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Social norms, fertility and economic development☆

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Abstract

This paper presents an overlapping generations model with endogenous fertility and human capital accumulation. Within such a framework, it shows how the presence of family-size norms can lead to multiple equilibria. It can thus potentially explain different development patterns without recourse to increasing returns and differences in initial conditions. Furthermore, it derives sufficient conditions under which different equilibria can be Pareto ranked. Finally, it shows that the main results hold also in the case where there exists parental altruism.

JEL classification: O11; O41; J13

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1. Introduction

Recently, there have been several empirical studies that provide strong evidence for the existence of multiple 'development clubs' (see, among others,

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Table 1
Cross-country data[a]

Countries	RGDP 1992	GRGNP 1980–91	TFR 1992	MA 1980–90	AYS 1992	FSER 1990	FTER 1990
Sub-Saharan African	1346	0.2	6.1	19.0	1.0	15	1.1
Least developed	886	− 1.1	6.5	18.7	0.9	12	0.9
OECD	18,122	2.2	1.8	25.3	11.0	85	47.0
Nordic	18,087	2.1	1.9	28.7	11.2	88	55.0

[a] *Sources*: UNDP, Human Development Report 1994 (Tables 5, 8, 23, 27, 32, 33, 45, and 50) and 1995 (Tables 12 and 28).

Key: RGDP: Real GDP per capita converted into US$ on the basis of PPP.

GRGNP: Annual growth rate of real GNP per capita.

TFR: Total fertility rate.

MA: Women's average age at first marriage.

AYS: Average number of years of schooling received per woman aged 25 and over.

FSER: Female secondary education enrollment ratio.

FTER: Female tertiary education enrollment ratio.

Number of countries in each group: Sub-Saharan Africa: 44, Least-developed countries: 45, OECD: 25, Nordic: 5.

Baumol and Wolff, 1988; Durlauf and Johnson, 1995; Palivos, 1995; Quah, 1996; Durlauf and Quah, 1999). Accordingly, the set of countries that constitute the world can be divided into at least two groups. Among the distinctive characteristics of each group are per capita income, the economic growth rate, education enrollment and the population growth rate. For example, if one compares the OECD countries with the 45 'least-developed' countries, as identified by the United Nations, then the following facts emerge. The average income of the first group is 20 times higher and grows 3 times faster. At the same time, a woman that lives in one of the least-developed countries bears approximately 5 more children and has 10 fewer years of schooling. (See Table 1, which presents cross-country data on income, fertility, and education.)

Motivated by these facts, the existing literature has suggested the endogenisation of fertility as a plausible avenue that generates multiple 'development clubs' (recent examples include: Becker et al., 1990; Palivos, 1995; Galor and Weil, 1996; and Tamura, 1996).[1] The typical model in this literature has two stable

[1] The multiplicity of equilibria in Becker et al. (1990) and in Tamura (1996) occurs because the rate of return on human capital rises as the stock of human capital increases. In Palivos (1995), on the other hand, it occurs because the net rate of return on capital is not monotonically decreasing in the capital stock. Finally, in Galor and Weil (1996) multiple equilibria emerge because of an initial acceleration in the growth rate that is associated with women joining the labor force.

equilibria, which are separated by an unstable one. Which (stable) equilibrium the economy will converge to depends on initial conditions. Thus, countries that have the same fundamentals except from their initial levels of human or physical capital may converge to different steady-state equilibria in terms of per capita output, fertility and, in some cases, the economic growth rate as well.[2]

Even though this approach provides a general framework for thinking about economic development, it still leaves several questions unanswered. For example, in these models the level of human or physical capital that corresponds to the unstable equilibrium acts as a threshold level that all countries must cross if they want to evolve from being poor to becoming rich. At some point, the currently rich economies were poor. How did they manage to cross the threshold level? Why is it that currently poor countries cannot cross it, as some of these models seem to imply? Furthermore, why do some countries that start with the same initial conditions follow different growth paths?[3]

This paper emphasizes, instead, the importance of interactions (spillovers) between agents, which manifest themselves in the form of family-size norms. These norms create strategic links between one agent's welfare and the actions of another, so that each agent's behavior depends on how she expects every other agent will act. The end result is a number of different equilibria, anyone of which may prevail. Thus, which equilibrium the economy converges to depends not on initial conditions, but rather on the predominant set of values and beliefs, i.e., the society's value system as reflected in religious beliefs, moral codes, institutions, and related factors.[4]

The structure of the paper is as follows. Section 2 develops a simple overlapping generations model with the following main features. Agents live for two

[2] The literature mentioned above attempts to explain mainly contemporaneous correlations across countries (e.g., the negative correlation between income and population growth). Recently, there has also been some growing literature that attempts to explain within a unified framework world development over the last several centuries, the emergence of Industrial Revolution and the demographic transition (see, for example, Lucas, 1998).

[3] I thank an anonymous referee for raising some of these questions in an earlier version of the paper.

[4] The paper does not attempt to explain the origin or the persistence of social norms. Instead, it takes their existence as given (see the evidence below) and examines their implications. Nevertheless, one possible explanation for the existence of family-size norms, offered here for the sake of completeness, is the following. Societies that face high mortality rates are organized in ways that favor high fertility rates. Their religious doctrines, social customs, moral and legal codes, institutions, marriage arrangements, etc., often promote fertility. Given such a value system, one finds it in one's best interest to adhere to such norms, since such adherence results in approval and respect by others (social status). Moreover, even when the mortality rate decreases, the society's value system may not adjust to the new conditions; hence, norms may persist for a long time and may often be in conflict with current economic conditions. This paper may be viewed as an attempt to analyze the interactions between family-size norms and economic incentives.

periods, as young and old adults. Young adults spend their time endowment either in enhancing their human capital via education/training or in bearing and rearing children. I adopt this formulation to capture in the sharpest and simplest way the deferment of marriage and child-bearing that characterizes the average individual pursuing secondary and higher education. (Table 1 presents also cross-country data on women's average age at first marriage and secondary and tertiary education enrolment.) The level of human capital acquired by young adults depends on the time they devote to education and on the existing societal human capital stock. Old adults, on the other hand, spend their time on the production of a single consumption good, using the skills they acquired in the previous period of life. Naturally, the higher their level of human capital, the more productive they are in the consumption sector.

A starting point of this paper is that certain actions are influenced not only by economic conditions but also by social norms; namely, societal rules that state how individuals ought to behave in certain circumstances. Examples of such norms include: Do X, or: If others do Y, then do X (Elster, 1989). Family-size norms, considered here, are captured by a 'reduced-form' externality in preferences.[5] Accordingly, each agent's fertility behavior depends not only on prices and income, but also on the fertility rate of her cohorts, a possibility long asserted not only by sociologists (e.g., Freedman, 1979) and non-sociological demographers (e.g., Ryder, 1973), but also by numerous population economists (see, for example, Leibenstein, 1974; Easterlin et al., 1980; Dasgupta, 1995).[6]

Section 3 shows that in the presence of family-size norms the model may display multiple development equilibria. More specifically, depending on agents' beliefs about the fertility behavior of their peers, the economy can get 'stuck' in a 'Malthusian' equilibrium, with a high fertility rate and low levels of human capital, output and consumption, or it can follow an equilibrium path along which the fertility rate is low while the levels of human capital, output and consumption are high and may even be increasing over time. In contrast, however, to Becker et al. (1990), Palivos (1995), and Tamura (1996), multiple equilibria arise even though the rate of return on investing in education is non-increasing with respect to human capital.

Section 3 analyzes also the welfare properties of the set of equilibria. It shows that, as a result of the intertemporal externalities that are present in the accumulation of human capital, the ranking of different equilibria is not determined exclusively by the nature of the contemporaneous interactions (i.e., whether they are positive or negative spillovers). This result is different from the one obtained within the pioneering model of Cooper and John (1988), which

[5] Cole et al. (1992) provide micro-foundations on how a relationship between economic and non-market decisions might arise.

[6] Empirical studies, in support of this assertion, are cited in Section 3.

also investigates (strategic) interactions between agents. Finally, the section presents sufficient conditions for the Pareto ranking of the equilibria and the presence of 'coordination failures'. It may be noted that the possibility of such coordination failures, found in this model, is in sharp contrast with results found in the canonical dynastic-family framework, where, depending on initial conditions, it may be optimal for an economy to sink into a Malthusian trap associated with a minimal level of per capita income.

Section 4 summarizes the results and draws conclusions from the analysis in the preceding sections. Finally, the appendix shows that the main results of the paper stay intact in the case of a more general learning technology and parental altruism.

2. The model

Consider an overlapping generations framework where all agents live for two periods. In the first period, they are young adults and have to decide upon their level of schooling and their fertility rate. Both of these variables/activities involve a time input (further details are given below). Since time is scarce, agents face immediately a trade-off between raising children and augmenting their human capital. I adopt this formulation to capture the deferment of marriage and child-bearing that characterizes the average individual pursuing secondary and higher education.

For analytical convenience, I also assume that individuals do not consume in the first period of life, although the case where they consume a fixed amount of output (endowed from their parents) can readily be introduced. More generally, however, allowing for the consumption of a single good in each period will not affect the main arguments of the paper.

Upon spending a fraction e_t ($e_t \in [0, 1]$) of their time on education/training, young adults acquire a level of human capital, h_{t+1}, which depends on the time spent on schooling, as well as on the average level of human capital of the previous generation, $\bar{h}_t$. More specifically, I postulate that

$$h_{t+1} = B\bar{h}_t^{\gamma} e_t, \tag{2.1}$$

where γ and B are given constant parameters, satisfying $\gamma \in [0, 1]$ and $B > 0$.[7] Human capital accumulation is linear in e_t purely for convenience. It helps to

[7] Variations of this learning technology are very common in the literature; see, for example, Glomm and Ravicumar (1992). The parameter B, in particular, can capture changes in the quality of education. For a human capital accumulation function that describes a more detailed process in an overlapping generations model see Eicher (1996).

obtain an analytical expression for the equilibrium time input to training. To let societal human capital accumulation commence, I also assume that each member of the initial generation of old agents is endowed with $h_0 > 0$.

The use of the average educational level as an input in the learning function is consistent with Barro and Lee (1997), who find that the average educational level, measured by the average number of years of primary school attainment for adults aged 25 and above, has a significantly positive effect on students' performance on standardized tests. They also find that the same variable has a significantly negative effect on repetition and dropout rates. Nevertheless, it is important to note that the main results of the paper stay intact if one uses, instead, a more general learning technology, according to which both the societal and the parental level of human capital contribute to the accumulation of human capital by younger generations (see the appendix).

The remainder of the time endowment is devoted to bearing and rearing children. In particular, the fertility rate (=population growth rate) n_t ($n_t \in [0,\delta]$) is governed by the following formulation:[8]

$$n_t = \delta(1 - e_t), \tag{2.2}$$

where $1/\delta > 0$ denotes the amount of time required to raise one child.

Finally in the last period of life, old adults supply labor inelastically (the time endowment is again normalized to one), and receive the competitive wage, w_{t+1}, per unit of human capital. Thus, the budget constraint that each agent faces in the last period is

$$c_{t+1} = w_{t+1} h_{t+1}. \tag{2.3}$$

Naturally, the higher is one's human capital, acquired in the previous period, the more consumption one can afford this period.

All individuals have identical preferences over the number of children when young and consumption when old. More specifically, the preferences of an individual born at time t are represented by

$$U_t = u(n_t, \bar{n}_t) + \beta \ln(c_{t+1}), \tag{2.4}$$

where $\bar{n}$ denotes the average fertility rate and u is assumed to be at least twice continuously differentiable. Thus, following the so-called 'synthesis model of fertility' (see, for example, Easterlin et al., 1980), I allow one agent's fertility behavior to be influenced by the fertility behavior of all other agents. This

[8] This formulation is similar to the one followed in, among others, Becker et al. (1990) and Galor and Weil (1996). Palivos (1995) analyzes the case where there exist economies of scale in raising children.

formulation is consonant with numerous empirical studies that provide either direct or indirect evidence on the importance of family-size norms.[9]

An agent born in period t chooses $\{n_t, e_t, h_{t+1}, c_{t+1}\}$ in order to

$$\begin{aligned} &\max U_t \\ &\text{subject to} \quad (2.1)\text{–}(2.3). \end{aligned} \tag{P}$$

The first-order necessary conditions for program (P) are

$$u_1(n_t, \bar{n}_t) = \lambda_{2t}, \tag{2.5}$$

$$\lambda_{1t} B \bar{h}_t^{\gamma} = \lambda_{2t}\delta, \tag{2.6}$$

$$\frac{\beta}{c_{t+1}} = \lambda_{3t}, \tag{2.7}$$

$$\lambda_{1t} = \lambda_{3t} w_{t+1} \tag{2.8}$$

and Eqs. (2.1)–(2.3), where λ_{it}, $i = 1, 2, 3$ are the Lagrangean multipliers associated with the constraints. Eqs. (2.5)–(2.8) have a standard interpretation; namely, they require that, at the optimum, the marginal cost of each activity be equal to its marginal benefit.

The production side of the economy is simple. The technology is described by the following constant-returns-to-scale production function:

$$y_{t+1} = Ah_{t+1}, \tag{2.9}$$

where A is simply a positive parameter that determines the units of measurement. Firms choose labor in effective units (h_{t+1}) to maximize profits, taking the wage rate (w_{t+1}) as given.

3. Equilibrium analysis

Consider first the definition of a symmetric Nash equilibrium.

[9] One line of research uses survey data as the basis of assessing family-size norms (see, for example, Arnold, 1975, which uses questions about perceived sanctions for alternative family sizes, and Ryder and Westoff, 1971, which is based on questions regarding desired family size). A different line provides indirect evidence by testing whether characteristics that are related to tradition and norms, such as religion and ethnic group, are significant in explaining variations in fertility (e.g., Sander, 1992). Strong evidence regarding the existence of family-size norms can also be found in intensive field studies of the type traditionally conducted by social or cultural anthropologists (see, for example, Srinivas, 1976, for the existence of norms on avoiding childlessness, and Collier and Rosaldo, 1981, for norms on avoiding too many children). Finally, it should be noted that, the use of social norms has allowed several authors to account for fertility swings in the United States, Europe and several other countries, which would otherwise be unexplained (see, for instance, Watkins, 1990).

Definition 1. Given $h_0 > 0$, a symmetric Nash equilibrium in this economy is a set of sequences $\{n_t\}_{t=0}^{\infty}$, $\{e_t\}_{t=0}^{\infty}$, $\{h_{t+1}\}_{t=0}^{\infty}$, $\{c_{t+1}\}_{t=0}^{\infty}$, $\{y_{t+1}\}_{t=0}^{\infty}$, $\{w_{t+1}\}_{t=0}^{\infty}$ such that for every $t = 0, 1, 2, \ldots$, (i) each agent's utility function is maximized, (ii) each firm's profit is maximized, (iii) $w_{t+1} = A$, so that the labor market clears (iv) $y_{t+1} = c_{t+1}$, so that the goods market clears, (v) $\bar{h}_t = h_t$, and (vi) $\bar{n}_t = n_t$.

To ensure that an interior equilibrium exists, I posit that the function u exhibits the following properties.

Assumption 1. (i) $u_1(n_t, n_t) > 0$, (ii) $u_{11}(n_t, n_t) \leq 0$, for all $n_t > 0$, (iii) $\lim_{n_t \to 0} u_1(n_t, n_t) = \Omega$, where $\beta/\delta \leq \Omega \leq \infty$ and $\lim_{n_t \to \delta} u_1(n_t, n_t) < \infty$.

Furthermore, the following common definitions (see, for example, Cooper and John, 1988) are utilized.

Definition 2. If $u_2(n_t, \bar{n}_t) > (<) 0$, then the system involves positive (negative) spillovers.

Definition 3. If $u_{12}(n_t, \bar{n}_t) > (<) 0$, then the system involves strategic complementarities (substitutabilities).

Applying the definition of a symmetric Nash equilibrium yields the following recursive system for the evolution of n and h:

$$u_1(n_t, n_t) = \frac{\beta}{\delta - n_t}, \tag{3.1}$$

$$h_{t+1} = B h_t^{\gamma} \frac{\delta - n_t}{\delta}. \tag{3.2}$$

Having determined the equilibrium path of n (using 3.1), one can solve for the equilibrium paths of h, e, y, and c using Eqs. (3.2), (2.2), (2.9), and (2.3), respectively.[10] Note that n and e remain constant along the adjustment towards

[10] A symmetric cooperative solution for n, defined as an action by all agents that maximizes the utility of the representative agent, is given by

$$u_1(n_t, n_t) + u_2(n_t, n_t) = \frac{\beta}{\delta - n_t},$$

provided that an interior solution exists. On the other hand, a social planner who takes into account the utility of future generations, applying R ($R \in [0,1)$) as the discount factor will choose a steady-state value of n that satisfies

$$u_1(n, n) + u_2(n, n) = \frac{1}{1 - R\gamma} \frac{\beta}{\delta - n}.$$

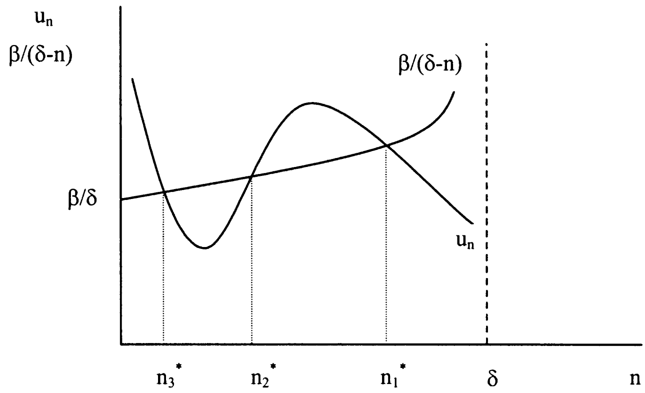

Fig. 1. Multiple equilibria.

a steady state (or a balanced growth path). This result is a direct consequence of the separability of preferences. (As shown in the appendix, it also disappears when there exists parental altruism.)

The following proposition is similar to Proposition 1 in Cooper and John (1988, p. 446).

Proposition 1. The presence of strategic complementarities is a necessary condition for multiple equilibria.

Proof. The proof follows immediately from Eq. (3.1). The term on the right-hand side is an increasing function of n_t. Multiple intersections are then possible only if u_1 is upward sloping over some range. Given Assumption 1(ii), this requires that u_{12} is positive at least over some range (see Fig. 1). □

Simply stated, the multiplicity of equilibria follows from the fact that each agent's reaction function is increasing in $\bar{n}_t$ (namely, $\mathrm{d}n_t/\mathrm{d}\bar{n}_t = -u_{12}/[u_{11} - \beta/(\delta - n_t)^2] > 0$ if $u_{12} > 0$). As a consequence, if each agent expects every other agent to choose n_1^* (n_3^*), then each agent will find it in her best interest to choose n_1^* (n_3^*) as well.[11] The equilibrium path of the economy is then *indeterminate*. Starting from the same initial condition, h_0, the economy will converge to the low- or the high-level equilibrium (points A and B, respectively, in Fig. 2), if the high or the low fertility rate, (n_1^* and n_3^*, respectively, in Fig. 1), is selected. If, on the other hand, the low fertility rate is selected in alternate periods then an endogenous two-period cycle will emerge. (This is illustrated by

[11] In the following analysis, I ignore the intermediate equilibrium (n_2^* in Fig. 1), since, at this level of fertility, the marginal cost intersects the marginal benefit from above.

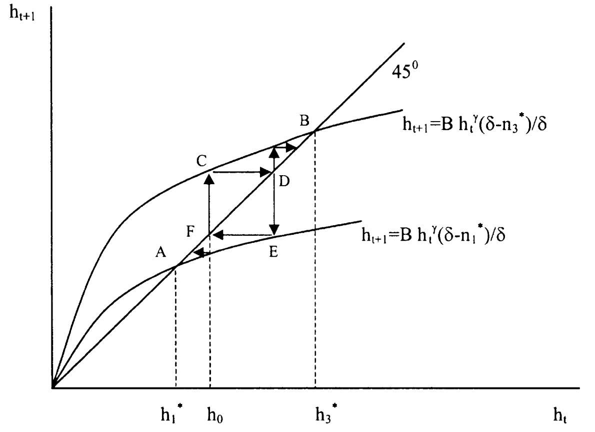

Fig. 2. Equilibrium growth paths when $\gamma < 1$.

the path CDEF in Fig. 2.) Finally, Fig. 3 depicts the case where $\gamma = 1$. Given h_0, the economy converges towards the origin, experiences sustained endogenous growth or oscillates.[12]

Cooper and John (1988), in an abstract game with strategic complementarities, show that if there are positive (negative) spillovers then higher (lower) action equilibria are preferred. (See Proposition 4, p. 446, and the discussion on p. 448 in their paper.) The following proposition shows that, in the present intertemporal framework, this result should be modified as follows.

Proposition 2. (a) *In the presence of negative spillovers, equilibria with low fertility rates are preferred by all agents.* (b) *In the presence of positive spillovers, different equilibria cannot, in general, be ranked.*

Proof. Consider first the optimal utility level achieved by a generation born in period t. This can be written as

$$U_t^* = u(n^*, n^*) + \beta \ln(c_{t+1}^*),$$

where $c_{t+1} = Ah_{t+1} = A(h_0^\gamma)^{t+1}\prod_{s=0}^{t}[B(\delta - n^*)/\delta]^{\gamma^s}$. Differentiating U_t and substituting (3.1), one obtains

$$\frac{\mathrm{d}U_t^*}{\mathrm{d}n^*} = u_2(n^*, n^*) - \sum_{s=1}^{t} \gamma^s \frac{\beta}{\delta - n^*}. \tag{3.3}$$

[12] Jones (1998) argues that endogenous fertility coupled with increasing returns to scale, by virtue of the nonrivalry of ideas, leads naturally to sustained and endogenous per capita growth.

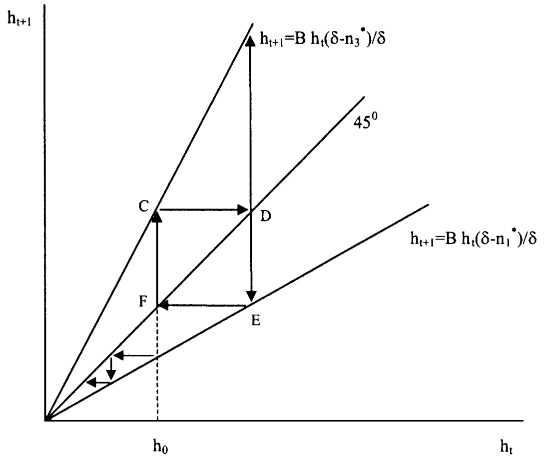

Fig. 3. Equilibrium growth paths when $\gamma = 1$.

(a) Obviously, in the presence of negative spillovers, where $u_2 < 0$, $\mathrm{d}U_t^*/\mathrm{d}n^* < 0$. Thus, equilibria with low fertility rates are preferred by all agents.

(b) Nevertheless, in the case where there are positive spillover effects (i.e., $u_2 > 0$) $\mathrm{d}U_t^*/\mathrm{d}n^*$ can be of either sign. In particular, if $\gamma < 1$ (i.e., the utility level achieves a stationary value), then Eq. (3.3) can be written as

$$\frac{\mathrm{d}U_t^*}{\mathrm{d}n^*} = u_2(n^*, n^*) - \frac{\gamma(1-\gamma^t)}{1-\gamma}\frac{\beta}{\delta - n^*}.$$

Hence, other things being equal, $\mathrm{d}U_t^*/\mathrm{d}n^*$ is more likely to be positive (negative) the lower (higher) the values of γ, β, and t. If, on the other hand, $\gamma = 1$, and thus there exists unbounded growth (as in Fig. 3), then

$$\frac{\mathrm{d}U_t^*}{\mathrm{d}n^*} = u_2(n^*, n^*) - t\frac{\beta}{\delta - n^*}.$$

Consequently, $\mathrm{d}U_t^*/\mathrm{d}n^*$ is again positive (negative), for sufficiently low (high) values of t or β. □

Intuitively, there are two effects. First, an increase in the equilibrium fertility rate has an immediate impact on every agent's utility level. If there are negative (positive) spillovers then this effect is also negative (positive). Second, an increase in the rate of fertility has also negative effects on the time devoted to schooling, as well as on the *paths* of human capital and consumption. Obviously, the latter effect has always a negative impact on utility. Hence, when there are negative spillovers, an increase in the fertility rate will unambiguously lower the utility level of every agent. In other words, an equilibrium associated with a low fertility rate (a low action equilibrium) is preferred by all agents. In the case, however, of positive spillovers, the two effects contravene each other. Which one dominates depends on the parameters of the model, such as β, γ, and δ, as well as on the time horizon considered. More specifically, an increase in the preference parameter (β), or the growth rate (γ), or the time horizon (t), or a decrease in the time cost of raising children (δ) strengthens the effect associated with lower consumption and tends to make $\mathrm{d}U_t^*/\mathrm{d}n^*$ negative (see also the examples below).

Importantly, Proposition 2 points out the possibility of coordination failures, where the economy is 'stuck' at an inefficient equilibrium. This result is in sharp contrast with most papers that use a dynastic family framework (e.g., Becker et al., 1990). In the latter, if the initial level of human capital of the dynasty head is low, then sinking into a Malthusian trap, associated with low investment in human capital, a minimal level of per capita income, and a high fertility rate, is optimal.

Example 1. The first example considers the case where there are negative spillovers; that is, $u_2(n_t, \bar{n}_t) < 0$. Suppose that $u(n_t, \bar{n}_t) = \alpha_1 \ln(n_t) - \alpha_2 \exp(-\alpha_3 n_t)\bar{n}_t$, where $\alpha_1 = 0.3$, $\alpha_2 = 1.5$, and $\alpha_3 = 0.28$. Furthermore, assume that $\beta = 16.936$ and $\delta = 29.016$. Then, there exist three equilibria:

Equilibria	n^*	e^*
1 (Lower)	2.7	0.907
2 (Middle)	1.7	0.941
3 (Upper)	1.25	0.957

Furthermore, $U_{3t}^* > U_{1t}^*$ $\forall t$, regardless of the value of γ; hence, *all* agents prefer the lower action equilibrium (the one with the lower population growth rate).

Example 2. The second example illustrates the case where there are positive spillovers, that is $u_2(n_t, \bar{n}_t) > 0$. Suppose that $u(n_t, \bar{n}_t) = \alpha_4 \ln(n_t) \exp(\alpha_5 \bar{n}_t)$, where $\alpha_4 = 0.1$ and $\alpha_5 = 3$. Let also $\beta = 3.704$ and $\delta = 2.8437$. Then, there will again be three equilibria:

Equilibria	n^*	e^*
1 (Lower)	2.822	0.00774
2 (Middle)	1	0.648
3 (Upper)	0.1	0.965

In this case, depending on the parameters values of the model, different equilibria may emerge as Pareto dominant. For instance, simple calculations reveal that $U^*_{1t} > U^*_{3t}$ $\forall t$ if $\gamma < 0.964$. On the other hand, for values of $\gamma > 0.964$, the opposite result may emerge for sufficiently high values of t, e.g., if $\gamma = 1$ then $U^*_{1t} < U^*_{3t}$ $\forall t > 27$. □

4. Concluding remarks

This paper has developed an overlapping generations model that can explain diverse experiences in income and population growth, without relying on increasing returns. Instead, it relies on family-size norms, which find strong empirical support in the work of sociologists, demographers, and population economists. In the presence then of strategic complementarities, generated by such norms, multiple equilibria may emerge, which, under certain conditions derived in the paper, can be Pareto ranked. Put differently, the paper analyzes the possibility of coordination failures when there exist family-size norms.

It is important to note that the multiplicity of equilibria occurs under a set of functional forms and parameter values that would otherwise guarantee uniqueness in the standard one-sector overlapping generations model. Moreover, as demonstrated formally in the appendix, multiple equilibria can occur even in the case where parents are altruistic and thus, in essence, infinitely lived.

Appendix. Parental altruism and a more general learning technology

This appendix demonstrates that multiple equilibria can also arise in the more general cases where (i) parents exhibit intergenerational altruism by valuing the utility level achieved by their descendants and (ii) both the societal as well as the parental level of human capital contribute to the human capital accumulation.

Consider the following maximization program:

$$\max V_0 = \sum_{t=0}^{\infty} R^t\{u(n_t, \bar{n}_t) + \beta \ln(c_{t+1})\}, \tag{P'}$$

subject to

$$h_{t+1} = B\bar{h}_t^{\gamma'} h_t^{\varepsilon} e_t, \tag{A.1}$$

(2.2) and (2.3),

where R ($R \in [0,1)$) denotes the discount factor applied towards the utility of future generations (degree of altruism), γ', $\varepsilon \in [0,1]$ and $\gamma' + \varepsilon \leq 1$.

The first-order necessary conditions for program (P′) are:

$$u_1(n_t, \bar{n}_t) = \lambda_{2t}, \tag{A.2}$$

$$\lambda_{1t} B \bar{h}_t^{\gamma'} h_t^{\varepsilon} = \lambda_{2t} \delta, \tag{A.3}$$

$$\frac{\beta}{c_{t+1}} = \lambda_{3t}, \tag{A.4}$$

$$\lambda_{1t} = \lambda_{3t} w_{t+1} + \lambda_{1t+1} R B \varepsilon \bar{h}_{t+1}^{\gamma'} h_{t+1}^{\varepsilon-1} e_{t+1}, \tag{A.5}$$

$$\lim_{t \to \infty} R^t \lambda_{2t} h_{t+1} = 0, \tag{A.6}$$

and Eqs. (A.1), (2.2) and (2.3), where λ_i, $i = 1, 2, 3$, are the Lagrangean multipliers associated with the constraints. Notice that if either $\varepsilon = 0$ and $\gamma' = \gamma$ or $R = 0$ and $\gamma' + \varepsilon = \gamma$, then the first-order necessary conditions for program (P′) are the same as those for program (P) in the main text.

Combining Eqs. (A.1)–(A.5), (2.2), (2.3), the symmetry conditions $\bar{h}_t = h_t$ and $\bar{n}_t = n_t$, and the equilibrium conditions $w_{t+1} = A$ and $y_{t+1} = c_{t+1}$ yields the following difference equation in place of (3.1):

$$u_1(n_t, n_t) = \frac{\beta}{\delta - n_t} + R\varepsilon\, u_1(n_{t+1}, n_{t+1}) \frac{\delta - n_{t+1}}{\delta - n_t}. \tag{A.7}$$

In steady state, $n_{t+1} = n_t = n^*$, and, hence, (A.7) becomes

$$u_1(n^*, n^*) = \frac{1}{1 - R\varepsilon} \frac{\beta}{\delta - n^*}. \tag{A.8}$$

The multiplicity of equilibria can then be established in a manner similar to the one followed in Proposition 1.

Furthermore, if $\gamma' > 0$, then, in general, an increase in the equilibrium path of n has an ambiguous effect on welfare. The easiest way to see this is to consider a stationary path of fertility, i.e., $n_t = n^*\ \forall t$. Then

$$h_{t+1} = \Gamma \prod_{s=0}^{t} (\delta - n^*)^{(\gamma' + \varepsilon)^s}, \tag{A.9}$$

where $\Gamma \equiv \prod_{s=0}^{t} (B/\delta)^{(\gamma' + \epsilon)^s} (h_0^{\gamma' + \epsilon})^{t+1}$. Substituting (A.9) in the expression for V_0 yields

$$V_0 = \sum_{t=0}^{\infty} R^t \left\{ u(n^*, n^*) + \beta \ln(A\Gamma) + \beta \sum_{s=0}^{t} (\gamma' + \varepsilon)^s \ln(\delta - n^*) \right\}. \tag{A.10}$$

Differentiating (A.10) and taking into account (A.8), one obtains

$$\frac{\mathrm{d}V_0}{\mathrm{d}n^*} = \frac{1}{1 - R} \left\{ u_2 - \frac{R\gamma'}{(1 - R\varepsilon)(1 - R(\gamma' + \varepsilon))} \frac{\beta}{\delta - n^*} \right\}. \tag{A.11}$$

(Note that, in the case where $\gamma' + \varepsilon = 1$, one must use the fact that $\sum_{t=0}^{\infty} tR^t = R/(1-R)^2$). It follows from (A.11) that if there are negative spillovers then $\mathrm{d}V_0/\mathrm{d}n^*$ is negative. If, however, there are positive spillovers, then, unless $\gamma' = 0$, the effect of an increase in the equilibrium fertility rate on lifetime welfare has an ambiguous sign.

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