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Child labour, human capital and life expectancy

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Abstract

This paper studies new mechanisms through which human capital and longevity interact with child labour and endogenous fertility. When children provide old age support in the form of care and companionship, the economy may display multiple development regimes: a development trap with low human capital and large use of child labour or a high steady state with high longevity and human capital and low child labour. A situation with indeterminacy of equilibrium outcomes may also occur if child mortality is introduced in the model.

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1. Introduction

In this paper we present a theoretical model of child labour, endogenous demography and growth. Through this model, we study how adult longevity interacts with fertility and investment in education when children provide old-age support to their parents. The model displays multiple development regimes, thus leaving a role for public policies to affect child labour through improvements in life expectancy. We then focus our attention on child mortality, as opposed to adult mortality and show that, in this case, we have indeterminacy of equilibrium, a situation where public policies could reduce child labour by coordination of expectations.

A number of theoretical approaches have been developed in recent years to study the problem of child labour. In particular a strand of this literature has studied this issue in relationship with the demographic transition and economic growth. The aim of this literature, to which our paper wishes to contribute, is to understand how child labour evolves with demographic variables in the process of development. Hazan and Berdungo (2002), for example, consider an overlapping generations model where adults choose their fertility rate and their children's education. The alternative to education is child labour, whose earnings accrue to the parents. Parents derive utility from consumption and from the potential income of their children next period. In this model, technological progress increases the wage gap between parental and child labour, thereby inducing parents to substitute child education for child labour, to decrease fertility and to generate growth.

Strulik (2004) develops another model that studies the interplay between fertility, child labour and growth, but here another important element is child mortality. Starting from the observed co-movement of child mortality and child labour, this paper shows that changes in fertility and child labour are triggered by changes in child mortality. Child mortality is determined by average income in the economy, as an external effect. Stagnation occurs when income and child survival are low. If, instead, initial income is high enough, then mortality is low and there is perpetual growth. Similarly, in a context with exogenous fertility, Estevan and Baland (2007) consider child mortality as a source of uncertainty which affects returns to education and therefore child labour.

Chakraborty and Das (2005) present a model where adult mortality, like in the present paper, is linked to child labour. Children provide old-age support to their parent, consisting in a fixed fraction of their labour income. Hence, sending a child to school decreases current parental consumption possibilities, but increases future parental consumption. Then, with endogenous fertility and mortality, a child labour trap may emerge. Mortality in this model depends on health investment in youth, which is undertaken by the parent.

Other recent contributions include Sugawara (2010) and Kitaura (2009). The first paper augments Blackburn and Cipriani (2005) by relating child labour to the Caldwell hypothesis on intergenerational transfers. The second introduces education aid into the analysis and focuses on the policy implications of the education aid fungibility for economic development.

Our first setting is closer in spirit to Chakraborty and Das (2005), since it studies the role of adult mortality on child labour. However, differently from them we do not rely on the old-age support hypothesis and therefore we do not need to implicitly assume a missing credit market. Parents decide on their own consumption, children education and labour. Adult longevity depends on human capital and old agents derive utility from child quality. This motive for investing in children has been recognized as important by a number of papers in the literature. The seminal paper by Ehrlich and Lui (1991) calls "companionship" the utility derived from a sense of family strength and influence which is especially important in developing countries, where the rule of law is weak. As in their model, we assume that the quality of children is proxied by their human capital. The dynamics of our model may display multiple steady states which include a poverty trap, depending on initial human capital.

In the second model we consider the role of child mortality. Like in Strulik (2004) we model child mortality as an external effect. However, in our setting it is a function of average human capital instead of average income. Also, surviving children still provide the same form of old-age support to their aged parents as in the previous setting. We show that in this case indeterminacy of equilibrium is a possibility. We see this extension as important, since it implies that countries with similar characteristics may follow very different dynamic paths of fertility, mortality, child labour and economic growth.

The organization of the paper is as follows: Section 1 introduces the paper, Section 2 lays out the first model, Section 3 characterizes the equilibrium paths, Section 4 considers a model with child mortality and Section 5 concludes.

2. A Model of old-age support through companionship

The model consists of an economy with three overlapping generations in each period. The superscript t, with $t = 1, ..., \infty$,denotes the time an agent was born. Young adults decide how much to consume, how many children to have and how much labour their children will supply. For simplicity, we assume that consumption of goods takes place only in adulthood. If young adults survive to old age, they also derive utility from child quality. In other words, we assume that child quality, represented by their human capital, can be better appreciated by agents who can observe it, i.e. the old parent, rather than by young adult agents. This is akin to what Ehrlich and Lui (1991) call "companionship" enjoyed by parents during old age. They define it as the "sheer pleasure that parents derive vicariously from the conduct and achievements of their children" (p. 1040) and assume it is a concave function of child quality. This form of old-age support is different from the standard economic assistance from children, already studied in numerous papers. It is, instead, a type of instrumental support which provides for the emotional needs of ageing parents. This type of support is in fact so important that, in some countries (in China for example), laws are being introduced to require children to provide for the emotional needs of their parents, for example by visiting them at regular intervals. However, while it is relatively easy to measure intergenerational transfers in income and the old age material support theory is well founded on the empirical evidence, "companionship" is more difficult to measure. Among the relevant empirical evidence, Cunningham et al. (2013) find that parents who invested in more schooling for their children receives more assistance with domestic chores when old. Interestingly, they find no evidence of an effect of investment in children education on economic assistance: more educated children were not more likely to act as a primary source of income for aged parents or to give gifts to them. Hence, focusing on caring or companionship as a type of old age support, the expected utility function of an adult agent born in period t is described by:

$$U^t = \ln c^t + \beta \ln n^t + \delta \pi^t \ln h^{t+1} \tag{1}$$

where c^t is adult consumption, n^t is the number of children, π^t is the probability of surviving to the third period, h^{t+1} is the human capital level of an agent's children and $\delta \in (0,1)$ denotes the discount factor. This utility function is similar to Moav (2005): child quantity and child quality, in the form of children's human capital, enter the utility function with the difference that in our model the relative weight given to the latter depends on expected longevity. For simplicity, as in Hazan and Berdungo (2002), we assume that an individual consumes only in one period (when young adult).

Each young adult is endowed with an amount of human capital, h^t, which determines, in a one-to-one way, the agent's labour productivity. This level of human capital is partly inherited from her parent and partly the result of educational time investment during childhood, $e^{t-1} = 1 - l^{t-1}$, where l^t is the fraction of time spent on the labour market by each child, decided by the parent. In particular, to keep the analysis simple and without loss of generality, we assume that

$$h^t = A(h^{t-1})^{\gamma}(e^{t-1})^{\alpha} \tag{2}$$

where $A > 0$ and $\gamma, \alpha \in (0,1)$. The consumption level of a generation-t adult agent with human capital h^t is

$$c^t = (1 - qn^t + n^t l^t \theta) w h^t \tag{3}$$

where $\theta < 1$ reflects the lower labour productivity of children with respect to adults, $q > 0$ is the child rearing cost, a fixed proportion of an adult income, and w is the effective wage determined at the world level (we use a standard small open economy assumption). An optimizing agent maximizes the utility function (1) with respect to e^t and n^t subject to (2) and (3). As in Strulik (2004), we assume away a pure Malthusian drive for reproduction, i.e. parents never want to have children for monetary reasons, hence $q > \theta$. The optimal decision derived from the first order conditions is the following:

$$e^t = \frac{(q-\theta)\delta\alpha\pi^t}{\theta(\beta - \delta\alpha\pi^t)} \tag{4}$$

$$n^t = \frac{\beta - \delta\alpha\pi^t}{(q-\theta)\beta} \tag{5}$$

To prevent an explicit discussion of the corner solution for $l^t = 0$ we assume that $\beta > \frac{\delta\alpha q}{\theta}$. It follows that e^t increases monotonically in π^t while the opposite holds for n^t. Hence fertility falls when longevity increases, consistently with a stylized fact of the demographic transition, and human capital increases with longevity while child labour falls. Finally, note that, as expected, the childrearing cost, q, and the parameter α in the human capital function affect negatively the number of children and positively education. The parameter α can reflect the school quality, if this is higher then parents find it more convenient to educate their children thus reducing child labour.

2.1 Endogenous Adult Longevity

We now turn to the specification of one important feature of our model: the endogenous determination of the survival probability, π. Like in many other papers in the literature, we assume that longevity depends on human capital. This assumption is in line with a large body of empirical evidence recently surveyed by Cutler et al. (2006). This literature finds that the amount of human capital available in society is an important determinant of longevity[1]. Also, it finds that schooling, more than income, improves the health of the population via the provision of general human capital that plays a role in maintaining and improving health in various circumstances.

In particular, we initially assume, like other papers in the literature such as Tamura (2006), that the longevity of generation t depends on the average human capital level of that generation[2]. That is,

$$\pi^t = \pi\left(\overline{h}^t\right) \tag{6}$$

where $\overline{h}^t$ is the average level of human capital of generation t, with $\pi'(.) > 0$, $\pi(0) = \underline{\pi}$ and $\lim_{\overline{h}->\infty} \pi\left(\overline{h}\right) = \overline{\pi} \leq 1$.

Note that in equilibrium $\overline{h}^t = h^t$ and that the equilibrium paths for e^t, n^t, π^t, follow from the solution to the above problem, (6) and $\overline{h}^t = h^t$.

3. Dynamics

The key to generating growth in our economy is the human capital accumulation function which can be derived from (2) and (4) to obtain

$$h^{t+1} = A\left(\frac{(q-\theta)\delta\alpha\pi^t}{\theta(\beta - \delta\alpha\pi^t)}\right)^{\alpha} (h^t)^{\gamma} \tag{7}$$

Then, if in equilibrium $\pi^t = \pi\left(h^t\right)$, the expression above defines a transition function $h^{t+1} = H(h^t)$ with $H' > 0$ and possible multiple development regimes according to the concavity of the longevity function. Suppose for example that longevity takes the form of a simple step function:

$$\pi(h^t) = \begin{matrix} \overline{\pi} & \text{if } h^t \geqslant \widetilde{h} \\ \underline{\pi} & \text{if } h^t < \widetilde{h} \end{matrix} \tag{8}$$

Then, as represented in Fig. 1, a possible outcome is the existence of a steady state, h^* toward which the economy will converge regardless of the initial human capital, and hence longevity, if $\widetilde{h}$ is low enough. Another possibility, when $\widetilde{h}$ is sufficiently high, is that there are two steady states, one with high human capital, high longevity and low child labour, $\overline{h}^*$, and another with low human capital, low longevity and high child labour, $\underline{h}^*$. In this case, an economy with low initial human capital will converge to the development trap. Within each regime, the model dynamics resemble the key

[1]There are also many studies arguing for a causality running in the opposite direction, from adult longevity to education. The literature which has explored this issue theoretically includes Ben-Porath (1967), Kalemli-Ozcan et al. (2000) and Soares (2005).

[2]We could also assume that longevity depends additionally on personal human capital. However, while this assumption would complicate the analysis, it would not change our main result as long as average human capital affects longevity. In addition Tamura (2006) considers international spillovers of human capital (for example the discovery of new vaccines in one country benefits other countries as well).

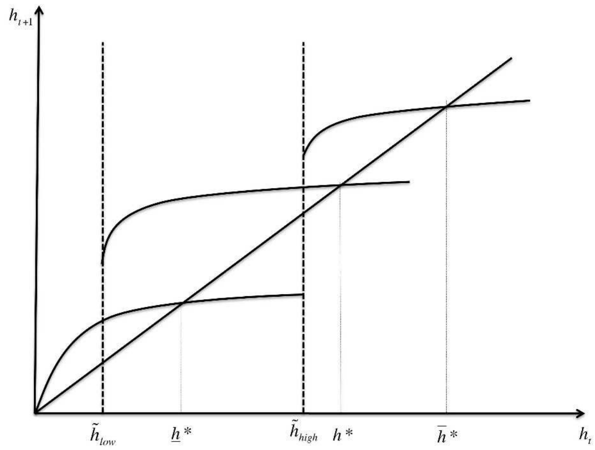

Figure 1: Multiple development regimes

features of the demographic transition. The increase in educational attainments evolves endogenously with an increase in longevity and a fall in fertility, while child labour also declines. Note, also, that the model can produce the hump-shaped profile of net fertility during the demographic transition, a well-established fact for most countries. This can easily be seen from Eq. 5, once net fertility is computed as the product of the fertility rate with the probability of survival[3].

Clearly, public policies in this model can play an important role towards the reduction of child labour. If longevity can be affected by the public investment in health, then such an investment will have a direct impact on the returns on investment in child schooling and hence decrease child labour. Similarly, if improvements in life expectancy come as a result of international spillovers from health investments and R&D.

4. Child Mortality

As mentioned in the Introduction, a number of papers in the literature have studied the role of child mortality on child labour. The main result of this literature is that child labour is affected by the returns to education, which depend on child mortality.

In this Section we present a model along the lines of the "companionship" model studied before, where the focus is on child mortality as opposed to adult mortality (which we now assume as exogenous and equal to δ for simplicity). Let us assume that the utility function takes the form

$$U^t = \ln c^t + \beta \ln n^t + \delta \pi^{t+1} \ln h^{t+1} \tag{9}$$

where $\pi^{t+1} = \pi\left(\overline{h}^{t+1}\right)$ is the probability that a child survives and become an adult, function of the average human capital of her generation. In this setting children provide

[3]We thank an anonymous referee of this Journal for pointing this out.

care to their aged parents like before, but they face a risk of dying young. As a result, we have a model with indeterminacy: if adult agents expect a high level of average human capital and hence low child mortality, they may invest more in their children's quality, thus fulfilling expectations.

The following example illustrates this case. Suppose that human capital of the current adult generation is h^0 and the longevity function takes the form of a simple step function like in (8) where now, in equilibrium, $\pi^{t+1} = \pi\left(h^{t+1}\right)$. Assume that

$$\left(\frac{\widetilde{h}\left[\theta(\beta - \delta\alpha\underline{\pi})\right]^{\alpha}}{A(q-\theta)^{\alpha}(\delta\alpha\underline{\pi})^{\alpha}}\right)^{\frac{1}{\gamma}} > h^0 \geq \left(\frac{\widetilde{h}\left[\theta(\beta - \delta\alpha\overline{\pi})\right]^{\alpha}}{A(q-\theta)^{\alpha}(\delta\alpha\overline{\pi})^{\alpha}}\right)^{\frac{1}{\gamma}}$$

Then, if parents expect that their children's longevity will be $\overline{\pi}$, they will choose child labour so that their children's human capital will be $h^1 \geq \widetilde{h}$, thus fulfilling expectations. Similarly, if expectations are lower, $\underline{\pi}$, we have $h^1 < \widetilde{h}$, again fulfilling expectations.

In other words, the model can give rise to a self-fulfilling prophecy equilibrium: if young adults expect a high level of average human capital of their children's generation, i.e. a low level of child mortality, then they will invest in their children's quality, thus fulfilling expectations. This type of result is relatively new to the child labour literature. In fact, only an interesting recent paper by Emerson and Knabb (2013) displays a dynamics with self-fulfilling expectations in a child labour model. In their model parents are boundedly rational when forecasting the returns to education of their children, since they use their own experience as a guide: if their own return to education was low, they expect the same for their children.

In our model parents perceptions on child mortality and hence expected care in old age (companionship) can affect investment in education, fertility and child labour in a self-fulfilling manner. Changing this perception would be a very important goal for public policies, since coordinating agents expectations on future human capital could result in a low level of child labour in equilibrium.

5. Discussion and conclusions

This paper presents a theoretical analysis of child labour, endogenous demographics and growth. We show that when parents care about the quantity and quality of children and decide upon their education and child labour, endogenous longevity may lead to multiple steady states, with a development trap with high fertility and low education and growth as a possible outcome. Additionally, by introducing endogenous child mortality, the model may display indeterminacy of equilibria. In such an environment, coordinating agents' expectations on human capital will then result in a low level of child labour in equilibrium.

Before we discuss the policy implications of this model, let us consider the empirical evidence on the relationship between children's education and parental wellbeing in old age. While it is easy to find evidence for the old-age support hypothesis, and a wide literature has studied intergenerational transfers and their evolution alongside the demographic transition, starting with the seminal paper by Caldwell (1976), very few papers have studied the non income type of old-age support that Ehrlich and Lui (1991) called "companionship" and its relationship with education. Among these papers, Torssander

(2013), using Swedish data, finds that children's education matters for their parents' health and longevity. Similarly, Zimmer et al. (2005) for Taiwan and Friedman and Mare (2010) for the United States. The reasons for the association between children's education and parental health and mortality risk are well discusses by Torssander (2013) that recalls the findings of the social network theories (see, for example, Berkman and Glass, 2000). Firstly, the provision of social support, especially in the form of informational support. In this respect, a more educated child could provide better health-related advice. For example they can teach their parents how to make good use of the available health care and technologies. Another pathway is social influence: when children are more educated than their parents, they might inspire in their parents the adoption of health-related behaviour.

These channels, through which children's education affect parental health and mortality, are obviously stronger in case of co-residence of adult children and their parents, as in traditional societies. However, it is nevertheless the case that adult children are an important part of their elderly parents' social network even if they live far apart. Also, whilst in all these papers the main focus is on the effects of children education on parents' longevity, they indirectly provide evidence for the companionship type of old-age support that we introduce in the utility function as a function of children's education.

In this light, the results of our first model point to the importance of public investment in health to trigger parental educational investment and the corresponding decrease in chid labour. In fact, public health investments increase adult longevity and therefore increase parental spending on children's education, which will then benefit aged parents.

In the second model, the focus is on child mortality. Given the role of children education on parental wellbeing discusses above, in the context of a poor country where child mortality is an important phenomenon, expected child mortality influences the return from educational investment when old. Hence coordinating expectations on lower levels of child mortality would in fact ensure a higher level of educational investment, low child labour and low realized child mortality in a self-fulfilling manner. In this context, public investment in child health could drive the economy towards a good equilibrium.

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