

FISCAL POLICY, EXPECTATION TRAPS, AND CHILD LABOR

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This paper develops a dynamic model with overlapping generations where there are two possible equilibria: one without child labor, and one with it. It is shown that intergenerational transfers can eliminate the child labor equilibrium and that this intervention is Pareto improving. However, if society does not believe that the government will implement the transfer program, it won't, reinforcing society's expectations. This is true even if the transfer program would have been implemented in the absence of uncertainty. Thus a government may be powerless to prevent the child labor equilibrium if it does not command the confidence of their populace, leaving the country in an expectations trap. (JEL D91, E60, J20, O20)

I. INTRODUCTION

Child labor is widespread in the contemporary world. In fact, the International Labor Organization (ILO) estimates that 246 million of the world's children aged 5–17, or 16%, are child laborers, most living in developing countries.¹ Recently, there has been renewed interest in this topic among economists, which has led to a series of theoretical studies with the aim of better understanding the causes and consequences of child labor in order to help guide appropriate policy responses, as in Grootaert and Kanbur (1995), Basu (1999), and Basu and Tzannatos (2003 for useful literature surveys).

Typically, theoretical models designed to address the important policy issues surrounding child labor posit that a family's decision to send a child to the labor market is taken only

as a last resort in order to escape the dire consequences of poverty, for example, Basu and Van (1998). Baland and Robinson (2000) show that this response on the part of the family may be stronger in a dynamic setting because contracts between children and adults are not self-enforcing, and capital markets are incomplete.² In this case, an adult decision-maker may not only send their children to work to escape poverty in the present, but do so to escape poverty in the future as well. This decision will hinder a child's ability to accumulate human capital and can lead to persistent cycles of poverty and child labor across generations.³

We begin by showing that a benevolent government can address the incidence of child labor that results from the non-enforceability of intergenerational contracts and incomplete capital markets through the appropriate use of fiscal policy and that this policy is Pareto improving. It is then shown that if society's confidence in their government is incomplete, this lack of confidence can render the same fiscal policy ineffective. In other words, if households do not believe that the government will follow through on their policy promise, then in fact, it is quite possible that the government will not be able to follow through on their

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1. ILO (2002), this is including the 15–17 age group. The figure excluding these children is 186 million. Child labor was also common in developed countries until fairly recently as in, for example, Kruse and Mahony (2000).

2. Other dynamic models studying child labor include Emerson and Knabb (2006), Dessy and Pallage (2005), Rogers and Swinnerton (2004), Emerson and Souza (2003), Bell and Gersbach (2001), Lopez-Calva and Miyamoto (2004), Ranjan (2001), Hazan and Berdugo (2002), and Jafarey and Lahiri (2002).

3. See Emerson and Souza (2003) and Wahba (2002) for the empirical support of child labor persistence.

promise as a result of these beliefs.⁴ This self-reinforcing nature of fiscal policy in the presence of uncertainty can leave a country in an *expectations trap* with a low level of human capital and child labor.⁵

To formally demonstrate this fiscal policy expectations trap hypothesis, we employ a three-period overlapping generations model in which child labor exists.⁶ This stylized setup will keep the dynamics manageable and allow us to highlight the effects of uncertainty. Also, within this framework we introduce a missing intergenerational contracts market, in conjunction with a human-capital production function that exhibits a threshold with respect to parental human capital, which gives rise to two locally stable steady states. There is a “good” equilibrium where there is a relatively high level of parental human capital, which results in a high level of income and no child labor, and there is a “bad” equilibrium where there is a relatively low level of parental human capital, which results in a low level of income and positive child labor. This low income–child labor equilibrium is the standard poverty trap scenario that typically exists in a deterministic economy with multiple equilibria.

It is then shown that a benevolent government can replicate the missing intergenerational contracts market with a pay-as-you-go social security program, thereby eliminating this component of child labor in an economy with perfect foresight. In addition, it is also shown that this policy is Pareto improving in the sense that all generations are strictly better off under this policy, except the initial old who are no worse off.

4. Rodrik (1989) uses a similar line of reasoning to demonstrate that expectations can affect the optimal design of trade policy reforms. Rodrik (1991) demonstrates that uncertainty can also affect (international) capital flows in a developing country context.

5. It is important to distinguish the arguments made in this paper from those made in the time-consistency literature established by Kydland and Prescott (1977), Calvo (1978), and Fischer (1980). We argue that it is the *perception* of uncertainty by households that potentially renders a Pareto-improving policy ineffective in a time-consistent framework. In other words, the government’s optimal decision rule is independent of time in our current setup but now depends on the households’ *perception* of the government’s willingness or ability to implement the program.

6. Typically, expectation traps are discussed in the context of monetary economies. For monetary applications see Albanesi, Chari, and Christiano (2003), Chari, Christiano, and Eichenbaum (1998), and Weil (1987). Also see Cole and Kehoe (2000) for an application to sovereign debt.

The dynamics of this social security program are intuitive: If child labor is one possible mechanism adults can use to redistribute resources from their children, then the government can reduce this incentive by announcing a social security program that will begin during the current adults’ old age (an institutional intergenerational contract). If society has complete faith in their government, that is, there is no uncertainty, then this policy results in a deterministic increase in lifetime wealth for the initial working generation. Thus, the adults of this generation will no longer need to use their children’s labor to supplement current consumption and savings for future consumption. The subsequent reduction in child labor that results from this increase in lifetime wealth also increases the child’s education, which in turn increases the child’s human capital, potentially setting off a chain of events that allows the household and/or country to escape from the poverty trap. A similar argument is put forth in Hazan and Berdugo (2002) and Becker and Murphy (1988) when agents have perfect foresight and the government’s intentions are common knowledge.⁷

The success of this intergenerational redistribution program, however, rests critically on its ability to change people’s behavior *in anticipation* of receiving the benefit. In developing countries, where there may be a high degree of uncertainty surrounding the stability and intentions of the government, the above results may not carry over to a more realistic setting that takes this uncertainty into account.⁸ To

7. Becker and Murphy (1988) discuss and Hazan and Berdugo (2002) formalize the idea that an intergenerational transfer program, along with the *regulation* of the child labor market (mandatory schooling or the banning of child labor), may be Pareto improving in a perfect foresight economy. Although the purpose of this paper is to address uncertainty and the concept of an expectations trap by building on Hazan and Berdugo (2002), our deterministic model differs from their paper in the following ways. First, we show that regulation of child labor is unnecessary with an appropriately designed intergenerational transfer program. Second, we show that under reasonable conditions the transfer program must continue indefinitely. The reason for these differences is that Hazan and Berdugo (2002) consider a three-period model with consumption in the last period only, which forces complete savings on the agent during their primary working years. We relax this assumption and consider an endogenous savings model.

8. Even in more stable democratic countries, uncertainty necessarily exists over long-term policies and programs due to the regularly changing leadership of the government. The United States and its Social Security program is an example.

formally demonstrate this possibility, we add a specific form of uncertainty to the model. We assume that society's confidence in the government is a function of the degree to which society 'trusts' their government.⁹ We argue that if society is not confident that their government will actually provide the promised transfers in the future, as a result of their fundamental lack of trust in the government, then these households do not increase the amount of time their children spend receiving an education by pulling them out of the child labor market. As a result, the child's income is insufficient to fund the promised pay-as-you-go public pension program causing the program to fail or not be implemented. Thus, society's lack of confidence in their government can, in fact, cause the Pareto-improving redistribution policy to fail, which would have otherwise eliminated the poverty trap, leaving the country in an expectations trap.

As an initial point of reference, the household's level of confidence in their government in our stylized setting might arise from a number of sources. It could be due to a history of governmental failure or, perhaps, a new reformist government may have come into power, but a part of the population is not confident that it is indeed committed to reforms—or it could simply be that the level of confidence is due to purely extrinsic factors and unrelated to the current fundamentals of the economy as in, for example, Azariadis (1981), Cass and Shell (1983), Weil (1987), and Farmer (1999). Regardless of the interpretation, this paper demonstrates that there exists a minimum level of confidence in government that is necessary for the Pareto-improving program to be successful. If the level of confidence is below this minimum, then a benevolent government will not be able to implement the Pareto-improving policy, *even though* it would have in an environment with no uncertainty. It is in this sense that the model generates an endogenous expectations trap that is self-reinforcing in nature.

The rest of the paper proceeds as follows: Section II presents the benchmark model of human-capital accumulation and child labor.

9. Trust here is used in a very general sense: It represents society's subjective beliefs or underlying faith in the intentions, stability, and ability to follow through on long-term promises. Zak and Knack (2001) provide a theoretical foundation of how trust can affect growth and development, with some empirical evidence.

Section III demonstrates that a pay-as-you-go social security program can eliminate the 'bad' equilibrium with child labor in a perfect foresight economy. Section IV adds uncertainty to the model and demonstrates the existence of a minimum level of confidence in government. Section V reviews some empirical evidence and Section VI summarizes the main findings of the paper.

II. THE BASIC MODEL

The model consists of an infinite sequence of identical overlapping generations living for three periods, where a household is defined as one child and one working age adult. The last period of life is spent outside the household, thus the working age adults have no filial responsibility to their elders.¹⁰ The population is constant and each generation is normalized to unity. These simplifying demographic assumptions allow us to concentrate on the key issue of the paper: the dynamic interaction between education, child labor, government policy, and society's confidence in their government. In addition, a credit constraint makes it impossible for the adult to borrow against any future redistribution from the government. Thus, household savings must be nonnegative because of the identical household assumption. Finally, a missing intergenerational contracts market makes it impossible to enter into a contract with the child of the household to finance the child's education.

In the first period of life the child receives an education and may work in the labor market. If the child participates in the labor market, he or she earns an adult equivalent $a \in [0, 1]$ for physical labor only. Thus, a child is endowed with no human capital. The decision to educate the child, $e \in [0, 1]$, or have the child participate in the labor market, $(1 - e) \in [0, 1]$, is made by the child's parent. In the second period of life, the adult supplies human capital $h \geq 0$ and one unit of physical labor to the labor market, has one child, and saves $s \geq 0$ for old age consumption. Finally in the last period of life the adult consumes his or her

10. This problem may be overcome if there exists a sufficient degree of reverse altruism or some sort of social norm of filial obligation on the part of the children as in Lopez-Calva and Miyamoto (2004), although allowing some reverse altruism would not change our main results.

savings plus interest, where the gross return is $R > 1$.¹¹

Thus, the representative adult of generation $t - 1$ maximizes household utility,

$$(1a) \quad U(c_t^W, c_{t+1}^R, h_{t+1}) = \alpha_1 \ln c_t^W + \alpha_2 \ln c_{t+1}^R + \alpha_3 \ln h_{t+1},$$

subject to the following constraints:¹²

$$(2a) \quad c_t^W + s_t = (1 + h_t) + a(1 - e_t)$$

$$(3a) \quad c_{t+1}^R = R s_t$$

$$(4) \quad h_{t+1} = H(h_t) e_t.$$

The parameters $\alpha_i \in (0, 1)$, $i = 1, 2, 3$ assign different weights to consumption utility during the working years, c_t^W , consumption utility during old age, c_{t+1}^R , and the utility the parent derives from the child's human capital, h_{t+1} , which is produced using the education technology described in equation (4). This form of paternalistic altruism implies that the parent cares about the child's potential for success.¹³ We also impose the restriction $\alpha_1 + \alpha_2 + \alpha_3 = 1$ on the preference parameters. Finally, we employ a number/letter convention to distinguish between the equations that change because of government policy or a change in assumptions throughout the paper.

The solution to the household's problem results in the following optimal linear expenditure system, where a household allocates a proportional amount of total *potential*

income, $1 + h_t + a$, to consumption in both periods of life, and the child's education:

$$(5a) \quad c_t^W = \alpha_1(1 + h_t + a)$$

$$(6a) \quad c_{t+1}^R = R\alpha_2(1 + h_t + a)$$

$$(7a) \quad e_t = \min \{(\alpha_3/a)(1 + h_t + a), 1\}.$$

The key equation here, equation (7a), demonstrates that there is a positive relationship between the time a child spends receiving an education and parental human capital (income). Thus, children in poorer households will spend more time in the labor market. Also, note that the savings constraint $s_t \geq 0$ does not bind in the current setting (without government) because old age consumption depends on savings alone.

The household's optimal education-child labor decision (7a), in conjunction with the education technology (4), describes the dynamic behavior of human capital across generations:

$$(8a) \quad h_{t+1} = H(h_t) \min \{\alpha_3(1 + a)/a + (\alpha_3/a)h_t, 1\}.$$

For analytical purposes, we assume $H(h_t)$ takes the form of a threshold step-function:

$$(9) \quad H(h_t) = \begin{cases} 1 & \text{iff } h_t < \eta \\ A & \text{iff } h_t \geq \eta \end{cases}$$

This equation implies that there exists a parental human-capital threshold in the education technology. In addition, once we condition on the parent's level of human capital the education technology becomes linear with respect to the time the child spends receiving an education.¹⁴ This modeling strategy is similar to the one taken by Azariadis and Drazen (1990), the seminal paper on thresholds and development, and the recent work of Moav (2005). In particular, Azariadis and Drazen (1990) motivate this argument by suggesting that once society reaches a given level of knowledge it becomes easier to acquire future knowledge, causes a relatively large increase in

11. Savings in our model does not necessarily include (or exclude) financial assets in the form of stocks and bonds. In developing countries with weak, or possibly absent, financial markets, savings will more than likely take on different forms. As an example, a father may maintain his family land holdings by investing his own time and potentially his child's.

12. The consumption constraints are consistent with either a linear technology as in Baland and Robinson (2000) and Hansson and Stuart (1989) or a small open-economy framework.

13. This paternalistic form altruism appears to have more empirical support than the nonpaternalistic form as in Altonji, Hayashi, and Kotlikoff (1992, 1997). In addition, this form of altruism is implicitly employed by Baland and Robinson (2000), since they restrict their analysis to a single generation. Finally, Galor and Zeira (1993), Galor and Weil (1996), Glomm (1997), and Moav (2005) employ a similar modeling strategy.

14. We thank a referee for helping us clarify this point.

production possibilities, or allows societies to implement education technologies with higher start-up costs and higher returns. Moav (2005), on the other hand, motivates a similar argument by suggesting that parental human capital *directly* increase the parent's ability to provide household education. In other words, better-educated parents can provide their children with better educations. We refer the interested reader to Moav (2005), which provides an excellent overview of the empirical research supporting this relationship between parental human capital and child development. In either case this simplifying assumption, the parental human-capital threshold, allows us to concentrate our attention on the key issue of the paper: the relative importance of government credibility, or society's trust in their government, when a Pareto-improving dynamic fiscal policy is present in the economy.

Next, by combining the threshold function (9) and the dynamic human-capital accumulation function (8a) we have the following first-order difference equation on opposite sides of the threshold η :

$$(10a) \quad h_{t+1} = \begin{cases} \min \{ \alpha_3(1+a)/a + (\alpha_3/a)h_t, 1 \} & \text{iff } h_t < \eta \text{ for all } t \\ A \min \{ \alpha_3(1+a)/a + (\alpha_3/a)h_t, 1 \} & \text{iff } h_t \geq \eta \text{ for any } t \end{cases}$$

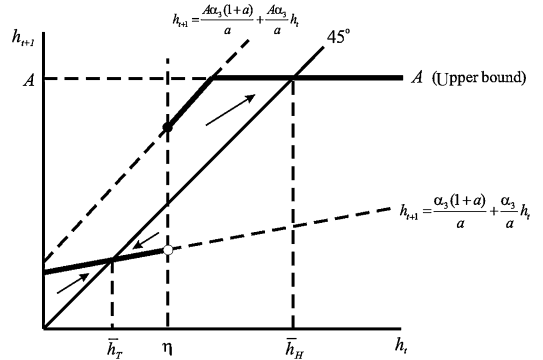
The steady states for these equilibrium paths are

$$(11a) \quad \bar{h} = \begin{cases} \bar{h}_T = \alpha_3(1+a)/(a-\alpha_3) & \text{iff } h_t < \eta \text{ for all } t \\ \bar{h}_H = A & \text{iff } h_t \geq \eta \text{ for any } t \end{cases}$$

To generate positive child labor in the low equilibrium, $\bar{e}_T \in (0, 1)$, let $\alpha_3(1+a) < a - \alpha_3$, which implies that $\min\{\cdot\}$ is interior. This assumption also implies stability, $\alpha_3 < a$. Next, to ensure that child labor is zero in the high-income equilibrium, $\bar{e}_H = 1$, let $A\alpha_3 > a$. For this case $\min\{\cdot\} = 1$ once the upper bound of education (time) is reached, $\bar{e}_H = 1$. An interior solution holds otherwise.

These dynamic properties are shown in Figure 1. For the case where initial parental human capital is below the threshold value $h_0 < \eta$ the economy converges to the low

FIGURE 1
Human Capital Dynamics in a Deterministic Setting



human-capital equilibrium \bar{h}_T ('T' denotes Trap), since $\alpha_3/a < 1$. For the case where initial human capital is above or equal to the threshold value, $h_0 \geq \eta$, the economy converges to the high human-capital equilibrium $\bar{h}_H = A$ ('H' denotes High). This follows from the assumption, $A\alpha_3/a > 1$, which implies divergence, and the fact that human capital is

bounded from above at $A > 1$. An economy that follows this human-capital trajectory will reach the upper bound in finite time and remain there in perpetuity. The (bold) horizontal line in Figure 1, at the value A , represents the continual mapping back to this upper bound once it is reached.

Based on these dynamics, along with the following assumption pertaining to the location of the threshold,

ASSUMPTION 2.1. *The threshold value lies in the interval $\eta \in [\bar{h}_T, \bar{h}_H]$.*

We have the key proposition and corollary in our stylized economy without government.

PROPOSITION 2.1. *A country with an initial level of parental human capital below the threshold value η monotonically converges to the low human-capital equilibrium \bar{h}_T . A country with an initial level of human capital above*

or equal to the threshold value η monotonically converges to the high human-capital equilibrium \bar{h}_H .¹⁵

This proposition demonstrates that an initially poor country will remain poor and an initially wealthy country will remain wealthy.

COROLLARY 2.1. *A country with an initial level of parental human capital below the threshold value monotonically converges to the positive child labor equilibrium. A country with an initial level of human capital above or equal to the threshold value monotonically converges to the no child labor equilibrium.*

This corollary demonstrates that child labor will persist if parental human capital is too low and will disappear over time if parental human capital is sufficiently high. Also note that these dynamics do not depend on the standard under-investment in education argument or coordination failure stories as in, for example, Dessy and Pallage (2001) and Dessy and Vencatachellum (2003) that typically rely on increasing returns to the time a child spends receiving an education. Poor households may fully internalize the human-capital externality, but the missing intergenerational contracts market and poverty causes them to optimally choose a lower level of education for their children with positive child labor.

III. THE MODEL WITH GOVERNMENT INTERGENERATIONAL TRANSFERS (FUNDAMENTALS)

Given that there are two possible steady states and dynamic paths an economy can follow, the question arises: what, if anything, can the government do to move a country out of the poverty trap? This section demonstrates that when the economy is completely determined by fundamentals, that is, preferences, income (human capital), and technology, the government can announce a pay-as-you-go social security program (a public pension system) that will begin transferring resources from next period's working generation to next period's old generation. This form of public pension program replicates the missing intergenerational contracts market, thus moving

15. The formal proofs for all the propositions in the paper are in the appendix.

the economy out of the poverty trap. Intuitively, the announcement of future transfers reduces the current working generation's need to save for old age as in Feldstein (1974) freeing up lifetime resources for current consumption and the child's education. If this increase in lifetime wealth is large enough, the social security program can generate a critical mass of human capital that allows the economy to escape from poverty.¹⁶ It is also important to note that in this section of the paper we assume complete knowledge. This implies that there is no uncertainty and society is completely confident that their government will follow through on their policy promise.

A. Escaping the Poverty Trap

The only role for government is to introduce and manage the social security program using lump-sum transfers and taxes to operate the system. Thus, we abstract from government purchases and operation costs. We also assume that at time $t = 0$ the government announces a plan to start the pay-as-you-go social security program next period, and the country of interest starts in the low income-child labor steady state \bar{h}_T .

The representative household maximizes the same utility function (1a) subject to the following modified household budget constraints, which now include working period taxes T_t along with social security transfers TR_{t+1} :

$$(2b) \quad c_t^W + s_t = (1 + h_t) + a(1 - e_t) - T_t$$

$$(3b) \quad c_{t+1}^R = R s_t + TR_{t+1}$$

This results in an optimal linear expenditure system that includes intergenerational redistribution:

$$(5b) \quad c_t^W = \alpha_1 [1 + h_t + a + ((TR_{t+1}/R) - T_t)]$$

16. There are many other policy mechanisms that could accomplish this same redistribution across generations, such as issuing vouchers (pieces of paper) to the current working generation redeemable next period, or announcing the future issuance of debt to redistribute resources next period. We focus on social security for expositional reasons and because it replicates any other lump-sum intergenerational transfer scheme in our current deterministic environment.

$$(6b) \quad c_{t+1}^R = R\alpha_2[1 + h_t + a + ((TR_{t+1}/R) - T_t)]$$

$$(7b) \quad e_t = (\alpha_3/a)[1 + h_t + a + ((TR_{t+1}/R) - T_t)]$$

The only difference between this system of equations and the system of equations without the government is that the household now allocates any net resources (or net losses) the program generates toward consumption and the child's education. Also, for the moment we once again assume the nonnegativity constraint on savings is not binding. Finally, for notational convenience we drop the $\min\{\cdot\}$ notation from equation (7b) and throughout the rest of the paper. However, it is important to remember that a complete education or no child labor equilibrium is, in fact, a corner or upper bound solution.

The dynamic behavior of human capital for future generations receiving benefits and paying taxes, $t \geq 1$, are also similar to those in the previous section with the following modifications.

$$(10b) \quad h_{t+1} = \begin{cases} (\alpha_3/a)[1 + a - (r/R)TR] + (\alpha_3/a)h_t & \text{iff } h_t < \eta \text{ for all } t \\ (A\alpha_3/a)[1 + a - (r/R)TR] + (A\alpha_3/a)h_t & \text{iff } h_t \geq \eta \text{ for any } t \end{cases}$$

The steady states for these equilibrium paths are

$$(11b) \quad \bar{h} = \begin{cases} \bar{h}_T = (\alpha_3/(a - \alpha_3))[1 + a - (r/R)TR] & \text{iff } h_t < \eta \text{ for all } t \\ \bar{h}_H = A & \text{iff } h_t \geq \eta \text{ for any } t \end{cases}$$

Equations (10b) and (11b) assume the tax and transfer program is constant across generations, $TR = T$. We will justify this constant tax and transfer assumption shortly. A key property of equation (11b), which we use later when discussing the Pareto-improving policy, is that the poverty trap steady state under the tax and transfer program is lower than the 'no policy' poverty trap steady state, shown in equation (11a), since the parameter $r = R - 1 > 0$ (net return on savings).

The current working generation, $t = 0$, receives only benefits, which alters their optimal decision. The consumption profile for this initial generation, assuming the economy is initially in the poverty trap steady state without transfer \bar{h}_T , is as follows, $c_0^W = \alpha_1[1 + \bar{h}_T + a + (TR/R)]$ and $c_1^R = R\alpha_2[1 + \bar{h}_T + a +$

$(TR/R)]$. The current amount of time the child spends receiving an education under the same assumption is,

$$(7c) \quad e_0(TR) = (\alpha_3/a)[1 + \bar{h}_T + a + (TR/R)].$$

The combination of equation (7c), the education choice made by the initial generation benefiting from the government transfer program, and equation (4) describes the initial change in human capital following the announcement of the public pension program:

$$(12) \quad h_1(TR) = e_0(TR) = \underbrace{[\alpha_3(1+a)/(a - \alpha_3)]}_{\bar{h}_T} + (\alpha_3/Ra)TR.$$

This equation shows that when $TR = 0$ human capital is mapped directly back to the low income-child labor equilibrium. More importantly, if $TR > 0$, equation (12) shows that the amount of time a child spends receiving an education will increase and the amount of time the child spends in the labor market will

decrease, thus increasing the child's human capital.

If the promise of a social security transfer to the current working generation is large enough to increase the child's human capital, so that $h_1(TR) \geq \eta$, the country can escape from poverty. But before we can determine the actual size of the transfer necessary to move the economy out of poverty, and to achieve the critical mass of human capital, $h_1(TR) = \eta$, we must formally define the threshold value.

ASSUMPTION 3.1. *Let the threshold value equal a weighted average of the two steady states, $\eta = \theta\bar{h}_T + (1 - \theta)\bar{h}_H$, where $\theta \in [0, 1]$.*

The necessary size of the transfer can now be found by equating equation (12) with the

threshold value defined in Assumption 3.1, $\eta = \theta \bar{h}_T + (1 - \theta) \bar{h}_H$, and then solving for TR .

$$(13) \quad TR^* = (Ra/\alpha_3)(1 - \theta)(\bar{h}_H - \bar{h}_T).$$

Equation (13) shows that the size of the transfer necessary to reach the critical mass of human capital η is increasing in the productivity of the child, the less weight a parent assigns to the child's human capital, the closer the threshold value is to the high income–no child labor steady state (the closer θ is to zero), and the gross interest differential between private savings and the social security program (the return from social security is zero because the population is constant). This result is shown in Figure 2. We formalize this argument with the following lemma.

LEMMA 3.1. *There exists an intergenerational transfer TR^* sufficient to induce the current working generation to invest enough resources in their child's education to reach the threshold value η using the pay-as-you-go social security program.*

B. Feasibility of the Social Security Program

When can a government implement such a program? To answer this question, consider the following stylized policy rule where the government behaves benevolently towards its populace.

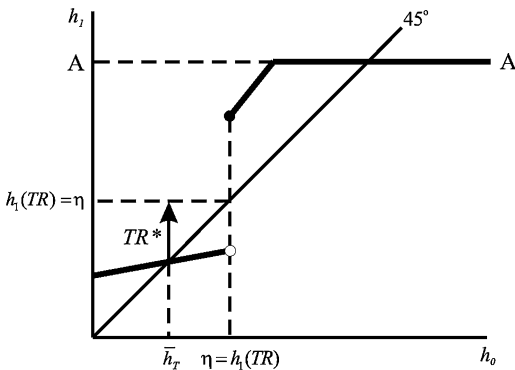
The Government's Policy Rule: (i) Choose the minimum intergenerational transfer necessary to reach the threshold value. (ii) Implement and maintain the intergenerational

transfer program if and only if no generation is made strictly worse off.

The first part of this policy rule imposes the condition that the government chooses the minimum intergenerational transfer necessary to reach the threshold value. A larger transfer would reduce lifetime consumption for future generations relative to what it would have been with a lower transfer, because the net return to savings $r = R - 1 > 0$ is greater than the net return from the social security system under our constant population assumption. Also from equation (10b) and (11b) we can see that anything smaller will eventually return the household to a lower level of human capital in the poverty equilibrium. Thus, the government's policy rule determines a unique and constant transfer TR^* , defined in equation (13) and implies that the government will only implement the program if no generation is made strictly worse off.

This assumption of benevolence on the part of government will allow us to isolate the 'credibility' effect of policy design. In other words, by imposing this (exogenous) benevolence assumption on our stylized economy, we do not allow for any potential political economy effects to influence the outcome. It is important to note that we are not in any way suggesting that political economy effects are unimportant. In fact, we believe that our work complements the political economy literature, in particular the recent paper by Doepke and Zilibotti (2005). This paper suggests that child labor may be the result of a fertility 'lock-in' effect and multiple political economy equilibria. Specifically, unskilled households with a large number of children will not support the implementation of child labor laws because the children bring in a significant part of household income, whereas unskilled households with a small number of children will support child labor laws because the children in the labor market lower the adult wage (child labor and unskilled labor are substitutes in production). Thus, if a majority of unskilled households have large families, child labor and relatively low levels of education attainment may persist across generations. Both of these explanations, the 'credibility effect' and the 'lock-in effect' in a political economy setting, are consistent with the existence and persistence of child labor. These are obviously not mutually exclusive and more than likely coexist in the developing world.

FIGURE 2
Minimal Effective Transfer



Returning to the model at hand, we now determine the specific set of conditions consistent with the feasibility of the program under the policy rule defined above. To accomplish this task we look at each generation sequentially. Obviously, the initial generation is strictly better off since it receives only transfers. The first generation to incur a cost and actually pay taxes T_1 under the program is next period's working generation. This generation also benefits from the program in two ways: First, they receive transfers during their retirement years offsetting some of the tax burden. Second, they receive more education and a higher level of human capital, which increases their earnings during their working years. However, this generation does not directly benefit from the parental human capital externality. Finally, since all future generations do benefit from the parental human capital externality and face the same tax burden under the above policy rule, the transfer program is feasible for all future generations if it is feasible for next period's working generation. Thus, we can use next period's working generation as our feasibility benchmark.

Specifically, the program is feasible under the current parameterization of the economy, and given the government's policy rule, if the following condition is satisfied.

LEMMA 3.2. *The government's social security program is feasible if the non-negativity constraint on savings for the first generation to pay the social security tax is nonbinding.*

This lemma provides us with the following equation.

$$(14) \quad s_1(TR) = \underbrace{\alpha_2(1 + h_1(TR) + a)}_{z(TR)} - \underbrace{((1 + \alpha_2 r)/R)TR}_{g(TR)} \geq 0$$

The logic underlying this lemma is straightforward. First, if the non-negativity constraint on this particular generation $t = 1$ is not binding, then the household can smooth the cost of the tax and transfer program, the working period tax, over both periods of life by reducing savings, as shown in equations (5b) through (7b). Also, with the increase in human capital for this generation, consumption in

both periods of life, c_1^W and c_2^R , will increase and the time allocated to their child's education e_1 will also increase relative to their own education time e_0 (which was sufficient to cross the threshold). This result unambiguously holds as long as the return to human capital is greater than the net present value of the program's cost, $(\alpha_3/a) > r$, an assumption maintained throughout the paper.

On the other hand, if the non-negativity constraint on savings is binding, then consumption during old age is restricted to the transfer value, $c_1^R = TR$, and current consumption must fall one-for-one with any additional social security tax levy. Since households would like to borrow against this future government transfer but cannot given the credit constraint, they instead use child labor to smooth income over time because of the missing intergenerational contracts market. This implies that a household will reduce the amount of time their child spends receiving an education relative to their own time. That is, e_1 now falls relative to e_0 . The fact that the child's education time decreases implies that human capital will once again fall below the threshold if α_3 is low enough.¹⁷ This implies that the economy begins to move back toward the relatively lower poverty trap steady state, and at some point in the future some generation becomes strictly worse off. Thus, this transfer policy is not feasible under the current policy rule.

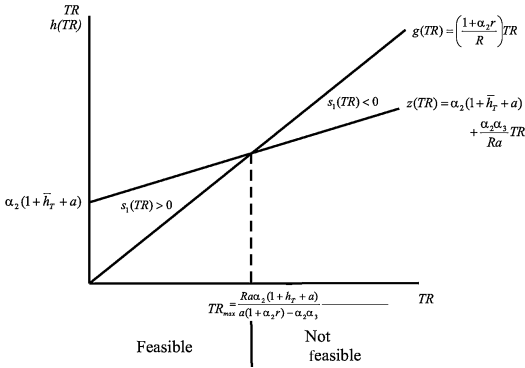
Given Lemma 3.2 and equation (14), we can now formally define the finite upper bound on the size of the transfer. The first part of the savings equation $z(TR)$ measures the positive effect the transfer program has on savings as a result of the increase in income and is shown in Figure 3. The second part of the savings equation $g(TR)$ shows the negative effect the transfer program has on savings as a result of redistribution (timing of lifetime income), which is also shown in Figure 3. The trade-off between these two forces results in the following proposition.

PROPOSITION 3.1. *There exists a positive range of government transfers $TR^* = T^* \in [0, TR_{\max}]$ where the pay-as-you-go social security program is feasible under the defined policy*

17. The specific restriction is $\alpha_3 \leq [a(1 - \alpha_2)(\theta \bar{h}_T + (1 - \theta)\bar{h}_H)]/[A(1 + \bar{h}_T + a)]$. The details defining Lemma 3.2 can be found in the appendix.

FIGURE 3

Feasible and Infeasible Transfers 3: Feasible and Infeasible Transfers



rule. This feasible range has a finite upper bound and equals $TR_{max} = (R\alpha_2(1 + \bar{h}_T + a)) / (a(1 + \alpha_2) - \alpha_2\alpha_3)$, which satisfies the sufficient condition $s_1(TR_{max}) = 0$.

This proposition shows that if $TR^* > TR_{max}$ then the government does not implement the program because next period’s working generation is strictly worse off. If $TR^* \leq TR_{max}$ then the program is feasible and the government does implement the program.

In summary, if the non-negativity savings constraint is not binding for generation $t = 1$, formally if $TR^* \in [0, TR_{max}]$, then a pay-as-you-go social security program can replicate the missing intergenerational contracts market. We will assume that this is the case for the remainder of the paper.

ASSUMPTION 3.2. *If society has complete confidence in their government, implying there is no uncertainty surrounding the government’s true intentions, the necessary size of the transfer lies within the feasible range $TR^* \in [0, TR_{max}]$.*

This assumption imposes program success on our current stylized economy. That is, if the economy’s dynamics are completely determined by fundamentals, then a pay-as-you-go social security program will succeed in moving the economy out of poverty, in a Pareto-improving manner and eliminate child labor in the long run.

Finally, we formally demonstrate that if the policy is feasible for next period’s working generation it is feasible for all future genera-

tions as well. This implies that if $TR^* \leq TR_{max}$ the intergenerational transfer program generates a Pareto-superior outcome.

PROPOSITION 3.2. *If the social security program is feasible, then the current working generation and next period’s working generation are strictly better off under the pay-as-you-go social security program. This implies that all future generations are strictly better off as well. Thus, the social security program is Pareto superior to the no program equilibrium and dynamics.*

Intuitively, as already mentioned, this result holds because human capital and earnings are higher for all future generations, relative to next period’s working generation, because future generations also benefit directly from the externality in the education technology.

C. A Child’s Human Capital and Parental Savings: A Graphical Approach

Before turning to the issue of society’s beliefs and confidence in their government, we first translate our model into the following graphical representation. This approach simplifies the analysis in the next section. The first-order conditions from the household’s optimization problem, with respect to savings s_t and education e_t , are as follows:

$$(15) \quad \alpha_1 / (1 + \bar{h}_T + a(1 - e_0) - s_0) = R\alpha_2 / (Rs_0 + TR)$$

$$(16) \quad a\alpha_1 / (1 + \bar{h}_T + a(1 - e_0) - s_0) = \alpha_3 / e_0.$$

Equation (15) equates the marginal utility loss from an increase in savings (decrease in first-period consumption) to the marginal utility gain from an increase in savings (increase in consumption next period). Equation (15) also shows how an increase in transfers reduces the marginal gain in utility from an additional unit of savings. This reduces the household’s desire to save, freeing up resources for current consumption and the child’s education. Equation (16) equates the marginal loss in utility from an increase in the child’s education with the direct marginal benefit of more human capital.

After eliminating e_0 from (15) using (16) we have

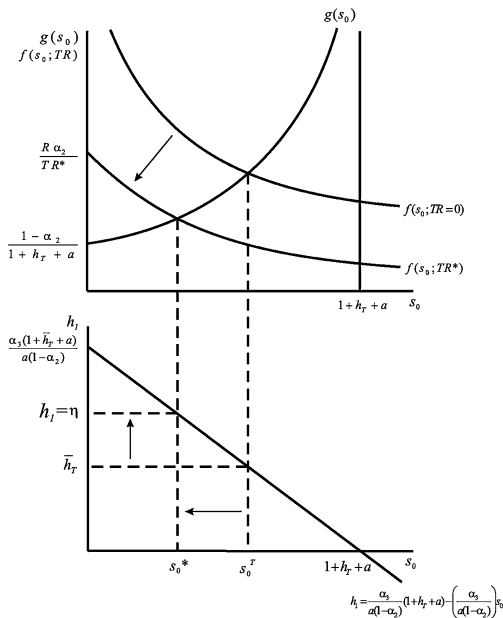
$$\underbrace{(1 - \alpha_2)/(1 + \bar{h}_T + a - s_0)}_{g(s_0)} = \underbrace{R\alpha_2/(Rs_0 + TR)}_{f(s_0; TR)}. \tag{17}$$

Figure 4 shows $g(s_0)$ is an upward-sloping function of the initial working generation's savings and $f(s_0; TR)$ is a downward-sloping function of the initial generation's savings for a given level of social security transfers. If $TR = 0$, the solution is identical to the no government case where $s_0 = \alpha_2(1 + \bar{h}_T + a)$. Using equation (16), after solving for e_0 as a function of s_0 , we can determine the level of human-capital accumulation for next period's working generation following the announcement of the social security program. If the government chooses an initial transfer of TR^* savings will fall, as shown in equation (17). This decrease in savings in response to TR^* increases the human capital of next period's working generation so that $h_1(TR^*) = \eta$, which places the economy in the high income–no child labor equilibrium's basin of attraction.

IV. CONFIDENCE AND THE EFFECTIVENESS OF GOVERNMENT POLICY

If this type of intergenerational redistribution program is feasible and can lead to a Par-

FIGURE 4
The Effect of Transfers on Savings



eto-superior outcome, then why do we not observe its implementation in developing countries? One possible answer, the one we put forth in this paper, is that governments may lack credibility and therefore do not enjoy the confidence of their populace. In the context of the current model, if today's working generation does not believe that the government will follow through on its promise of transfers in the future, they will not respond to the announced policy in the same manner they would have if the economic environment were deterministic. In other words, it is the change in the individual's behavior in *anticipation* of the transfer, rather than the actual transfer itself, that makes the program successful. So, if the transfer is not perceived as certain, the program may fail. This lack of confidence in the government can render the Pareto-improving government transfer program infeasible, leaving a country in an *expectations trap*.

A. Adding Uncertainty to the Stylized Economy

In our framework, the only generation uncertain about the implementation of the social security program is the current working generation. If the government implements the program, the policy continues forever under the government's policy rule, and agents in the model understand this. However, if society's subjective beliefs are such that the program is rendered infeasible, then the government will not implement the program, and the households' initial pessimistic expectations will be reinforced. In this case, the policy will never be implemented. Therefore, society learns if the government will implement the program in a single generation.

To demonstrate that this transfer program can fail as result of the households' lack of confidence in the government, we consider the following modified problem. The household's objective function now takes the following form:

$$\tilde{U}(c_0^W, c_1^R, h_1) = \alpha_1 \ln c_0^W + \alpha_2 E_0 \ln c_1^R + \alpha_3 \ln h_1 \tag{1b}$$

All of the parameters in the utility function are the same as in equation (1), except for the addition of the expectations operator, E_0 . Households in the initial working generation

now form expectations over whether they believe the government will follow through on its promise to implement the social security program. The first-period budget constraint and the education technology for this generation remain unchanged, equations (2), or (2b), with $T_0 = 0$, and equation (4). The budget constraint for the second period is defined by equation (3b) if the transfer program is initiated and (3) if the program is not initiated, which are weighted by society's subjective beliefs accordingly.

B. Confidence in the Government: Policy Success or Failure

For simplicity, we consider two perceived states of nature in our stylized setup. Households believe that the government will implement the program with probability $q(\mu_t, \Omega_t, TR)$ and will not implement the program with probability $1 - q(\mu_t, \Omega_t, TR)$. The time-dependent vector Ω_t describes the country's 'fundamentals' at time t . Along with the standard preference and production parameters, this vector can also include such things as parental income and past parental child labor. The trust parameter, $\mu_t \in [0, 1]$, defines the weight households assign to the economy's fundamentals.

The properties of the continuous function $q(\mu_t, \Omega_t, TR)$, which defines society's level of confidence in their government, are as follows. First, to ensure the probability distribution is well defined, $q(\Omega_t, TR) = 1$ and $q(0, TR) = 0$.¹⁸ That is, when $\mu_t = 1$ society has complete confidence in their government and when $\mu_t = 0$ society has a complete lack of confidence in their government. Second, $\partial q_t / \partial \mu_t = q_\mu(\cdot) > 0$ within the interval $\mu_t \in (0, 1)$. This implies that society's confidence in their government is

an increasing function of trust.¹⁹ Third, $q_\mu(\cdot) \rightarrow N > 0$ as $\mu_t \rightarrow 0$, where N is some positive constant. This property for $q_\mu(\cdot)$ provides a necessary existence condition. Fourth, $\partial q_t / \partial TR_t = q_{TR}(\cdot) < 0$ for all transfers, TR . This implies that as the size of the transfer increases, society's confidence in their government decreases for a given level of trust. Finally, $q_{TR}(\cdot) \rightarrow 0$ as $\mu_t \rightarrow 0$ and/or $TR \rightarrow \infty$, with the additional restriction $-M \leq q_{TR}(\cdot) \leq 0$, where $M \geq 0$ defines an appropriate bound.²⁰ Again, these properties for $q_{TR}(\cdot)$ provide the conditions necessary for existence.

We now formally demonstrate that a lack of confidence in the government on the part of households has the potential to undermine a benevolent government's ability to implement the Pareto-improving intergenerational transfer program. That is, if households believe that there is a positive probability that the government will renege on its promise to implement the program, it is shown that these beliefs can, in fact, become self-reinforcing (i.e., the government will indeed renege) if the level of confidence, $q(\mu_0, \Omega_0, TR)$, is below some critical value.

Consider the modified first-order conditions for savings and education, respectively, in the presence of uncertainty for the initial generation:

$$(18) \quad \alpha_1 / (1 + \bar{h}_T + a(1 - e_0) - s_0) = R\alpha_2 q(\mu_0, \Omega_0, TR) / (Rs_0 + TR) + \alpha_2 (1 - q(\mu_0, \Omega_0, TR)) / s_0$$

$$(19) \quad \alpha_1 a / (1 + \bar{h}_T + a(1 - e) - s_0) = \alpha_3 / e_0.$$

Rearranging equations (18) and (19) we have the following representation of this system,

$$(20) \quad \underbrace{(1 - \alpha_2) / (1 + \bar{h}_T + a - s_0)}_{g(s_0)} = \underbrace{R\alpha_2 q(\mu_0, \Omega_0, TR) / (Rs_0 + TR) + \alpha_2 (1 - q(\mu_0, \Omega_0, TR)) / s_0}_{f_1(s_0, TR, q)}$$

18. Note that if there is full trust in the government, then the results are independent of the fundamentals. This is reasonable in our framework as the transfer scheme is costless for the government, but relaxing this assumption would preserve the main results. As long as the trust parameter is not equal to one, however, the level of fundamentals will affect the level of confidence, or q .

19. It is also an increasing function of fundamentals as well as long as trust is less than one.

20. A formal definition of M is given below.

$$(21) \quad h_1 = e_0(s_0) = \alpha_3(1 + \bar{h}_T + a)/a(1 - \alpha_2) - (\alpha_3/a(1 - \alpha_2))s_0,$$

which we display in Figure 5.

As Figure 5 shows, equations (20) and (21) implicitly define the relationship between the necessary size of the transfer and society's trust in their government, $TR^N(\mu_0)$. There are two polar cases in presence of uncertainty: First, when $q(0, TR) = 0$ government policy is completely ineffective regardless of the size of the social security transfer payment and we have $f(s_0; TR^*, q = 0)$ in Figure 5. This case implies that $TR^N(\mu_0 = 0)$ is infinitely large because there is a direct mapping back to the low income-child labor steady state regardless of the size of the transfer. Second, when $q(\Omega_0, TR) = 1$ the size of transfer necessary to reach the threshold is equal to TR^* , that is $TR^N(\mu_0 = 1) = TR^*$, as described in equation (13). By Assumption 3.2, this transfer value lies in the feasible range $TR^* \in [0, TR_{\max}]$. This deterministic transfer case is important because it pins down the savings s_0^* necessary to reach the critical mass of human capital via (21). We represent this graphically in Figure 5 as $f(s_0^*; TR^*, q = 1)$.

This case obviously crosses the threshold η and falls into the high income-no child labor equilibrium's basin of attraction and converges to \bar{h}_H .

Figure 5 also demonstrates the logic for the argument to follow. Consider the intermediate case where $q(\mu_0\Omega_0, TR^*) \in (0,1)$ when $\mu_0 \in (0,1)$. This case shows that as society's level of confidence in their government falls, the size of the transfer, TR^N , necessary to reach the threshold and critical mass of human capital (and s_0^*) must also increase. That is, $TR^N > TR^*$ when $q(\mu_0\Omega_0, TR) \in (0,1)$. Thus, we have the following proposition:

PROPOSITION 4.1. *There exists a minimum level of trust (and therefore confidence) in the government, $q^{\min}(\mu^{\min}\Omega_0, TR_{\max})$, where the pay-as-you-go social security program is no longer feasible if $0 < q(\cdot) < q^{\min}(\mu^{\min}\Omega_0, TR_{\max}) < 1$.*

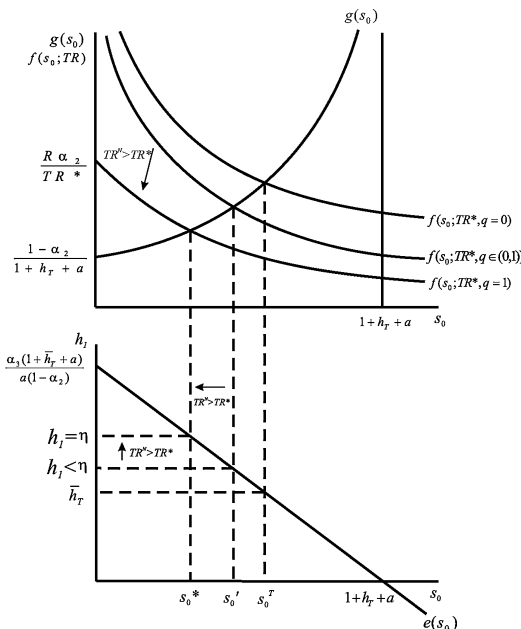
To see this result, totally differentiate equation (20) with respect to TR^N and μ_0 .²¹

$$(22) \quad dTR^N/d\mu_0 = -[q_{\mu}(\cdot)\Omega_0TR^N(Rs_0^* + TR^N) / (q_{TR}(\cdot)TR^N(Rs_0^* + TR^N) + s_0^*Rq(\cdot))] < 0$$

This relationship holds as long as $-M \leq q_{TR}(\cdot) \leq 0$, where the lower bound $M = [s_0^*Rq(\cdot)/TR^N(Rs_0^* + TR^N)]$. In the limit $q_{\mu}(\cdot) \rightarrow N$, $q(\cdot) \rightarrow 0$, and $q_{TR}(\cdot) \rightarrow 0$ as $\mu_0 \rightarrow 0$. This implies that $dTR^N/d\mu_0 \rightarrow -\infty$ as $\mu_0 \rightarrow 0$. Thus, as the level of trust in the government falls, the size of the transfer necessary to reach the human capital threshold increases at an increasing rate and approaches infinity as the level of trust approaches 0. This argument is shown in Figure 6.

From Proposition 3.1 we know that there exists a finite maximum transfer, TR_{\max} . This implies the existence of a minimum level of trust in the government, μ^{\min} , at which the necessary size of the transfer is just feasible, or $TR^N = TR_{\max}$. Below this minimum level of trust, the policy is no longer feasible under the government's policy rule because the size of the transfer necessary to reach the human-capital threshold will reduce the welfare of next period's working generation. Thus, the government does not implement

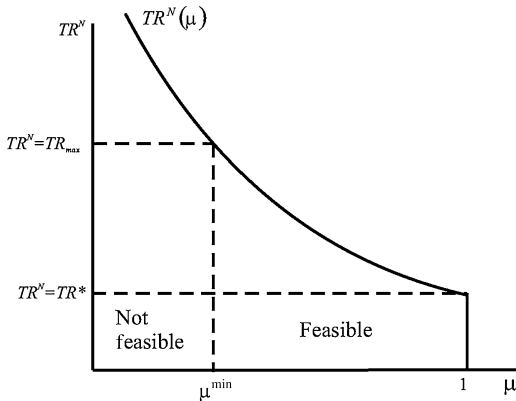
FIGURE 5
The Effect of Transfers on Savings with Uncertainty



21. Again, the formal proof is provided in the appendix.

FIGURE 6

Feasibility and Infeasibility with Uncertainty



the program. Once we have defined the minimum level of trust in the government associated with maximum transfer possible under the government's policy rule, we can define the minimum level of confidence in the government necessary to implement the Pareto-improving program, $q^{\min}(\mu^{\min}, \Omega_0, TR_{\max})$.

Thus, Proposition 4.1 formally demonstrates the main point of the paper: If society's confidence in their government is so low that they believe there is a good chance the government will not implement the social security program, the benevolent government will, in fact, choose not to implement the program. This is true even if the government could have, and would have, implemented the program (i.e., if $q(\cdot)$ were greater than q^{\min}). In other words, even if the social security program is feasible (in the Pareto sense) and could eliminate the poverty trap equilibrium, it will fail if $q(\cdot) < q^{\min}$.

This formally defines what we refer to as an *expectations trap*. The mere fact that households do not believe that the government will implement the Pareto-improving policy can eliminate this policy from the benevolent government's choice set, thus reinforcing the households' initial pessimistic subjective beliefs.

We conclude this section with a brief discussion about the linear technology or small open-economy assumption. This assumption imposes a constant adult wage rate on the model, normalized to unity, which implies that parental earnings do not respond to the reduction in labor supply as children exit from the

labor market. This is a simplifying assumption that allows us to maintain analytical tractability without changing the qualitative predictions of the model.

The quantitative nature of the problem will change, however. Consider the following argument. As children exit from the labor market, the wage rate in the economy will increase. We represent this relationship with child labor alone because all adults supply a unit of labor and households are symmetric: $w(1 - e)$, where $w'(1 - e) < 0$. If we maintain the substitution axiom, as in Basu and Van (1998), then the first-period budget constraint becomes, $c_t^W + s_t = w(1 - e)[(1 + h_t) + \alpha(1 - e_t)]$. This implies that as children exit the labor market parental 'potential' earnings will increase, $w(1 - e_t)(1 + h_t)$, but so will the opportunity cost of the child's time. If the former of these effects is stronger, then as children exit the labor market adult income increases. Therefore, the amount of time a child spends receiving an education will also increase for a given level of parental human capital. This will decrease the critical level of trust and therefore government confidence necessary for the Pareto-improving policy to be successful. If the latter of these two effects holds, this would tend to increase the level of trust, or confidence, necessary for the policy to be successful. The relative importance of this effect will depend upon the labor demand elasticity. The more inelastic labor demand is, the more quantitatively important this effect becomes. Thus, relaxing the linearity assumption does indeed change the quantitative level of confidence necessary, but the qualitative prediction of the model remains: the expectations trap equilibrium still exists. This assumption would also raise stability issues for the 'high' equilibrium case, an issue we do not attempt to address here.²²

V. DISCUSSION OF THE EMPIRICAL EVIDENCE

The empirical evidence of the effectiveness of transfer programs in reducing child labor and increasing schooling is still being received, but early studies suggest that these programs are less effective at reducing child labor than

22. Another potential issue is the change in relative wage between unskilled and skilled labor as in Doepke and Zilibotti (2005).

they are at increasing schooling. Unconditional cash transfer programs have been found to have relatively small marginal effects on both child labor and school enrollment, as in Behrman and Knowles (1999) and Nielsen (1998). This could be the result of uncertainty surrounding future transfers. If the adults of the household perceive this as a temporary transfer, then the permanent income hypothesis comes into play. Ravallion and Wodon (2000) find that a food-for-education program in Bangladesh did, indeed, increase schooling among the participants, but the concomitant reduction in child labor was quite small. Bourguignon, Ferreira, and Leite (2002), in their study of the Bolsa Escola educational subsidy program in Brazil, find similar results. Skoufias and Parker (2001), however, find that the conditional transfer program, PROGRESA, in Mexico showed significant effects on both school enrollment and child labor. In this case, perhaps, the transfer programs were perceived as permanent and the household responded accordingly.

Although the policies above are not identical in practice, the general idea carries through. Even if countries implement identical policies, these programs may succeed in some countries and fail in others because of differing levels of confidence in government. For policy design this implies that only after the transfer program is implemented in a particular country will we be able to determine whether or not the program is successful. Ex-ante analysis from past policy successes or failures in different countries may not be appropriate for determining a policy's effectiveness for a specific developing country.

VI. CONCLUSION

This paper develops a model of child labor in a dynamic, general equilibrium setting. It is shown that lack of access to capital markets gives rise to a Pareto-inferior outcome that is characterized by the presence of child labor and a low level of human capital. When a pay-as-you-go social security program is introduced to the perfect foresight economy, where society has complete confidence in their government, it is shown that this type of intergenerational transfer program can move the economy out of this inferior equilibrium by allowing families to redirect

household income they would otherwise have saved for old age or consumed in the current period towards the education of their children.

It is then shown that the effectiveness of the intergenerational transfer program relies critically on its ability to change the behavior of households through their expectations. If there is uncertainty surrounding the government's intention to follow through on the program as a result of society's lack of confidence in the government, households may not change their behavior sufficiently to move the economy from the 'bad' equilibrium with child labor to the Pareto-superior or 'good' equilibrium with no child labor, leaving the country in an expectations trap. This demonstrates that confidence in the government is potentially a key element in effective policy design.

APPENDIX: PROOFS

Proof of Proposition 2.1. Using the parameter restriction $\alpha_3(1+a) < a - \alpha_3$, which implies $\alpha_3 < a$, along with equation (10a) produces a monotone sequence $\{h_t\}_{t=0}^{\infty}$ converging to low equilibrium \bar{h}_T . Using the parameter restriction $A\alpha_3 > a$ implies $A\alpha_3/a > 1$. Combining this result along with equation (10a) produces a monotone sequence $\{h_t\}_{t=0}^{\infty}$ converging to $\bar{h}_H = A$ and $\bar{e}_H = 1$ via equation (4), the upper bound. ■

Proof of Corollary 2.1. This result follows directly from the proof of Proposition 2.1. ■

Proof of Lemma 3.1. By (A3.1) and equation (12) the government chooses the unique transfer that satisfies $h_1(TR) = \eta$. Existence follows directly from (12) given that η is a constant and greater than zero by assumption, and $h_1(TR) > 0$ with $h_1(0) > 0$. ■

Proof of Lemma 3.2. The proof, or argument, supporting this Lemma is in two parts:

Part 1: Assuming the savings constraint, equation (14), is non-binding then the optimal decision rules are $c_1^W = \alpha_1[1 + h_1(TR) + a + ((TR/R) - T)]$; $c_1^R = R\alpha_2[1 + h_1(TR) + a + ((TR/R) - T)]$; $e_1 = (\alpha_3/a)[1 + h_1(TR) + a + ((TR/R) - T)]$. Using the balanced budget condition, $TR = T$, and the human capital for this generation, $h_1(TR) = \bar{h}_T + (\alpha_3/Ra)TR$, after substitution, the optimal decision rules become $c_1^W = \alpha_1[1 + \bar{h}_T + a + ((\alpha_3 - ra)/Ra)TR]$; $c_1^R = R\alpha_2[1 + \bar{h}_T + a + ((\alpha_3 - ra)/Ra)TR]$; $e_1 = (\alpha_3/a)[1 + \bar{h}_T + a + ((\alpha_3 - ra)/Ra)TR]$. Finally, imposing the condition $\alpha_3 < ra$ on the economy, which is consistent with the current parameterization, implies this generation is strictly better off under a positive transfer program when the savings constraint does not bind.

Part 2: Assuming the savings constraint, equation (14), is binding the household faces the following modified budget constraints: (a) $c_1^W = (1 + h_1(TR)) + a(1 - e_1) - T$; (b) $c_1^R = TR$; (c) $h_2(TR) = Ae_1$ after imposing the binding

constraint $s_1 = 0$ on the household's decision problem. The objective function is the same, as defined by equation (1a), except now the only decision variable is the child's time spent receiving an education. The optimal decision rule for the education variable is now $e_1(TR) = (\alpha_3/a(1 - \alpha_2))[1 + \bar{h}_T + a - ((Ra - \alpha_3)/Ra)TR]$; this follows from the substitution of the balanced budget constraint, $TR = T$, and the human capital for this generation, $h_1(TR) = \bar{h}_T + (\alpha_3/Ra)TR$ into the education equation (12). Also we use the condition $\alpha_1 + \alpha_2 + \alpha_3 = 1$. Combining this constrained optimal decision rule with equation (c) gives us next period's human capital $h_2(TR) = (A\alpha_3/a(1 - \alpha_2))[1 + \bar{h}_T + a] - (A\alpha_3/a(1 - \alpha_2))[(Ra - \alpha_3)/Ra)TR]$. If $h_2(TR) < \eta = \theta\bar{h}_T + (1 - \theta)\bar{h}_H$ for all levels of transfers, when the savings constraint is binding, then the transfer program is no longer feasible under the current policy rule because some future generation is strictly worse off as the economy moves back towards the poverty trap steady state under the transfer program, $\bar{h}_T = (\alpha_3/(a - \alpha_3))[1 + a - (r/R)TR]$, which is strictly less than the poverty trap steady state without the program, $\bar{h}_T = \alpha_3(1 + a)/(a - \alpha_3)$, given $R - 1 = r > 0$. A sufficient condition, in terms of the parameterization of the economy, for this result to hold for all levels of transfers TR is $(A\alpha_3/a(1 - \alpha_2))[1 + \bar{h}_T + a] \leq \theta\bar{h}_T + (1 - \theta)\bar{h}_H$, given $(A\alpha_3/a(1 - \alpha_2))[(Ra - \alpha_3)/Ra)TR] > 0$. Rearranging this condition places the following upper bound on the parental utility weight assigned to the child's human capital, $\alpha_3 \leq a(1 - \alpha_2)[\theta\bar{h}_T + (1 - \theta)\bar{h}_H]/A(1 + \bar{h}_T + a) = \hat{\alpha}_3$. Imposing this condition, which is more stringent than the condition derived in part 1 of the proof, on the economy provides the following condition $\alpha_3 \leq \hat{\alpha}_3$ where the savings constraint directly determines the feasibility of the transfer program. This condition is maintained throughout the paper. Thus, we have the result in Lemma 3.1. ■

Note: This condition is nonlinear and requires numerical methods for detailed analysis. It suffices to say that this condition places a strict upper bound of 1/3 on the parameter α_3 and is satisfied under reasonable conditions. A more detailed study of this condition is available upon request.

Proof of Proposition 3.1. Next period's working generation, the first generation to pay taxes, savings equation is: $s_1(TR) = \alpha_2(1 + h_1(TR) + a) - ((1 + \alpha_2r)/R)TR$. Feasibility under the government's policy rule states that savings must remain weakly positive, $\alpha_2(1 + \bar{h}_T + a) + (\alpha_2\alpha_3/Ra)TR \geq ((1 + \alpha_2r)/R)TR$. This result holds because $\alpha_2\alpha_3/Ra < (1 + \alpha_2r)/R$, given $\alpha_3 < a$, which implies that $\alpha_3 < (a/\alpha_2) + r$ (consistent with Lemma 3.1). Thus, there exists a unique maximum, given $\alpha_2\alpha_3 < (1 + \alpha_2r)$, $TR_{max} = Ra\alpha_2(1 + \bar{h}_T + a)/(a(1 + \alpha_2r) - \alpha_2\alpha_3) > 0$. ■

Proof of Proposition 3.2. First we assume that $TR^* \in [0, TR_{max}]$. Trivially, the current working generation is strictly better off because they receive only transfers. Given that TR^* is feasible, $h_1 > h_0 = \bar{h}_T$, and using the government's budget constraint $TR^* = T^*$, next period's working generation is strictly better off under the assumption that $\alpha_3 < ar$ because $c_1^H = \alpha_1[1 + \bar{h}_T + a + ((\alpha_3 - ar)/R)TR^*]$, $c_1^R = R\alpha_2[1 + \bar{h}_T + a + ((\alpha_3 - ar)/R)TR^*]$, and $s_1(TR^*) \geq 0$. This implies all future generations are also strictly better because the sequence of human capital satisfies the condition $h_{t+1} > h_t > \dots > h_1 > h_0$ converging to the upper bound A . Also note, since the non-negativity constraint is non-binding for h_1 then it is non-binding for h_t when $t > 1$ because TR^* is constant. ■

Proof of Proposition 4.1. From equation (21) we have $\eta = h_1^* = e_0(s_0^*)$, which determines the appropriate amount of savings s_0^* to reach the critical mass of human capital. Using this result, along with equation (20), we can implicitly determine the necessary size of the transfer in the presence of uncertainty $(1 - \alpha_2)/(1 + \bar{h}_T + a - s_0^*) = R\alpha_2q(\mu_0\Omega_0, TR^N)/(Rs_0^* + TR^N) + \alpha_2(1 - q(\mu_0\Omega_0, TR^N))/s_0^*$ for a given μ_0 . By the implicit function theorem, after totally differentiating equation (20) with respect to TR^N and μ_0 , we have the following relationship $dTR^N/d\mu_0 = -[q_{\mu}(\cdot)\Omega_0(Rs_0^* + TR^N)TR^N/(q_{TR}(\cdot)TR^N(Rs_0^* + TR^N) + s_0^*Rq(\cdot))] < 0$ given: $q_{\mu}(\cdot) \geq 0$ and $-(s_0^*Rq(\cdot)/(TR^N(Rs_0^* + TR^N))) \leq q_{TR}(\cdot) \leq 0$, where $M = (s_0^*Rq(\cdot)/TR^N(Rs_0^* + TR^N))$, which defines the lower bound of $q_{TR}(\cdot)$. In the limit as $\mu_0 \rightarrow 0$ we have $q_{TR}(\cdot) \rightarrow 0$ and $q_{\mu}(\cdot) \rightarrow N > 0$. Combining these limit conditions with the relationship, as $\mu_0 \rightarrow 0$ then $q(\mu_0\Omega_0, TR^N) \rightarrow 0$ (also note $q(0, TR^N) = 0$), we have the key result that $dTR^N/d\mu_0 \rightarrow -\infty$. This result implies that $TR^N \rightarrow \infty$ as $\mu_0 \rightarrow 0$. From (P3.2) we know that there exists a $0 < TR_{max} < \infty$. Thus, there exists a $\mu^{min} \in (0, 1)$, such that the size of the transfer necessary to reach the human capital threshold satisfies the following implicit condition defined in equation (20) $(1 - \alpha_2)/(1 + \bar{h}_T + a - s_0) = \alpha_2q^{min}(\mu^{min}\Omega_0, TR_{max})/(s_0 + TR_{max}) + (\alpha_2(1 - q^{min}(\mu^{min}\Omega_0, TR_{max}))) / s_0$. With this defined minimum level of trust $\mu^{min} \in (0, 1)$ we can define the minimum level of confidence as $q^{min}(\mu^{min}\Omega_0, TR_{max}) \in (0, 1)$. Below $q^{min}(\mu^{min}\Omega_0, TR_{max})$ we have $TR^N > TR_{max}$ given the monotonic relationship of $TR^N(\mu_0)$. Thus, the policy is no longer feasible under the government's policy rule once society's confidence falls below $q^{min}(\mu^{min}\Omega_0, TR_{max})$. ■

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