E C O N O M I C S B U L L E T I N

Human capital, income, fertility and child policy

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Abstract

This paper analyses the effectiveness of child-subsidy support policies in a general equilibrium overlapping generations model with endogenous fertility, child quality choices and human capital formation. It is shown, somewhat paradoxically, that only if the preference for the quality of children is higher than the preference for the quantity of children, then a child subsidy policy gives raise to an increase in both income per-capita and fertility rates, while, on the contrary, in the case in which parents are relatively more interested to the number rather than to the quality of children, a child-subsidy support policy may just reduce fertility behaviour, and, in any case, it always depresses the level of income per-capita.

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1 Introduction

In recent times developed countries have experienced widespread decreases in fertility rates. This event gave rise to the question, among many others, of supporting social security systems, such as pay-as-you-go (PAYG) pension schemes. In most part of countries economic policy has retained the child subsidy an effective instrument for tackling the population ageing problem. Recently, the literature dealt with endogenous fertility, child policies and public pensions in an overlapping generations (OLG) context (e.g., van Groezen et al., 2003; Abio et al., 2004; van Groezen and Meijdam, 2006; Fenge and Meier, 2005, 2008), but abstracting from the child quality issue, which is however an important element for the analysis of long-run income per-capita as well as of some inter-generational effects, in particular for the effects of child benefits on fertility behaviour. In this paper, differently from the previous literature, we assume that, following standard models with endogenous fertility (starting from Becker, 1960, until to, among many others, Strulik, 2004a), parents choose both the number and the quality of the children raised,[1] and we address the question of whether and how a child-subsidy support policy aiming to increase birth rates influences effectively fertility behaviour, and, as usual, the family expenditure in child education drives the formation of human capital. The essential message of this paper is the following: child subsidy policies, which are in the political agenda in the most part of developed countries in order to contrast the population ageing problem, may be either detrimental or beneficial for both income per-capita and fertility behaviour (especially in countries, such as Italy, with a large capital' share in production, see, for instance Jones, 2003), depending crucially on whether the preference for quality of children is either higher or lower than the preference for the quantity of children.

The remainder of the paper is organised as follows: in Section 2 we develop the model; in Section 3 we analyse the relationship between child policy, fertility behaviour and income per-capita; finally, Section 4 bears the conclusions.

2 The model

2.1 Government

The child subsidy is supposed to be entirely financed by levying and adjusting over time lump-sum taxes on the young-adult generation. Therefore, the system of child allowances is balanced in every period according to the following equation:

$$\beta n_t = \tau_t , \tag{1}$$

where the left-hand side represents the total childcare expenditure and the right-hand side the tax receipts, with $\beta > 0$ being the (constant) subsidy per child and $\tau_t > 0$ is a lump-sum tax. Notice that agents act in an atomistic way and do not take the government budget (1) into account when deciding on the desired number of children, the savings path and the fraction of income voluntarily spent on child quality.

2.2 Individuals

Identical agents (N_t) are supposed to have a finite lifetime and overlap over three periods: childhood, young adulthood and old-age. During childhood individuals do not make economic decisions and thus they consume a fixed fraction of the time endowment from their parents. Adult individuals belonging to generation t have a homothetic and separable utility function defined over young-aged consumption ($c_{1,t}$), old-aged consumption ($c_{2,t+1}$), the number of children they have (n_t),

[1] Another investigation of the child subsidy effects on individuals' fertility behaviour, where however the child quality issue is neglected, may be found in Fanti and Gori (2007). Moreover, it is worth to note that in this paper we do not consider the effects of pension benefits since we focus exclusively on the relationship between child subsidies and fertility rates, and adding a pension mechanism would only have complicated the analytical tractability without affecting the qualitative results.

as in Galor and Weil (1996), and the total expenditure per child (defined to be the sum of the fixed nourishment expenditure, e, plus the fraction of income voluntarily spent on child quality, q_t). The way in which the child expenditure enters the individual's utility function is rather usual; in particular, we strictly follow Strulik (2003, 2004a, 2004b). For instance, one may think that rearing a child up to school age requires a given cost of $e > 0$ units of income (including expenditure on nutrition and health) and "assume that parents can additionally decide to spend a fraction $q \geq 0$ of their income on each child that reaches school-age. According to Becker (1960) the total expenditure per child $Q = (e+q)w$ is called child quality and provides utility to the parent." (see Strulik, 2004a, p. 551). However, differently from Strulik (2004a), we assume a fixed (rather than an income-indexed) value of Q, since our model does not show endogenous growth, while Strulik (2004a) analysed an endogenous growth model where the presence of endogenous income growth required child costs growing with income.

Only young-adult individuals join the workforce, and the labour supply is supposed to be constant and normalised to unity. During adulthood, each individual – endowed with h_t units of human capital – receives the competitive wage w_t, paid for one efficiency unit of labour at time t, which is used to consume, to pay taxes, to raise children and to save. During old-age agents are retired and live on the proceeds of their savings (s_t) plus the accrued interest at the rate r_{t+1}.

Therefore, the representative individual born at time t is faced with the following program:

$$\max_{\{c_{1,t}, c_{2,t+1}, n_t, q_t\}} U_t(c_{1,t}, c_{2,t+1}, n_t, q_t) = \ln(c_{1,t}) + \chi \ln(c_{2,t+1}) + \phi \ln(n_t) + \mu \ln(e+q_t), \tag{P}$$

subject to

$$\begin{aligned} & c_{1,t} + s_t = w_t h_t - \tau_t - (e + q_t - \beta) n_t \\ & c_{2,t+1} = (1 + r_{t+1}) s_t \\ & q_t \geq 0 \end{aligned}, \tag{2}$$

where $0 < \chi < 1$ is the subjective discount factor and $\phi, \mu \in (0,1)$ capture the importance in the welfare function of consuming while young relative to the quantity and the quality of children, respectively.

Therefore, the first order conditions for an interior solution are given by:

$$\frac{c_{2,t+1}}{c_{1,t}} \cdot \frac{1}{\chi} = 1 + r_{t+1}, \tag{FOC1}$$

$$\frac{\phi}{n_t} = \frac{1}{c_{1,t}} \cdot (e + q_t - \beta), \tag{FOC2}$$

$$\frac{\mu}{e + q_t} = \frac{n_t}{c_{1,t}}. \tag{FOC3}$$

Exploiting (1), (2) and (FOC1)-(FOC3) gives the fraction of income spent on child quality, the demand for children and the savings path chosen optimally by individuals.

Case $\mu - \phi < 0$ *(no child quality expenditure)*

If the preference for the quality of children is lower than the preference for the quantity of children, then parents do not invest in child quality, that is $q = 0$, and the qualitative results of this model are exactly the same than those found by Fanti and Gori (2007) without human capital. We therefore cross-refer to that paper for a more detailed analysis of the effects of the child-subsidy support policy on individual's fertility behaviour in an overlapping generations general equilibrium model of growth, but we report here the crucial results found by Fanti and Gori (2007) as regards the long-run capital per-capita:

$$k^*(\beta) = \frac{\chi}{\phi}(e - \beta),$$

and the long-run fertility rate:

$$n^*(\beta)=\frac{\phi(1-\alpha)A\left[\frac{\chi}{\phi}(e-\beta)\right]^{\alpha}}{(1+\chi)(e-\beta)+\phi\beta},$$

The introduction of a child grant increases the long-run rate of fertility if and only if $\alpha<\frac{1+\chi-\phi}{1+\chi}$.

Therefore, we may conclude that a child subsidy policy: (1) is always detrimental for long-run income per-capita, and (2) it may even reduce the rate of fertility when the capital's share in production is sufficiently high and/or the preference for having children is high enough.

In what follows we will concentrate exclusively on the case in which parents decide to invest in child quality.

Case $\mu-\phi>0$ *(positive child quality expenditure)*

If the preference for the quality of children is higher than the preference for the quantity of children,[2] then individuals voluntarily invest a positive fraction of their income to increase the quality expenditure for their children. Therefore, we have:

$$q=\frac{\mu}{\mu-\phi}\beta-e, \tag{3}$$

$$n_t=\frac{(\mu-\phi)w_t h_t}{(1+\chi+\mu)\beta}, \tag{4}$$

$$s_t=\frac{\chi w_t h_t}{1+\chi+\mu}. \tag{5}$$

From Eq. (4) the following proposition holds:

Proposition 1. *If the preference for the quality of children is higher than the preference for the quantity of children, then, in the short-run, the fertility rate is always lower than whether the child-subsidy support policy is not introduced at all.*

Proof. The proof uses the following derivative:

$$\frac{\partial n_t}{\partial\beta}=\frac{-(\mu-\phi)w_t h_t}{(1+\chi+\mu)\beta^2}<0,$$

for any $\beta>0$. **Q.E.D.**

The economic intuition behind Proposition 1 is straightforward: when the preference for the quality of children is higher the preference for the quantity of children, individuals invest a positive fraction of their income to increase the quality expenditure for their children, and thus there exists a substitution effect which tends to increase the expenditure in child quality and to reduce the number of children raised.

Note that these results holds in a partial equilibrium (or, alternatively, in a small open economy) context. In what follows, we also investigate the effects of the subsidy policy when there exists an external effect on the accumulation of human capital which increases child's productivity (see, for instance, Strulik, 2003), and when prices are endogenously determined.

2.3 Human capital

[2] This assumption is widespread in the economic literature, especially as regards developed countries. For instance, Zhang et al. (2001, p. 503) stated that "it is often assumed that modern parents have stronger preferences for child quality than for quantity".

We suppose the child quality expenditure creates a positive externality on the accumulation of human capital by increasing the productivity of children. In particular, we assume human capital evolves according to the following Cobb-Douglas schooling function, where the skills produced in period $t+1$ depend on the child quality expenditure as well as on the existing level of human capital, that is:

$$h_{t+1} = Bh_t^{\varepsilon} q_t^{1-\varepsilon}, \tag{6}$$

where $B > 0$ is a production scale parameter and $\varepsilon \in (0,1)$.[3]

2.4 Firms

As regards the production of final goods and services, we suppose firms are identical and act competitively. The (aggregate) constant returns to scale Cobb-Douglas technology of production is $Y_t = AK_t^{\alpha} L_t^{1-\alpha}$, where Y_t, K_t and $L_t = N_t h_t$ are output, capital and the time-t efficient labour input respectively, $A > 0$ represents a scale parameter and $\alpha \in (0,1)$ is the capital's weight in technology. Defining $k_t := K_t / N_t$ and $y_t := Y_t / N_t$ as capital and output per-capita respectively, the intensive form production function may be written as

$$y_t = Ak_t^{\alpha} h_t^{1-\alpha}. \tag{7}$$

Assuming total depreciation of capital at the end of each period and knowing that final output is treated at unit price, profits maximisation leads to the following marginal conditions for capital and efficiency units of labour, respectively:

$$r_t = \alpha A\left(\frac{k_t}{h_t}\right)^{\alpha-1} - 1, \tag{8}$$

$$w_t = (1-\alpha)A\left(\frac{k_t}{h_t}\right)^{\alpha}. \tag{9}$$

2.5 Equilibrium

Given the government budget (1) and knowing that population evolves according to $N_{t+1} = n_t N_t$, the market-clearing condition in goods as well as in capital markets is expressed by the equality $n_t k_{t+1} = s_t$. Therefore, exploiting (4) and (5), the long-run per-capita stock of capital is determined by:

$$k^*(\beta) = \frac{\chi\beta}{\mu - \phi}. \tag{10}$$

Moreover, making use of (3) and (6) the steady-state level of human capital is simply:

$$h^*(\beta) = Z\left(\frac{\mu\beta}{\mu - \phi} - e\right), \tag{11}$$

where $Z \equiv B^{\frac{1}{1-\varepsilon}}$. From Eq. (11) it can easily be seen that in order ensure a finite positive solution for h^* we need the child subsidy to be sufficiently high, that is $\beta > \dfrac{e(\mu-\phi)}{\mu} \equiv \beta_T$.

3 Child policy, long-run income and fertility behaviour

In this section we analyse the long-run effects of the child subsidy support policy both on the long-run income and on individuals' fertility behaviour.

[3] For simplicity, we suppose human capital totally depreciate at the end of each period.

3.1 Fertility in the long-run

May the child subsidy be used as an effective instrument to increase (reduce the drop in) population growth in a context in which parents prefer the quality of children more than the quantity of children, and thus invest in child quality which entails a positive externality on the accumulation of human capital?

To answer this question, we consider the long-run fertility rate as a generic function of the child subsidy, that is:

$$n^* = n^*\left\{\beta, k^*(\beta), h^*(\beta)\right\}. \tag{12}$$

Therefore, the total derivative of Eq. (12) with respect to β gives:

$$\frac{dn^*}{d\beta} = \overbrace{\frac{\partial n^*}{\partial \beta}}^{-} + \underbrace{\overbrace{\frac{\partial n^*}{\partial k^*}}^{+} \cdot \overbrace{\frac{\partial k^*}{\partial \beta}}^{+}}_{+} + \underbrace{\overbrace{\frac{\partial n^*}{\partial h^*}}^{+} \cdot \overbrace{\frac{\partial h^*}{\partial \beta^*}}^{+}}_{+}.$$

It is worth to note that the final effect of an increase in the child grant on the long-run fertility decisions of individuals depends on three counterbalancing forces, and it appears to be ambiguous: (1) a negative (direct) effect which tends to decrease fertility owing to an increased child quality expenditure, and (2) a positive (indirect) feedback effect which acts on fertility through both an increased physical and human capital accumulation. However, the algebraic analysis of Eq. (13) below leads to a general equilibrium unambiguous result, showing that the negative effect owing to an increased child quality expenditure is always dominated by the positive physical and human capital accumulation effect.

Therefore, making use of (4), (9), (10) and (11), the long-run fertility rate is given by:

$$n^*(\beta) = \frac{(\mu-\phi)(1-\alpha)A\left(\frac{\chi\beta}{\mu-\phi}\right)^{\alpha} Z^{1-\alpha}\left(\frac{\mu\beta}{\mu-\phi}-e\right)^{1-\alpha}}{(1+\chi+\mu)\beta}, \tag{13}$$

and the following proposition holds:

Proposition 2. *If the preference for the quality of children is higher than the preference for the quantity of children, then in the long-run the fertility rate is positively related with the child subsidy for any* $\beta > \beta_T$.

Proof. The proof uses the following derivatives:

$$\frac{\partial n^*(\beta)}{\partial \beta} = \frac{n^*(\beta)(\mu-\phi)(1-\alpha)e}{\beta[\mu(\beta-e)+\phi e]} > 0,$$

for any $\beta > \beta_T$. **Q.E.D.**

Proposition 2 says that the partial equilibrium negative effect of the child subsidy on individual's fertility behaviour is completely reversed when the child quality expenditure is used to increase the child's productivity on the accumulation of human capital and prices are endogenous.

3.2 Income in the long-run

The long-run income per-capita may be written as:

$$y^*(\beta) = A\left(\frac{\chi\beta}{\mu-\phi}\right)^{\alpha}\left[Z\left(\frac{\mu\beta}{\mu-\phi}-e\right)\right]^{1-\alpha}, \tag{14}$$

and the following proposition holds:

Proposition 3. *When the child quality expenditure in schooling is positive, the child-subsidy policy increases the long-run income per-capita for any* $\beta > \beta_T$.

Proof. The proof straightforwardly derives by:

$$\frac{\partial y^*(\beta)}{\partial \beta} = \frac{y^*(\beta)[\mu\beta - (\mu - \phi)\alpha e]}{\beta[\mu\beta - (\mu - \phi)e]} > 0, \tag{14}$$

for any $\beta > \beta_T$. **Q.E.D.**

To sum up, when the child quality expenditure in schooling is positive the effect of the child subsidy policy is at all different with respect to the case in which parents do not invest to increase the quality expenditure for their children. While in the latter case, a child policy aiming to increase fertility is detrimental as it always reduces income per-capita and in many cases even fertility behaviour (that is, when the capital's share in production and/or the preference for having children are high enough), in the case in which the preference for the quality of children is higher than the preference for the quantity of children, so that we expected a reduction in fertility rates, the positive effect of the child subsidy on both physical and human capital accumulation tends to increase wages to the extent to which the number of children increases either. In other words, the child policy not only increases rather decreases the neoclassical economic growth but, it always increases, somewhat paradoxically, fertility only when the preference for the quality of children is higher than the preference for the quantity of children.

4 Conclusions

This paper addresses the question of whether and how a child subsidy, implemented as a pro-natalist policy, influences fertility rates and the long run income per-capita when parents choose both the number and the quality of children, and as a consequence the human capital formation for each child. Extending the recent literature which neglected the child quality issue, we show that the preference for child quality is responsible of very interesting effects.

The novelty of the paper may be resumed in this somewhat paradoxical result: increasing child benefits in order to provide birth incentives is detrimental for both income per-capita and fertility rates when it is just the number of children to give rise to a relatively higher utility and, alternatively, they are beneficial for income and fertility if and only if individuals have a higher preference for the quality rather than for the quantity of children. The economic intuition for this result may be explained as follows: (1) when prices are exogenously given the common wisdom holds, that is providing birth incentives works in the right direction (in the wrong direction) if individuals have a relatively higher preference for the number of children (for the quality of children); (2) on the contrary, when prices are endogenously determined, the strong effect of the child quality expenditure in terms of increased physical and human capital accumulation brings upon an increase in wages; (3) the increased wage rate indirectly produced by the child subsidy, stimulates fertility more than the direct depressing effect owing to the higher child quality expenditure. This way, the policy implications are straightforward: policymakers with a pro-natalist objective as well as desirous to improve the level of income per-capita should use child subsidy policies only when the individuals' preference for the quality of children is sufficiently high, since in the opposite case, i.e., when the preference for the quality of children is lower than the preference for the quantity of children, the final result of the child-subsidy support policy is to depress the level of income per-capita, and in some cases even the individuals' fertility behaviour.

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