

$$K_{t+1} = s_t N_t.$$

In period $t+1$, because each young individual spends time equal to θn_{t+1} for child rearing, L_{t+1} is equal to $(1-\theta n_{t+1})N_{t+1}$. Dividing both sides by L_{t+1} and defining $k_t \equiv K_t/L_t$, we have the following equilibrium condition expressed in per unit of labor terms:

$$k_{t+1} = \frac{s_t}{n_t(1-\theta n_{t+1})}. \tag{10}$$

Substituting (4), (5), and (9) into (10) gives the capital market equilibrium condition in per unit of labor terms:

$$(1+\alpha)A(1-\epsilon)k_{t+1} = \frac{\alpha\theta}{\beta}A^2(1-\epsilon)^2(1+\alpha+\beta)k_t - \beta\gamma a_{t+1}. \tag{11}$$

From (6), by setting $c_t = a_{t+1}$ and using (9), this bequeathed tastes formation equation becomes:

$$a_{t+1} = \frac{1}{1+\alpha+\beta}[A(1-\epsilon)k_t + (\alpha+\beta)\gamma a_t]. \tag{12}$$

Defining k_t/a_t as κ_t, (11) and (12) give the following autonomous dynamic equation:

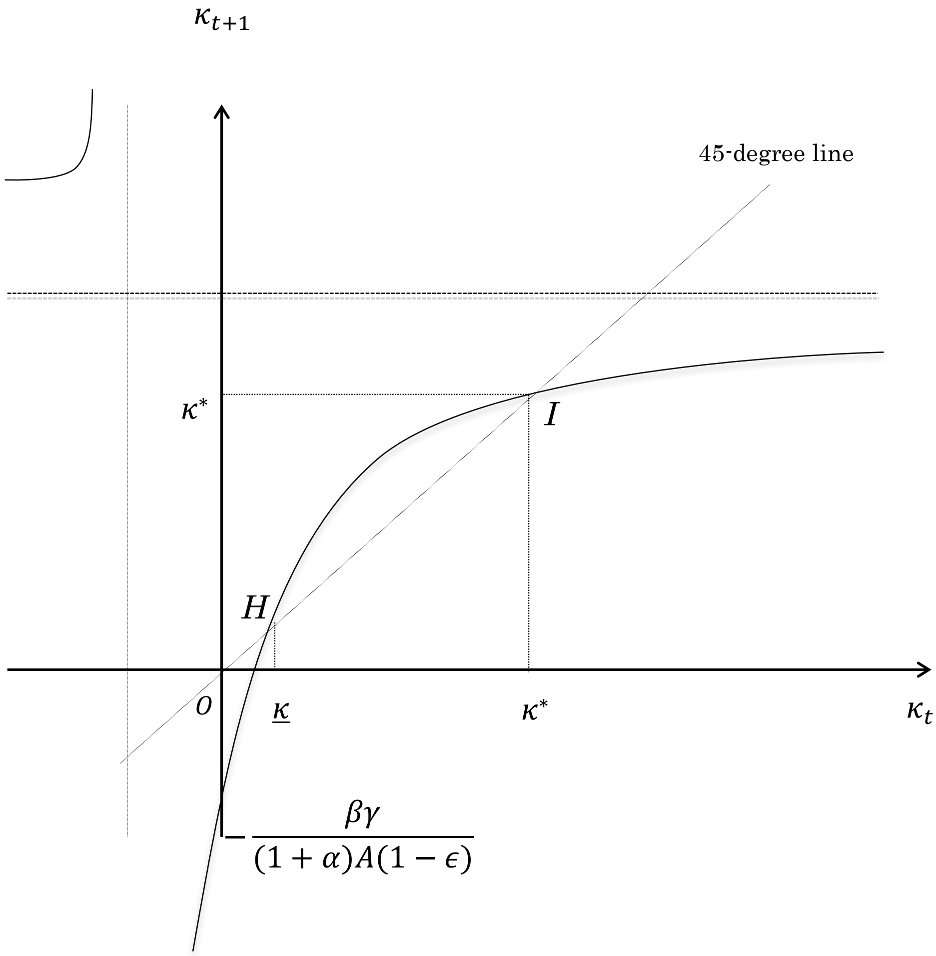
$$(1+\alpha)A(1-\epsilon)\kappa_{t+1} = \frac{\alpha\theta}{\beta}A^2(1-\epsilon)^2\frac{(1+\alpha+\beta)^2}{A(1-\epsilon)\kappa_t + (\alpha+\beta)\gamma}\kappa_t - \beta\gamma. \tag{13}$$

Rearranging the above equation, we have:

$$\kappa_{t+1} = \frac{\alpha\theta(1+\alpha+\beta)^2}{(1+\alpha)\beta} - \frac{\beta\gamma}{(1+\alpha)A(1-\epsilon)} - \frac{\frac{\alpha\theta}{\beta(1+\alpha)}(1+\alpha+\beta)^2(\alpha+\beta)\gamma}{A(1-\epsilon)\kappa_t + (\alpha+\beta)\gamma}. \tag{14}$$

This suggests that the graph of this equation will be a hyperbola. Re-examining (13), the intercept must be negative if we take the vertical line as κ_{t+1} and the horizontal line as κ_t, so that the graph of this equation can be drawn as shown in Figure 1.

Figure 1. Long run equilibria and dynamics



(14) and the 45-degree line disappears, which implies that there is no balanced growth equilibrium. Otherwise, there are two equilibria: a lower unstable equilibrium, such as point H, and an upper stable equilibrium, such as point I. If the initial capital-aspiration ratio κ_0 is lower than that in the unstable equilibrium, $\underline{\kappa}$, the capital-aspiration ratio converges to zero. This implies that the economy is not sustainable: the economy will fall into a poverty trap.[3] In contrast, if $\kappa_0 > \underline{\kappa}$, the economy converges to the unique stable steady-state equilibrium, κ^*.

In the following discussion, we only consider the latter case, i.e., the economy that converges to a stable, balanced growth equilibrium.

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[3] de la Croix (2001) and Artige et al. (2004) also demonstrate a poverty trap in a model with bequeathed tastes. By incorporating human capital accumulation, the dynamic systems of their model are subject to a Hopf bifurcation, which implies the existence of a poverty trap. In our AK-type endogenous growth framework with bequeathed tastes, the poverty trap can be obtained more simply.

3. The fertility rate in the bequeathed tastes model

We can analyze the behavior of the fertility rate in the transition process using a phase diagram. First, from (4) and (9), the fertility rate can be obtained as a function of κ:

$$n_t = \frac{\beta}{(1+\alpha+\beta)\theta} - \frac{\beta\gamma}{(1+\alpha+\beta)A(1-\epsilon)\theta\,\kappa_t}. \tag{15}$$

It is clear that from (15) the fertility rate, n, is positively correlated with κ. This relationship between the fertility rate and the capital-aspiration ratio can be interpreted as follows. From (9), we know that a decrease in κ means that the level of bequeathed tastes grows faster than the wage rate. As discussed in the latter half of Section 2.1, a change in the fertility rate is determined by the configuration of the spending reduction effect, which decreases the fertility rate because of an increase in consumption aspirations, and the relative price effect, which increases fertility rate because of the wage increase. Under the situation where κ decreases, the spending reduction effect dominates the relative price effect. Therefore, the fertility rate falls as κ decreases.

Now we turn to the dynamics of the fertility rate. Suppose that the economy is out of the balanced growth equilibrium and that $\kappa > \kappa^*$ in Figure 1. As the economy evolves, κ decreases to the balanced growth equilibrium level. Thus, from (15), the fertility rate falls as κ decreases in the transition process. The opposite argument can be applied to the case where κ is smaller than κ^* ($\underline{\kappa} < \kappa < \kappa^*$). If the economy begins with an initial κ that is smaller than the balanced growth equilibrium level, the fertility rate rises in the transition process.

Proposition

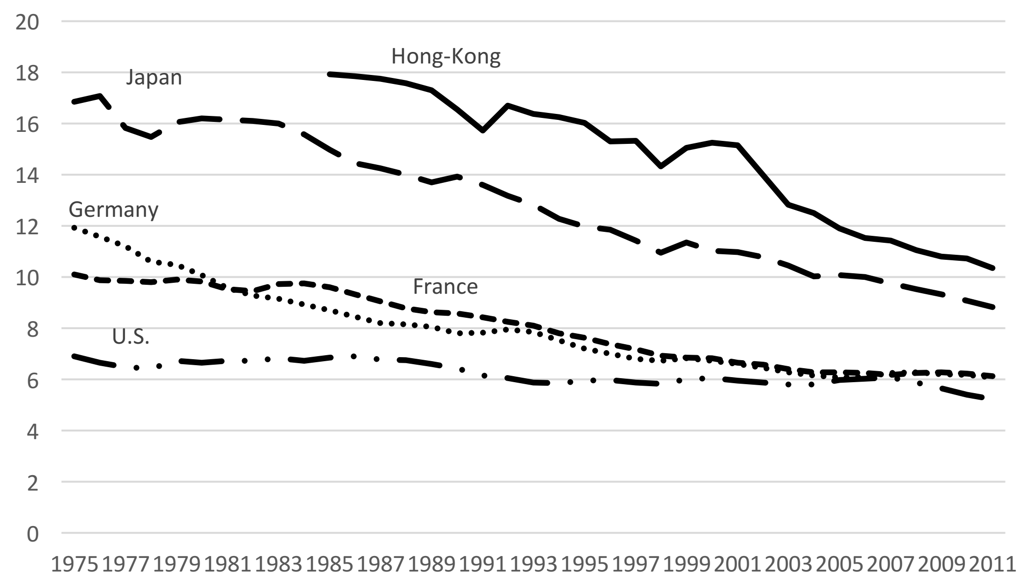
In the transition process, the fertility rate declines (increases) as the capital-aspiration ratio, κ, falls (rises), if the initial capital-aspiration ratio is higher (lower) than the balanced growth equilibrium level, κ^*.

As far as the authors of this paper know, there has been no previous attempt to empirically estimate the transitional behavior of κ. To do this, cohort data on the level of consumption and the capital stock is required. Given the lack of such data, we use casual observations on the data for several developed countries, taken from the Penn World Table 8.1 (Feenstra et al., 2015). Figure 2 plots the ratio of the level of capital stock to the level of aggregate consumption 25 years prior as a proxy for κ.[4] The proxy for κ has been declining from 1975 to 2011 (because of data availability, the proxy can only be calculated from 1985 in the case of Hong-Kong).

[4] We use capital stock at constant 2005 national prices as total capital stock, and real consumption at constant 2005 national price as total consumption.

Thus, we presume that the transitional process of our model, in which the level of the capital-aspiration ratio, κ, decreases, replicates the actual demographic transition in developed countries.

Fugure 2. The ratio of the level of capital stock to the level of aggregate consumption 25 years prior



Source: The Penn World Table 8.1.

4. Conclusion

In this paper, we incorporated an endogenous fertility decision into a bequeathed tastes model. We demonstrated that the presence of aspirations for consumption generates a persistent decline in the fertility rate even under the assumption of a log-linear utility function. It is well known that, in the absence of bequeathed tastes, fertility will be constant. However, the model with bequeathed tastes shows that fertility decreases when consumption aspirations increase faster than the wage rate. The data suggests that the capital-aspiration ratio has been declining in selected developed countries. Thus, our model is compatible with the persistent decline of the fertility rate in the real world.

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