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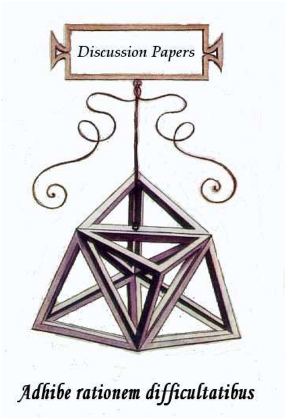

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Child rearing subsidies and fertility in small open economies with life uncertainty

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Discussion Paper
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Abstract

We examine how subsidy policies to support child-rearing affect the fertility rate in a standard OLG small open economy with life uncertainty and involuntary bequests. It is shown the counter-intuitive result that increasing the child grant may actually reduce the long-run fertility rate.

1. Introduction

The fertility rate in advanced countries has dramatically decreased in the recent years. For instance the total fertility rate is around 1.3 in large countries such as Italy, Japan, Germany and Spain, a value largely below the replacement rate. This trend may cause serious problems: for example, if the share of the old in total population is steadily rising, the sustainability of pension systems is menaced in many developed countries where old-age facilities are financed on a PAYG-basis. Therefore these countries actively support childcare in order to increase the fertility rate, especially providing (although not only) financial support in the form of child subsidies. As regards the causes of the observed fertility drop, for instance Becker and Barro (1988) and Barro and Becker (1989) showed that the increase of child-rearing costs is an important factor contributing to low fertility rates. In this paper we show that high child-rearing costs may be responsible also for the failure of the child subsidy policy, which may unexpectedly reduce the fertility rate.

The aim of this paper is to study the relationships between the choice of the fertility rate and a child subsidy policy when: 1) children are a consumption good and enter to their parents' utility function (e.g. Eckstein and Wolpin, 1985; Galor and Weil, 1996)[1], and 2) the duration of life is uncertain. The assumption that the length of life is uncertain is rather realistic, especially at the time in which the young people make their economic choices.

The introduction of an uncertain duration of life in a standard OLG model gives raise the problem of how to treat the saving of the deceased persons. There are two polar cases, which obviously also include intermediate cases: 1) there is a perfect annuity market and all savings are fully annuitized; 2) there is no annuity market, for instance as in Abel (1985), so the saving of a deceased person becomes an accidental bequest in favour of her own children. Given that annuity markets are imperfect in many countries and accidental bequests are very relevant, we focus on the latter case. [2]

Although some papers (e.g. Zhang et al., 2003, which consider accidental bequests, and Zhang et al., 2001, and Yakita, 2001, which consider annuitized savings) embody – generally in an endogenous growth context – exogenous uncertain duration of life and endogenous fertility, they focused on other issues such as the relationship between growth and social security and in any case, to the best of my knowledge, all the previous papers abstract from child subsidy policies. Other papers, such as van Groezen et al. (2003) and Fanti and Gori (2007), have considered child subsidy policies, but abstracting from the uncertainty of life.

We assume a small open economy, which is the relevant context for the most part of countries in the world. This assumption, together with life uncertainty and involuntary bequests assumptions, differs from those in Fanti and Gori (2007) (FG), which is the paper more related to the present one. FG show that, in a closed economy with life certainty, a child subsidy policy might obtain the undesired result of reducing the fertility rate when the distributive capital share is sufficiently high. Such a result is entirely due to the general equilibrium feedback effects of the child policy on wages and interest rates, which are endogenously determined in a closed economy context. The merit of the result of FG cannot however hide the fact that it does not hold in a small open economy context. Indeed, it is easy to see that the model of FG in such a context would predict that child subsidies are always effective in order to increase fertility rates.

Interestingly, we show that, under the realistic assumptions of uncertain duration of life and unintended bequests, child subsidies may be harmful for a fertility recovery also in the case of small

[1] Note that the approach to the endogeneisation of the fertility decision by Barro and Becker, 1988, Becker and Barro, 1988, differs from the present one (which follows, e.g., Eckstein and Wolpin, 1985; Galor and Weil, 1996) not only for the assumption of children as a consumption good, but also because they postulate either the children's utility or the utility of all the future generations enter to their parents' utility function.

[2] The assumption of accidental rather than voluntary end-of-life bequests is corroborated by the empirical findings of numerous papers: see, among many others, Auerbach et al. (1992), Borsh-Supan (1993) , and Hurd (1997).

open economies, provided that costs of rearing children are sufficiently high. Since such high costs seems to be even indicated as a major cause of the fertility drop, then the result of the paper may be an useful policy warning as regards the widespread use of child allowance policies as a remedy to the fertility drop. Another consequent policy implication is that the reduction of children costs should be primarily pursued as a means for a fertility recovery, and only after reaching a cost reduction below the critical value identified in this paper then child subsidies policy may be used for further increasing fertility rates.
Therefore, given that the small open economy context is rather relevant, the finding of this paper, which extends to such a context the previous finding of FG, may be of some interest.
The remainder of this paper is organized as follows. Section 2 introduces the general model. Section 3 and section 4 derive and illustrate the steady state results and discuss some implications. Section 5 gives some concluding remarks.

2 The general model

2.1 The firms

Consider a small open economy that faces an exogenously given interest rate *r*, which is assumed to be constant over time. Production is described by a standard neoclassical constant-returns-to-scale production function, $f(k_t)$, where *k* is the amount of capital per young individual in period *t*. Because capital is perfectly mobile, both the capital–labour ratio and the wage rate (*w*) are fixed and constant.

2.1 Government

We assume, in accord with FG, that government aims to increase fertility rates for some exogenous reason (such as, for instance, the problems concerning pay-as-you-go pension systems which are not addressed here).

The government runs a balanced budget child policy in every period through the financing of a fixed monetary transfer (σ) for each newborn to support the child-rearing of households. The child allowance is supposed to be entirely funded by levying and adjusting over time a labour income tax on current workers at the rate $0 < \tau_t < 1$. Therefore, the per-capita time-t government constraint is simply:

$$\sigma n_t = w_t \tau_t , \tag{1}$$

where the left-hand side represents the total childcare expenditure and the right-hand side the tax receipts. We assume agents act in a atomistic way and do not take the government budget (1) into account when deciding on the desired savings and number of children.

2.2 Individuals

Life of a representative individual[3] is separated among three periods: childhood, young adulthood and old-age. During childhood individuals do not make decisions. Young adulthood is a working period fixed with certainty and old-age is a retirement period whose length is uncertain. We assume, for the sake of simplicity, that the individual is either alive or dead at the beginning of the retirement period, with probability π and $(1-\pi)$ respectively. The wage (w_t) is used to consume, to raise children, and to save. The cost of child rearing is *m* for each child, measured in terms of

[3] As usual, for simplicity we abstract from gender differences as well as the difference between an individual and a household.

output. The labour supply is constant and normalised to unity. Moreover, part of the individuals' working income is taxed away at the rate τ_t to fund at balanced budget a (fixed) subsidy $0 < \sigma < m$ for each child raised by parents to support child-rearing of households.
The representative agent born at time *t* chooses saving and number of children[4] to maximize a standard Cobb-Douglas utility function

$$U = (1-\phi)\ln c_t^1 + \pi\gamma \ln c_{t+1}^2 + \phi \ln n_t \tag{2}$$

where $c_t^{\,1}$ and $c_{t+1}^{\,2}$ are consumption in the first period and in the second period, respectively, γ is the subjective discount factor and $(1-\phi)$ and ϕ are the preference toward the first-period consumption and the number of children, respectively.
We now further develop the model, by assuming unintentional bequests (e.g. perfect annuity markets do not exist).
Since agents do not know when they will die, additional unintentional bequests may occur. If an agent dies at the onset of old age (with probability (1-π)), his accumulated savings, $(1+r_{t+1})s_t$ are bequeathed in full to his heirs. To maintain the representative agent formulation, bequests

$$b_{t+1} = \frac{(1-\pi)(1+r)s_t}{n_t} \tag{3}$$

are equally divided among all the young individuals.[5]
The representative agent born at time t maximize the utility function (2) subject to

$$c^1{}_t = w(1-\tau_t) - (m-\sigma)n_t - s_t + b_t \tag{4}$$

$$c^2{}_{t+1} = s_t(1+r) \tag{5}$$

taking as given bequests from his parents, and constraint (3) encompasses the assumption that bequests are allocated equally across all members of a generation.
The following optimal choices of saving and fertility rate are derived, respectively:

$$s_t = \frac{\gamma\pi(w(1-\tau_t)+b_t)}{1+\gamma\pi} \tag{6}$$

$$n_t = \frac{\phi(w(1-\tau_t)+b_t)}{(m-\sigma)(1+\gamma\pi)} \tag{7}$$

In the next section, we examine the steady state outcome of this model.

3. Steady-state analysis

By using Eqs. (1), (3), (6) and (7) we obtain the steady-state values of bequests, savings and fertility, respectively:

$$b = \frac{\gamma\pi(m-\sigma)(1+r)(1-\pi)}{\phi} \tag{8}$$

$$s = \frac{\gamma\pi(m-\sigma)\left[\phi w + (m-\sigma)\gamma\pi(1+r)(1-\pi)\right]}{\phi\left[(m-\sigma)(1+\gamma\pi)+\phi\sigma\right]} \tag{9}$$

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[4] We assume, as usual, that every individual is able to freely choose a number of children from the set of nonnegative real numbers
[5] This means that the bequest dependent wealth distribution is uniform, as in Hubbard and Judd (1987). This assumption allows us to conduct a representative agent analysis and thus to focus more clearly on the effects of changes in expected longevity.

$$n = \frac{[\phi w + (m-\sigma)\gamma\pi(1+r)(1-\pi)]}{[(m-\sigma)(1+\gamma\pi)+\phi\sigma]} \tag{10}$$

First, we note that, in the absence of uncertainty on the death age i.e. π=*1*) and consequently on accidental bequests, again exploiting the government budget (1), the steady state demand for children would be given by the following equation:

$$n_t = \frac{\phi w_t}{(1+\gamma)(m-\sigma)+\phi\sigma}, \tag{11}$$

It is easy to see, from Eq. (11), that in such a case the number of children would be, as expected, increasing with the level of child subsidy.
In contrast, in the present model, Eq. (7) shows that the child subsidy is present both into the numerator and denominator, while in Eq. (11) it is present only into the denominator, and therefore the effect of child subsidies on fertility rates appears to be, a priori, ambiguous. More formally, such an effect is determined by the investigation of the following derivative:

$$\frac{\partial n}{\partial \sigma} = \frac{\phi[\gamma\pi(w - m(1+r)(1-\pi)) + w(1-\phi)]}{[m(1+\pi\gamma) - \sigma(1+\gamma\pi-\phi)]^2} \tag{12}$$

Proposition 1. The increase of child subsidies reduces (increases) the number of children if and only if

$$m > (<) m^* = \frac{w(1+\gamma\pi-\phi)}{(1+r)\gamma(\pi-\pi^2)} \tag{13}$$

Proof: By deriving the steady-state value of the fertility rate (Eq. 10) w.r.t. the child subsidy, Eq. (12) is yielded and $\frac{\partial n}{\partial \sigma} > (<) 0 \Leftrightarrow m > (<) m^*$. Q.E.D.

The economic meaning of the proposition says that if the cost of rearing children is sufficiently high, then, rather paradoxically, subsidizing families in order to reduce such a high cost leads to the undesired effect to reduce the number of children chosen by families.
This interesting result is due to the role played by the unintended bequest as a source of additional income for the young people: in fact, as is shown by Eq. (11), the higher is the cost of rearing, the lower is the number of children, and thus the lower is the number of son and daughter who must shared the additional income derived by the unintended bequest left by the deceased old parents (as shown by Eq. (3)).
As a consequence, the level of accidental bequest perceived by each young individual is inversely linked with the size of the cost of rearing, and, in the presence of a subsidy reducing such a cost, with the size of the net cost of rearing (see Eq. (8)). This implies that the higher the subsidy for each child, the lower is the additional income due to the unintended bequest, that is child subsidy policies cause a negative income effect through the channel of the accidental bequest.
Since 1) the number of children depends positively on the total income perceived by parents and negatively by the net cost of each child, and 2) the child subsidy always reduces 2.1) the total income through the unintended bequest (while the wage income remains constant) [6], and 2.2) the net cost of children, then the overall effect of policies reducing the net cost of children is ambiguous. In particular we have shown that, through the channels above discussed, a critical level of the size of the cost of rearing which exactly balances the two opposite effects does exist.

[6] The fact that wage income is constant is due to the assumption of small open economy. In contrast, in a closed economy, also the wage income will be affected by child policies through the effects on the capital accumulation.

Moreover from the analysis of Eq. (12) it can be shown that the higher the interest rate relatively to the wage rate and the higher is the preference for having children, the more likely child subsidies may reduce, rather unexpectedly, the number of children chosen by families.

4 An illustration of the main result.

4.1. A Cobb-Douglas technology

In order to perform a numerical illustration of the result above presented, we specialise the technology of production. Aggregate production takes place according to a Cobb-Douglas constant-returns-to-scale technology $Y_t = AK_t^{\alpha} L_t^{1-\alpha}$, where Y_t is aggregate production of goods and services, K_t is the aggregate stock of physical capital hired that firm, $L_t = N_t$ is the labour input and N_t the number of young people of generation t, $A > 0$ is a scale parameter (index of technology) and $0 < \alpha < 1$ the distributive capital share. Therefore, the intensive form production function becomes $y_t = Ak_t^{\alpha}$, where $k_t := K_t / N_t$ and $y_t := Y_t / N_t$ are the per capita stock of physical capital and the per capita output, respectively.

Given that firms are identical and act competitively on the market, standard profit maximisation yields

$$1 + r_t = \alpha A (k_t)^{\alpha - 1}, \tag{17}$$

$$w_t = (1 - \alpha) A (k_t)^{\alpha}. \tag{18}$$

Consider a small open economy with perfect capital mobility that faces an exogenously given (constant) interest rate r – determined as the interest rate which prevails in the world capital market. Therefore, $r_t = r$ and, hence, from Eq. (17) we get

$$k = \left(\frac{\alpha A}{1 + r} \right)^{\frac{1}{1-\alpha}}, \tag{19}$$

which is a negative monotonic function of the constant world interest rate.

Combining Eqs. (18) and (19), we find that the wage rate is constant and determined as

$$w = (1 - \alpha) A \left(\frac{\alpha A}{1 + r} \right)^{\frac{\alpha}{1-\alpha}}. \tag{20}$$

4.2. A numerical illustration

The content of above proposition 1 may be easily illustrated through a graphical analysis, by showing in the plane for two critical parameters for which combinations of these two parameters the introduction of a child subsidy decreases/increases fertility. We choose as parameters of interest the preference for having children (ϕ) and the cost of rearing a child (m).[7] As regards the other parameters (which are chosen only for illustrative purposes), we assume for what concerns 1) preferences: $\gamma=0.6$ [8]; 2) technology: $A=1$ (which is only a scale parameter), $\alpha=0.33$ (in line with the standard value adopted in most papers), $r=1$ (which approximately corresponds to a yearly rate of interest about *2.6%* for a time span about *30* years), and, by adopting the usual Cobb-Douglas production function according to Eqs. (17-20), it is obtained a value of $w=0.2755$; 3) longevity: a value of $\pi=0.60$. Figure 1 displays that for sufficiently high values of ϕ and m (the combinations of which are represented by the region B) child subsidy policies fail to have their intended effect.

[7] We give thanks to an anonymous referee for the suggestion of this graphical analysis.
[8] This implies that the preference for consumption in the old age is in line, for instance, with Zamac (2007).

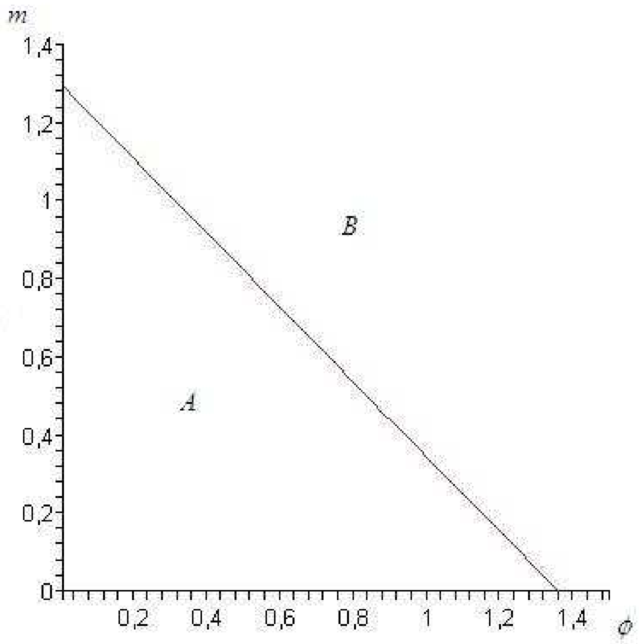

Figure 1. *A pictorial view in the (φ, m) plane of the parametric regions for which a child policy increases (region A) or decreases (region B) fertility.*

Furthermore in order to evaluate "quantitatively" the unintended effect of child subsidy policies with a numerical example, we assume a value of *m=0.41*, which just belongs to the region B (see fig. 1)[9], where, in accord with the Prop. 1, an inverted relationship between child subsidy and fertility does exist.
Indeed, while in the absence of child subsidy policy (σ=0) the fertility rate is *n=0.6818* (which is in line with the current value in the most part of advanced countries plagued by the so called lowest-low fertility[10]), an introduction of the policy obtains the undesired effect to further reduce the rate of fertility in a sensible way, as the following Table 1 displays.

Table 1- Numerical results of the relationships between child subsidy and long run fertility rate, when the child subsidy increases.

	σ=0	σ=0.10	σ=0.20	σ=0.40
Fertility rate (n)	0.6818	0.6800	0.6774	0.6724

5 Conclusions

This paper examines how subsidy policies to support child-rearing of households affect the fertility rate in small open economies. We found that, when the standard OLG model is generalized taking account for the life uncertainty and involuntary bequests, the fertility rate may be lower than when

[9] Indeed it is easy to see (from Eq. 13) that with the present parameter set and *ϕ=0.95* (which means that the preference of young people for consumption is higher than for children) the threshold value of the child-rearing cost is *m*=0.3944*.
[10] See Kohler et al. (2006). We recall that in the present model for simplicity it has been assumed an one-individual family, so that a value of *n=0.6818* corresponds to about *1.364* children for each couple, which is in line with the values recently observed in many European countries such as Italy.

subsidy policies are not implemented at all. This rather counterintuitive effect occurs when the child rearing cost is sufficiently high. [11] In particular, we note that, while, on the one hand, a high cost of rearing children has been considered a major cause of the fertility drop, on the other hand this paper has shown that such a high cost may be also responsible of the unexpected failure of the child subsidy policy. Finally, we note that: 1) this paper complements other papers (i.e., Fanti and Gori, 2007) in evidencing a policy warning about the unexpected effects of child subsidies policy, and 2) while in this paper the results are mainly driven by the presence of involuntary bequests, other channels, such as, for example, different ways of financing the child policy (e.g. through capital income taxes or consumption taxes), are candidates to trigger similar results: such an investigation is left for future research.

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[11] Moreover we remark that such a result occurs for realistic values of the current longevity rate, and is more likely when both the interest rate is relatively high in comparison with the wage rate and the weight of the preference for children is sufficiently high.

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