Intergenerational Redistribution, Expectation Traps and Child Labor

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Abstract

This paper develops a dynamic general equilibrium model of child labor with two possible equilibrium outcomes: a 'good' equilibrium with high education and no child labor, and a 'bad' equilibrium with low education and positive child labor. It is first shown that a government program of intergenerational transfers, such as social security, can eliminate the low schooling-child labor equilibrium leading to a Pareto superior outcome in a deterministic setting. Uncertainty is then added to the model and it is shown that if a society does not believe that the government will implement the transfer program, then in fact it won't, thus fulfilling society's expectations. This is true even if the government would have implemented the transfer program in the deterministic setting, or if society had 'enough' confidence in the government. This result implies that government policy may be powerless to prevent the low education-child labor equilibrium due to the uncertainty surrounding the government's future intentions, thus leaving the country in an expectation trap.

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I. Introduction

Child labor is widespread in the contemporary world. In fact, the International Labor Organization estimates that 246 million of the world's children aged 5 to 17, or 16 percent, 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 (see Basu (1999) and Basu and Tzannatos (2002) 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 (see e.g. 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] As a result, adult decision makers may not only send their children to work to escape poverty in the present, but also to escape poverty in the future. This will further hinder a child's ability to accumulate human capital and possibly generate persistent cycles of poverty and child labor across generations.[3]

[1] ILO (2002). Child labor was also common in developed countries until fairly recently, see, e.g., Kruse and Mahony, 2000.
[2] Other dynamic models studying the interaction of child labor are Emerson and Souza, 2002; Bell and Gersbach, 2000; Lopez-Calva and Myiamoto, 2002; Baland and Robinson, 2000; and Ranjan, 2001; Hazan and Burdugo, 2002; Jafarey and Lahiri, 2002.
[3] See Emerson and Souza (2002) and Wahba (2002) for the empirical support of child labor persistence.

This paper studies how the government can use fiscal policy to address child labor that results from non-enforceable intergenerational contracts and incomplete capital markets.[4] In particular, it is shown that the government can replicate these contracts between children and adults with a pay-as-you-go social security program, thereby eliminating this component of child labor.[5] The effect of this program is 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 the introduction of a social security program that will begin during the current adults' retirement. Thus the adult will no longer use their child's labor to supplement savings for future consumption.[6] It is demonstrated that the reduction in child labor will increase the child's education and the child's human capital, possibly setting off a chain of events that allows the household and/or country to escape from poverty.[7]

More formally, a simple three period model with overlapping generations and human capital is employed to generate persistent cycles of poverty with child labor in a dynamic environment. The dynamic setup is similar to Azariadis and Drazen (1990) and child labor is incorporated into the model by extending the work of Basu and Van (1998). Then, the standard fiscal policy tools of labor taxation and income transfers are incorporated into the model to study the impact a program of intergenerational transfers has on the dynamic behavior of the economy.

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[4] Bell and Gersbach (2000) also study redistribution policy, but in their case they examine an iterative series of within generation transfers through time.
[5] There are other types of government programs that are equivalent to social security in a deterministic economic environment, such as government debt and vouchers (money). Since we also study uncertainty in our paper, we restrict our attention to social security, although one could easily think of the redistribution mechanism we discuss in terms of debt without any loss of relevance.
[6] 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, see, e.g., Lopez-Calva and Myiamoto (2002).
[7] The assumption that child labor hampers adult earnings is empirically well founded, See, for example, Emerson and Souza, 2002.

The analysis begins by showing that the stylized economy gives rise to two locally stable steady states: one 'bad,' where there is a relatively low level of parental human capital, which results in low levels of income and child labor, and the other 'good,' where there is a relatively high level of parental human capital, which results in high levels of income and no child labor.[8] In addition, the 'good' equilibrium is shown to Pareto dominate the 'bad' equilibrium. If a household or country is trapped in the 'bad' equilibrium with child labor, the introduction of social security reduces the household's incentive to save for the future (as discussed in Feldstein, 1974). This reduction in savings frees up current household resources for current needs, resulting in a decrease in child labor and an increase in the child's human capital. If this increase is large enough to cross a human capital threshold, the economy transitions to the high income-no child labor equilibrium, and a Pareto superior outcome[9].

Thus, in a deterministic environment, social security has the potential to move a country from the 'bad' equilibrium to the 'good' equilibrium by replicating intergenerational contracts that fail to develop in private markets. Thus, the government can eliminate the 'bad' equilibrium through the appropriate use of fiscal policy.

The success of the social security program, or any other form of intergenerational redistribution program, however, rests critically on its ability to change people's behavior. In developing countries, where there may be much greater uncertainty about the

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[8]The dynamic behavior of the economy is governed by a threshold externality in the human capital accumulation process very similar to that of Azariadis and Drazen (1990).

[9] 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 is also discussed in Becker and Murphy (1988) and Hazan and Berdugo (2002). This paper demonstrates that government regulation is unnecessary in a deterministic environment if the intergenerational transfer program is designed appropriately. This result is important because laws that attempt to regulate individual behavior are difficult to enforce, especially in developing countries. If the same objective, the elimination of child labor and higher per capita incomes, can be achieved by altering the incentive structure of the economy without regulation the program obviously has a greater chance of success.

stability and intentions of government, these deterministic results may not carry over to a more realistic model that takes into account this uncertainty.

To illustrate this aspect of uncertainty surrounding government intentions, the model is extended to show there is a minimum level of confidence required in government for the social security program, or any intergenerational transfer program, to be successful. The argument is similar to the one made by Weil (1987) justifying the existence of a monetary equilibrium in an uncertain environment. If the likelihood people assign to the implementation of the program is greater than some endogenously determined minimum level of confidence, the government will implement the program and the country can escape from poverty (and child labor). If, on the other hand, the likelihood people assign to the actual implementation of the program is less than this minimum level of confidence, the government does not implement the program.

This implies Pareto improvements can only be realized if the likelihood society assigns to the government's actual implementation of the social security program is relatively high. If the likelihood society assigns to the implementation of the program is relatively low, this can make the high income-no child labor equilibrium impossible to achieve. In fact, even if the government has every intention to follow through on its promise to implement the social security program, it may be prevented from doing so because of the beliefs of the citizenry (however unfounded) that the government will renege. It is in this sense that the model generates an *expectation trap*.[10]

Whether this expectation trap is the result of fundamental past failures of government or the result of pure perception depends on how the probability distribution

[10]Typically, expectation traps are discussed in the context of monetary economies. For monetary applications see Albanesi, Chari and Christiano (2002) and Chari, Christiano and Eichenbaum (1998). Also see Cole and Kehoe (2000) for an application to sovereign debt.

over the implementation and non-implementation of the social security program is interpreted. If it is interpreted as the result of 'fundamentals' the government can potentially overcome this expectation trap by using short-term policy changes in fiscal policy to shift the distribution itself. If it is interpreted as the result of extrinsic uncertainty (in the spirit of Azariadis, 1981; Cass and Shell, 1983; Azariadis and Guesnerie, 1986; and Farmer; 1999), there may be little, if anything, the government can do to escape their current situation. Under this interpretation of uncertainty the cycle of poverty and child labor may, in some sense, be self-fulfilling.

The policy implications that arise from uncertainty are very troublesome from a development perspective. If society perceives their government as unstable or untrustworthy, they may end up with more child labor as a result. Even transfer programs that guarantee a family income when old might not alleviate the problem if the citizenry does not trust that this program will actually exist when it comes time for them to collect.

The rest of the paper continues as follows: The basic dynamic, general equilibrium model of child labor is presented in section two and the two possible equilibria that arise are described. It is then shown under certain assumptions that the pay-as-you-go social security program can eliminate the 'bad' equilibrium in section three. In section four, uncertainty is added to the model and it is demonstrated that sufficient uncertainty can render the government's intergenerational transfer program ineffective even though it is Pareto improving. The potential causes of uncertainty and the policy implications are also discussed. Finally, section five concludes by summarizing 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 of the household, thus the working age adults have no filial responsibility to their elders. The population is constant and each generation is normalized to unity. These simplifying demographic assumptions allow us to concentrate on the key issues of the paper: the dynamic interaction between child labor, government policy, and uncertainty. Also, given the overlapping generations structure, we also assume that imperfect capital markets make it impossible for families to borrow against their children's future earnings.

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 $a \in [0,1]$ with respect to physical labor only. Thus, a child is endowed with no human capital. The decision whether to educate the child, $e \in (0,1)$, or have the child participate in the labor market, $(1-e)$, is made by the child's parent. This decision will depend on the child's productivity parameter a, parental human capital h, and adult preferences. In the second period of life, the adult population supplies human capital accumulated during childhood, chosen by their parents, and one unit of physical labor to the competitive labor market. Also each adult has one child, determines their child's labor force participation rate and education, and saves for retirement. Finally, in the last period of life the adult consumes savings.

For the benchmark model in a deterministic environment, an adult of generation $t-1$ maximizes the representative household's utility, given by:

$$(1) \qquad U\left(c_t^W, c_{t+1}^R, h_{t+1}\right) = \boldsymbol{a}_1 \ln c_t^W + \boldsymbol{a}_2 \ln c_{t+1}^R + \boldsymbol{a}_3 \ln h_{t+1}.$$

The parameters $\boldsymbol{a}_i \in (0,1)$, $i = 1,2,3$ assigns different weights to consumption utility during the working years, c_t^W, consumption utility during retirement, c_{t+1}^R, and the utility parents derive from the child's human capital, h_{t+1}. We also impose the restriction $\boldsymbol{a}_1 + \boldsymbol{a}_2 + \boldsymbol{a}_3 = 1$ on the preference parameters.

The adult's decision is also subject to the following constraints. The adult earns an income of $(1+h_t)$ by supplying physical labor and human capital to the labor market and receives an additional amount of income equal to $a(1-e_t)$ if the child participates in the labor market. The household allocates this income to present consumption and savings for the adult's future consumption. For notational convenience we assume a zero net rate of return on savings.[11]

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

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

[11] The constraints facing the household are consistent with a linear technology in terms of capital and labor. Specifically, let $y = k + (1+h) + a(1-e)$ and assume competitive markets. This production approach is similar to the one employed by Hansson and Stuart (1989) in their study of social security as a form of intergenerational trade, also see Baland and Robinson (2000). Also note linear production, along with the zero population growth assumption, places the economy at the golden rule level of capital. (See Blanchard and Fisher (1989) for a more general discussion.), thus the economy is dynamically efficient by definition.

The final constraint facing the household is the education technology:

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

Equation (4) assumes the child's human capital is a nonlinear function of parental human capital and the time spent receiving an education.

The natural logarithmic specification of preferences eliminates the lower bound solutions (i.e. $e_t, c_t^W, c_{t+1}^R > 0$). Also, for the moment, we assume the solution to the above problem results in a value $e_t \leq 1$, with the upper bound being achieved only as a direct solution to the current optimization problem.[12] This results in the following optimal linear expenditure system, which determining the parent's lifetime consumption profile and the child's time spent receiving an education and time in the labor market:

$$(5) \qquad c_t^W = \alpha_1[1 + h_t + a]$$

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

$$(7) \qquad e_t = \frac{\alpha_3}{a}[1 + h_t + a].$$

This system of equations demonstrates that 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. In particular, equation (7) demonstrates that there is a positive relationship between the child's education and the parental weight assigned to the child's

[12] We address this issue shortly.

human capital $\boldsymbol{a}_3$ and an inverse relationship between the child's education and the child's productivity in the labor market.[13]

The child's time spent receiving an education and the education technology determine the dynamic behavior of human capital across generations:

$$(8) \qquad h_{t+1} = \frac{H(h_t)\boldsymbol{a}_3(1 + h_t + a)}{a}.$$

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

$$(9) \qquad H(h_t) = \begin{cases} 1 \ \mathit{iff} \ h_t < \boldsymbol{h} \\ A \ \mathit{iff} \ h_t \geq \boldsymbol{h} \end{cases}$$

This non-linearity captures potential differences in the education technology for various levels of parental human capital. If the adult level of human capital is below the threshold value $\boldsymbol{h}$ the child accumulates one unit of human capital per unit (fraction) of education time. If the adult level of human capital is equal to or above the threshold value $\boldsymbol{h}$ then the child accumulates $A > 1$ units of human capital per unit of education time.[14] Note that h_t can either be viewed as parental human capital within the household or as the average of adult human capital in society, given our assumption that all households

[13] It can easily be shown that $\frac{\partial e_t}{\partial a} < 0$.

[14] This specification is also similar to that of Galor and Zeira (1993) which models investment in education as a function of inheritance income.

are identical. So as long as there are complementarities in human capital in production (i.e. that individual marginal product of human capital is increasing in the human capital of co-workers), this specification makes sense.

Though this polar assumption allows for analytical tractability in our model, it is not necessary – any human capital function that generates an s-shaped curve (i.e. that intersects the 45 degree line twice) will produce the same multiple equilibria result that drives the analysis in this paper. In fact, simple convexity will suffice as well since we have defined an upper bound.[15] In any case, the non-linearity in returns to education (sheepskin effects) and/or social increasing returns in human capital, would both generate multiple equilibria and are empirically well founded (see, e.g., Hungerford and Salon, 1987; and Moretti, 2002).[16]

Combining the threshold function (9) and the dynamic human capital accumulation function (8) results in the following first order difference equation (step function) on opposite sides of the parental human capital threshold $\boldsymbol{h}$:

$$(10) \qquad h_{t+1} = \begin{cases} \dfrac{\boldsymbol{a}_3(1+a)}{a} + \dfrac{\boldsymbol{a}_3}{a} h_t \;\; iff \;\; h_t < \boldsymbol{h} \;\; for\ all\ t \\ \dfrac{A\boldsymbol{a}_3(1+a)}{a} + \dfrac{A\boldsymbol{a}_3}{a} h_t \;\; iff \;\; h_t \geq \boldsymbol{h} \;\; for\ any\ t \end{cases}$$

For the sake of interest, we restrict the parameter space in which our stylized economy operates with the following assumptions:

[15] For instance, the multiplicative function $h_{t+1} = h_t e_t$ (we thank Kaushik Basu for pointing this out).

[16] There is also a theoretical literature on social returns to education, see, e.g., Acemoglu (1996).

Assumption 2.1: *The utility weight on the child's human capital* $\boldsymbol{a}_3$ *is strictly less than* $\frac{a}{2+a}$.

This assumption ensures stability and monotone convergence for the model above and below the threshold value.

Assumption 2.2: *The education productivity parameter* A *equals* $\frac{a}{\boldsymbol{a}_3} - (1+a)$, *which is strictly greater than one if* $\boldsymbol{a}_3 < \frac{a}{2+a}$.

This assumption places the economy on a dynamic path that converges to the upper bound of human capital when the economy is above the threshold value $\boldsymbol{h}$. This assumption is not a requirement of the model, but it allows us to study the dynamic behavior of the economy without clouding the analysis with Kuhn-Tucker conditions.

These two parameter restrictions result in the following steady states for human capital, along with an interval of interest for the threshold value:

$$(11) \qquad \bar{h} = \begin{cases} \bar{h}_T = \dfrac{\boldsymbol{a}_3(1+a)}{a-\boldsymbol{a}_3} \text{ iff } h_t < \boldsymbol{h} \text{ for all } t \\ \bar{h}_H = A \text{ iff } h_t \geq \boldsymbol{h} \text{ for any } t \end{cases}$$

Assumption 2.3: *The threshold value lies in the interval* $\boldsymbol{h} \in [\bar{h}_T, A]$.

The dynamic behavior of our stylized economy, so far, is summarized in **Figure 1**.

The dynamics discussed above result in the following propositions for income levels and child labor in the current deterministic setting without government.

Proposition 2.1: A *country with an initial level of parental human capital below the threshold value* $\boldsymbol{h}$ *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* $\boldsymbol{h}$ *monotonically converges to the high human capital equilibrium* $\bar{h}_H$.[17]

Intuitively, a country with a low level of starting human capital, $h_0 < \boldsymbol{h}$, falls into the low income-child labor equilibrium's basin of attraction and a country that starts off with a relatively high level of human capital human capital, $h_0 \geq \boldsymbol{h}$, falls into the high income-no child labor equilibrium's basin of attraction. Thus countries that are poor remain poor and countries that are wealthy remain wealthy.

In addition to these, now standard, dynamics with respect to human capital, the threshold property in the current framework also generates important child labor dynamics through the education technology.

Proposition 2.2: *A country with an initial level of parental human capital below the threshold value monotonically converges to the positive child labor equilibrium. A*

[17] The formal proofs for all the propositions in the paper are contained in the appendix.

country with an initial level of human capital above or equal to the threshold value $\hat{h}$ *monotonically converges to the no child labor equilibrium.*

The intuition behind the child labor dynamics follows directly from equation (7): if the adult's human capital is sufficiently high, the parental income effect on the child's education reduces the need to send the child to work. If parental human capital is relatively low, the parent chooses to send the child to work to provide for current and future consumption. These two propositions demonstrate the existence of two types of equilibrium: a low income - child labor poverty trap equilibrium, and a high income - no child labor wealthy equilibrium.

III. Government Intergenerational Transfers

Given that there are two possible steady states and dynamic paths an economy can follow depending on the initial level of parental human capital, the question then becomes: what, if anything, can the government do to move a country trapped in poverty, with a positive amount of child labor, out of the poverty trap? In other words, is there a government policy or program that can sufficiently alter the incentive structure of the economy to induce households to invest enough time in their child's education to escape the poverty trap?

We show that the answer to this question is yes, and one such policy or program is a government run pay-as-you-go social security program. The government can announce in the current period that a social security program will begin transferring funds from next period's working generation to next period's retirees. This announcement will reduce the current working generation's desire to save for retirement, thus freeing up current resources for the child's education in the current deterministic environment. If this increase in the child's education is large enough, the social security program can generate a critical mass of human capital that will result in an economic takeoff out of poverty. Also, if the policy is successful, all generations are better off with higher levels of consumption and a higher level of human capital relative to the economy without social security. This is, of course, with the exception of the initial old, who are no worse off.

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 issuing of debt next period to redistribute resources to next period's old. We focus on social security for two reasons. First, since the equivalence between programs in a deterministic environment implies social security represents any lump-sum intergenerational transfer scheme, we choose to focus on this policy for expositional reasons. Second, and perhaps more importantly, government promises in the form of institutions may be more secure in the eyes of society (an issue we discuss shortly) so social security may provide a greater sense of security in contrast to pieces of paper issued or backed by government promises only.

3.1. Adding Government to the Stylized Economy

Without any loss of generality we abstract from government purchases and operation costs. The only role for government is to introduce and manage the social security program using lump-sum transfers and taxes to operate the system. We also assume the government implements the social security program if all generations alive at the time of implementation support the program.[18]

We begin by assuming that at time $T = 0$ the government announces a plan to start the pay-as-you-go social security program next period. We also assume the country of interest is starting in the low income-child labor steady state of $\bar{h}_T$. The representative household maximizes the same utility function (1) subject to the following modified budget constraints, which include working period taxes T_t along with social security transfers TR_{t+1}:

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

$$(3') \qquad c_{t+1}^R = s_t + TR_{t+1}$$

The human capital accumulation equation and the threshold function remain the same. We now have the following optimal linear expenditure system with government:

$$(5') \qquad c_t^W = \alpha_1 \left[1 + h_t + a + (TR_{t+1} - T_t)\right]$$

$$(6') \qquad c_{t+1}^R = \alpha_2 \left[1 + h_t + a + (TR_{t+1} - T_t)\right]$$

[18] From a voting perspective, we can think of the following procedural rule. Any generation made worse off by the transfer policy, or the default on the transfer policy, in terms of their lifetime consumption profile has veto power. Given each generation is normalized to unity, as we will show, if the policy is feasible then next period's working generation is strictly better off and will not have veto power to renege on the transfer to next period's elderly even if they did wish to default on the program. Also the program is supported in equilibrium because any attempt to default on the program would make next period's retirees worse off, this would give them veto power over the cancellation of the program. Although this is not the focus of the paper, this type of voting mechanism is sufficient to ensure the program is dynamically consistent. For a more thorough and thoughtful discussion of this issue, see Cooley and Soares (1999).

$$(7') \qquad e_t = \frac{a_3}{a}\left[1 + h_t + a + \left(TR_{t+1} - T_t\right)\right].$$

The only difference between this system of equations and the system of equations without government is that the household now allocates any net resources the program generates toward consumption and the child's human capital.

Since the population profile is constant, we make the additional assumption that the government announces a constant tax and transfer social security program that operates under a balanced budget. This implies $TR = T$ for all periods. From equations (5'), (6'), and (7') we can see that the shifting of resources across generations has no *direct* affect on the household's optimal choices except for the initial generation receiving transfers only.

The positive transfer to the initial generation increases consumption in both periods of life and increases investment in the child's human capital. The logic of this argument is straightforward: child labor is one way of redistributing resources across generations given that financial markets are incomplete. By sending the child to work the parent can capture some of the child's income. If the government replaces this type of intergenerational transfer with a more direct form of intergenerational transfer, via the pay-as-you-go social security system, the initial household can devote extra resources to the child's education increasing their human capital. Thus, the social security program replicates the financial market that fails to develop between parent and child in terms of intergenerational trade (see Hansson and Stuart, 1989).

More formally, we can see this by looking at the education choice made by the initial generation benefiting from the government transfer program:

$$(12) \qquad h_1(TR) = \underbrace{\left[\frac{\boldsymbol{a}_3(1+a)}{\boldsymbol{a}_3 - a}\right]}_{\bar{h}_T} + \frac{\boldsymbol{a}_3}{a} TR \, .$$

This equation shows that when $TR = 0$ human capital is mapped directly back to the low income-child labor equilibrium. When $TR > 0$ this increases the child's human capital by freeing up additional current period resources from savings. If the promise of a social security transfer is large enough to increase the current child's human capital, so that $h_1(TR) = \boldsymbol{h}$, the country can then escape from poverty.

Before we can determine the necessary size of the transfer to achieve the critical mass of human capital $h_1(TR) = \boldsymbol{h}$, we must first define a specific threshold value and the government's policy rule.

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

Assumption 3.2: *The government's policy rule is to choose the minimum intergenerational transfer necessary to cross the threshold value* $\boldsymbol{h}$.[19]

Using equation (12) and the proceeding two assumptions, we demonstrate the existence of a unique transfer TR^* necessary to reach the threshold value $\boldsymbol{h}$.

[19] This assumption is rather obvious and can be justified on the grounds that societies, in general, tend to prefer minimal government size to achieve a certain objective.

Proposition 3.1: *Under the government's policy rule there exists a unique intergenerational transfer* TR^*, *using the pay-as-you-go social security program, sufficient to induce the current working generation to invest enough resources in their child's education to cross the parental human capital threshold value* η.

The actual transfer for our stylized economy equals:

$$(13) \qquad TR^* = \frac{a}{\alpha_3}(1-\theta)\left(A-\bar{h}_T\right).$$

The interpretation of this equation is intuitive: the more productive the child is in the labor market, or the larger is a, the larger the transfer must be to induce the household to pull their child out of the labor market. The smaller is α_3, or the less weight a parent assigns to the child's human capital, the larger is the necessary size of the transfer. The closer the threshold value is to the high income - no child labor steady state (the closer θ is to zero), the larger is the necessary size of the transfer because the threshold is farther away from the household's current human capital position. Finally, the greater the distance between the two steady states for a given θ, the larger the transfer must be to cross the threshold. We summarize the dynamic behavior of the economy with TR^* in **Figure 2**.

3.2. The Relationship between a Child's Human Capital and Parental Savings

To gain some further insight into how the government's transfer program affects the human capital accumulation process (and for later use when we introduce uncertainty) we look at the direct relationship between the initial generation's savings response and the choice of the child's education. The first order conditions from the household's optimization problem with social security in terms of savings and human capital are as follows:

$$(14) \qquad \frac{\boldsymbol{a}_1}{1+\bar{h}_T + a(1-e_0) - s_0} = \frac{\boldsymbol{a}_2}{s_0 + TR}$$

$$(15) \qquad \frac{a\boldsymbol{a}_1}{1+\bar{h}_T + a(1-e_0) - s_0} = \frac{\boldsymbol{a}_3}{e_0} .$$

Equation (14) equates the marginal loss in utility from an increase in savings (decrease in first period consumption) to the marginal gain in utility from an increase in savings (increase in consumption next period). Also from equation (14) we can see how an increase in transfers reduces the marginal gain in utility from savings. This result is in fact what reduces the household's desire to save, freeing up current period resources for current consumption and the child's education. Equation (15) equates the marginal loss in utility due to an increase in the child's education with the direct marginal benefit of more human capital.

After eliminating e_0 from (14) using (15) we have:

$$(16) \qquad \underbrace{\frac{(1-\boldsymbol{a}_2)}{1+\bar{h}_T + a - s_0}}_{g(s_0)} = \underbrace{\frac{\boldsymbol{a}_2}{s_0 + TR}}_{f(s_0;TR)} .$$

In **Figure 3** $g(s_0)$ 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 $s_0 = \alpha_2(1+\overline{h}_T + a)$. Using equation (15), 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 (16). This decrease in savings in response to TR^* increases the human capital of next period's working generation so that $h_1(TR^*) = \eta$ placing the economy in the high income - no child labor equilibrium's basin of attraction. This approach graphically and intuitively explains the relationship between intergenerational transfers, savings, education, and child labor.

3.3. Properties of the Stylized Economy with Transfers

We assume the social security program is viable only if no generation is made strictly worse off. The question then becomes what, if any, generation would appose the implementation of the program? Obviously the initial generation is strictly better off since it receives only transfers, therefore this generation would not appose the implementation of the program. The first generation to actually pay taxes is next period's working generation, but this generation benefits from the program in two ways: First they receive transfers during retirement offsetting the tax burden in their inter-temporal budget constraint. Second, this generation receives more education and a higher level of human capital next period. The problem is that this generation does not benefit directly from the human capital externality nor can they borrow against their child's earnings (negative savings) because financial markets are incomplete.

The following assumption restricts the ability of the government to implement the social security program, for the given the policy rule, by comparing the costs and benefits of the social security program for the initial generation paying taxes.

Assumption 3.3: *The government implements the pay-as-you-go social security program for the given policy rule only if the policy does not distort the consumption profile of next period's working generation. That is, the policy is feasible as long as the program satisfies the following constraint,* $s_1(TR) \geq 0$.

Basically, if the costs of implementing the program exceed the benefits for the first generation to pay taxes, then by assumption the government cannot implement the program.

To determine the exact condition that will bind the government's ability to implement the policy we need to look at the relationship between savings and transfers for next period's working generation, $s_1(TR) = \boldsymbol{a}_2(1 + h_1 + a) - TR$. This generational household will reduce savings one-for-one with transfers as long as $\boldsymbol{a}_2(1 + h_1 + a) > TR$ because intergenerational redistribution does not directly alter this household's inter-temporal budget constraint. Explicitly, Assumption 3.3 imposes the following feasibility condition on the government's fiscal policy instrument:

Proposition 3.2: *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 and* $s_1(TR^{*}) \geq 0$. *The feasible range's finite upper bound equals* $TR_{\max} = \frac{a\boldsymbol{a}_2(1+\bar{h}_T + a)}{a-\boldsymbol{a}_2\boldsymbol{a}_3}$, *which satisfies the condition* $s_1(TR_{\max}) = 0$.

Proposition 3.2 and **Figure 4** demonstrate that next period's working generation will support the transfer scheme as long as $TR^{*} \in [0, TR_{\max}]$. If $TR^{*} > TR_{\max}$ next period's working generation will not support the program because c_1^W must fall to meet the tax burden distorting their lifetime consumption profile. As already mentioned, if this is indeed the case, we assume the government does not implement the program.

We now generalize our analysis to all future generations and discuss the Pareto properties of the model.

Proposition 3.3: *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.*

This result holds for all future generations because human capital is higher for these generations, relative to the initial generation. Recall that future generations also benefit directly from the externality in the education technology that the initial generation misses out on.

From the above analysis we conclude that a government funded intergenerational transfer scheme, specifically through the pay-as-you-go social security program, can help a country escape from poverty in our stylized setting. Under the government policy of intergenerational redistribution child labor disappears, human capital accumulation increases, and lifetime consumption increases for all generations of direct interest in a deterministic environment. Thus, this type of program can improve the efficiency of the economy in the sense that it leads to a Pareto superior outcome.

This can be contrasted with a child labor law that restricts a child's participation in the labor market. If there is no compensation for the adult generation whom can no longer send their child to work, this generation loses (Baland and Robinson, 2000). Thus intergenerational transfers, along with child labor restrictions, may remove this inefficiency as well. In effect, we assume that if the government can achieve a particular outcome - higher incomes and no child labor - by altering the incentive structure of the economy without imposing strict regulations, they choose to do so.

IV. Credibility and the Effectiveness of Government Policy

In a deterministic environment a pay-as-you-go social security program designed to shift resources across generations, beginning next period, could induce today's households to invest enough resources in their children's education to escape a low income - child labor poverty trap. For the sake of interest, we assume throughout the remainder of the paper that TR^* falls within the feasible range and that the government can and does implement the program in a deterministic environment:

Assumption 4.1: *In a deterministic environment the size of the necessary transfer to reach the threshold value* $\boldsymbol{h}$ *lies in the interval* $TR^* \in [0, TR_{\max}]$.

However, the fact that many governments (especially in developing countries) are unstable or untrustworthy raises the question: how does uncertainty over the actual implementation of the program affect the deterministic dynamics of the economy and the size of the transfer TR^*? Or somewhat rephrasing the question, how credible is the government's promise to redistribute resources across generations twenty or thirty years from now, or in fact meet any obligation twenty or thirty years from now?[20]

For developing countries this is potentially a serious problem. If today's working generation does not believe that the government will follow through on the transfer program next period, they will not respond to the government's program in the same manner they would in the deterministic environment. Thus, the government's transfer program may no longer be feasible if there is uncertainty surrounding the implementation of the policy.

Though in the model we remain agnostic about the sources of uncertainty, there are two ways of thinking about this issue. The first interpretation relates the household's perception of uncertainty to past government policies. In this case the *perceived*

[20] In footnote (17) we discussed a procedural rule that supports dynamic consistency in the deterministic environment. With the addition of uncertainty, we can now either think of the government as a separate agent or there is uncertainty surrounding the sustainability of the procedural rule itself. Our story is consistent with both concepts but we frame the story in terms of the former.

likelihood that the government will implement the social security program is a function of the government's past policy successes and failures. The second interpretation relates the perception of uncertainty to extrinsic information. In this case, a household may just not believe the government. In either case, we show that it is the perception of uncertainty that generates the uncertainty over the actual implementation of the program in the first place, given assumption (4.1). This result suggests that it is the expectations of the household that will determine whether or not the program is successful. In other words, the government may not be able to implement the social security program because society does not believe that they will implement the program.

4.1 Adding Uncertainty to the Stylized Economy

We assume 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 (since no generation of retirees would support its cancellation). If the program is not feasible because of the perceived uncertainty surrounding the program, then the government does not implement the program. This implies the policy is never feasible and therefore will never be implemented. In a sense society learns whether or not the government will implement the program, where the degree of uncertainty over the program determines the outcome of the learning process.

The problem facing the representative household with uncertainty combines the two previous sections. We first modify the objective function to account for the perception of uncertainty surrounding the actual implementation of the social security program:

$$(1') \qquad \tilde{U}\left(c_0^W, c_1^R, h_1\right) = \alpha_1 \ln c_0^W + \alpha_2 E_0 \ln c_1^R + \alpha_3 \ln h_1$$

All of the parameters in the utility function are the same as in equation (1) except for the addition of the conditional expectations operator E_0. Households form expectations over whether or not they believe the government will follow through on their promise to implement the social security program. Therefore, there are two perceived possible states of nature. Either the government implements the program or the government does not implement the program with the following conditional probability distribution:

$$(17) \qquad \pi_0(i) = \begin{cases} q & \text{if } i = \text{policy implemented} \\ 1-q & \text{if } i = \text{policy not implemented} \end{cases}$$

We define the value $q \in [0,1]$ as the level of confidence society has in government. As q gets smaller society has less faith in their government.

The resulting first order conditions for the representative household, in terms of household savings and the child's education, are:

$$(18) \qquad \frac{\alpha_1}{1+\bar{h}_T + a(1-e_0) - s_0} = \frac{\alpha_2 q}{s_0 + TR} + \frac{\alpha_2(1-q)}{s_0}$$

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

Note that equation (19) is identical to equation (15), and equation (18) is identical to equation (14), if the household believes the government will implement the program with certainty: $q = 1$. Also note that when $q = 0$, equation (18) captures the deterministic case without transfers. This demonstrates that when society does not believe their government at all, the outcome is the same as having no policy at all. These two extreme cases nest all other possible scenarios, where $q \in (0,1)$.

To see this more formally we once again represent the system of equations defined by (18) and (19) graphically in **Figure 5**.

$$\text{(20)} \qquad \underbrace{\frac{(1-\alpha_2)}{1+\bar{h}_T + a - s_0}}_{g(s_0)} = \underbrace{\frac{\alpha_2 q}{s_0 + TR} + \frac{\alpha_2(1-q)}{s_0}}_{f_1(s_0, TR, q)}$$

$$\text{(21)} \qquad h_1 = e_0(s_0) = \frac{\alpha_3(1+\bar{h}_T + a)}{a(1-\alpha_2)} - \frac{\alpha_3}{a(1-\alpha_2)} s_0$$

The left-hand side of equation (20) is identical to equation (16), where $g(s_0)$ is an upward sloping function of savings. The right-hand side nests the two cases discussed above. First, when government policy is completely ineffective regardless of the size of the social security transfer payment we have $f_1(s_0, TR, 0)$. Second, under certainty, the necessary transfer TR^* is sufficient to reach the threshold value $\boldsymbol{\eta}$. This deterministic transfer scheme also pins down the savings s_0^* necessary to achieve the critical mass of parental human capital next period via (21). Graphically, this case is represented by $f_1(s_0^*, TR^*, 1)$.

From the lower figure in **Figure 5** we see that for $f_1(s_0, TR, 0)$ the human capital accumulation equation maps directly back to the low income - child labor steady state.[21] For the case when $f_1(s_0^*, TR^*, 1)$, the country crosses the threshold $\boldsymbol{h}$ and falls into the high income - no child labor equilibrium's basin of attraction and converges to $\overline{h}_H$. In **Figure 5** we also show an intermediate case when the probability $q \in (0,1)$. In this case, the level of confidence society has in their government is not complete.

The discussion above yields the following important proposition:

<u>Proposition 4.1</u>: *There exists a minimum level of confidence in government $q^{\min}$ where the pay-as-you-go social security program is no longer feasible if $q < q^{\min}$.*

We demonstrate this argument graphically in **Figure 6.** As the level of confidence in the government falls, the necessary size of the transfer increases at an increasing rate, and approaches infinity as the level of confidence approaches zero. From proposition 3.2 we know there exists a finite maximum transfer $TR_{\max}$. This implies that there is a minimum level of confidence, $q^{\min}$, at which point the necessary size of the transfer is just feasible, or $TR^N = TR_{\max}$. Below $q^{\min}$, the policy is no longer feasible. We can also see this result implicitly in Figure 5. As q gets smaller, $f_1(s_0^*, TR^*, q)$ moves closer to $f_1(s_0, TR^*, 0)$, which implies that transfers must increase by larger and larger amounts to reach the critical savings value, s_0^*, that allows the child's human capital to reach $\boldsymbol{h}$.

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[21] Recall, we assume the country starts at $\overline{h}_T$ prior to the possible implementation of the transfer program.

Proposition 4.1 demonstrates that if a society's level of confidence in the government is so low that society does not believe their government will implement the social security program the government does not implement the program. This is true even if the government could and would implement the program if q were greater than $q^{\min}$. In other words, even if the social security program is feasible from a Pareto sense and government policy can eliminate the 'bad' equilibrium in the deterministic environment, it is no longer feasible when $q < q^{\min}$ and the country falls into what we define as an *expectation trap*. In other words, because society does not believe that the government will implement the program, the government does not implement the program, thus fulfilling the household's low expectations leaving the country in the low income-child labor equilibrium[22]. It is the perception of uncertainty that determines the economic success or failure of the intergenerational transfer program.

4.2. Interpreting Uncertainty Surrounding Government Policy

How can the government increase society's level of confidence so that $q > q^{\min}$ if the country is in an expectation trap? The answer depends on our interpretation of the probabilities. If we interpret the probability society assigns to the actual implementation of the social security program as being low because of past government policy failures, the government could possibly shift the distribution in favor of expected implementation by undertaking short-term policy reforms that signal to society they will follow through on their promise to honor social security in the long-term.

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[22] It is important to note that expectations are not *self-fulfilling*, in the proper sense, because the expected payoff, or outcome, does not equal the actual realization (the implementation or failure to implement the program). However, both of the outcomes fulfill the household's relative expectations in terms of the success or failure of the program. This is a result of the household's perception of the two potential government actions and the relative likelihood assigned to each perceived outcome. This is what, in fact, determines the outcome itself.

On the other hand, if the probability assigned to implementation is low because of extrinsic uncertainty there may be very little the domestic government can do to change this probability distribution. One potential solution is for multinational institutions to step in and externally replicate the intergenerational contracts market through some form of debt management program or by directly managing the social security program. As an example, the domestic government could ban child labor and the multinationals could compensate the household for their loss in income. The problem is, that the management of such a program would be costly and expectations would then be with respect to multinationals fulfilling their promises, which may not eliminate the problem. Another possible solution is for multinational institutions to tie future transfers, such as future loan guarantees, to the government's fulfillment of their social security program. Once again, these results hinge critically on the probability society assigns to the promises of these multinational institutions. The debate surrounding external policy design and the uncertainty surrounding multinational institutions is an important topic but is obviously beyond the scope of this paper.

The evidence, in general, on 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 then 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 (e.g. Behrman and Knowles, 1999; Nielsen, 1998). This could be the result of uncertainty surrounding future transfers. If the adult of the household perceives this as a temporary transfer 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 (1999), 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 as a result of uncertainty. If the probability society assigns to the government following through on their promises is less than the minimum level of confidence, the policy will fail. 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 are not appropriate for determining policy effectiveness for the country of interest[23].

V. 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

[23] Another possible solution would be to regulate child labor, as argued by Becker and Murphy (1988) and Hazan and Berdugo (2002), along with the announced social security program. The problem with this is that households may not respond to the regulation (the ban of child labor or mandatory schooling) if the perceived incentive to do so is not present in the economy. This leaves the economy stuck in the expectation trap. On the other hand if we assume the regulation component of the policy can, and is, enforced (a strong assumption) our results demonstrate that it is the uncertainty over the incentive component of the policy that makes regulation necessary.

outcome that is characterized by the presence of child labor in society and low average human capital. When a pay-as-you-go social security program is introduced in a deterministic setting, 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 retirement, towards the education of their children.

It is also 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, or the future of the government itself, we demonstrate that 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. While the model remains relatively agnostic about the formulations of these beliefs on the part of the populace, conjectures are made about the impact of unstable regimes, frequent regime changes and macroeconomic instability, all of which may be more common in less developed countries than in developed ones. In any part of the world, however, this paper demonstrates that confidence in, and the trust of, the government is potentially a key element in effective policy design.

Appendix: proposition proofs

<u>Proposition 2.1</u>: A *country with an initial level of parental human capital below the threshold value* $\boldsymbol{h}$ *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* $\boldsymbol{h}$ *monotonically converges to the high human capital equilibrium* $\bar{h}_H$.

Proof: By (A2.1) $\boldsymbol{a}_3 < a$, this result along with equation (10), produces a monotone sequence $\{h_i\}_{i=0}^{\infty}$ converging to $\bar{h}_T$. By (A2.2) $\frac{A\boldsymbol{a}_3}{a} = 1 - \frac{\boldsymbol{a}_3(1+a)}{a}$, using this result along with (A2.1) $\frac{A\boldsymbol{a}_3}{a} \in (0,1)$ given $\boldsymbol{a}_3 \in (0,1)$, $a \in [0,1]$ and $\boldsymbol{a}_3 < \frac{a}{2+a} < \frac{a}{1+a}$. This result, along with equation (10), produces a monotone sequence $\{h_i\}_{i=0}^{\infty}$ converging to $\bar{h}_H$.

<u>Proposition 2.2</u>: *A country with an initial level of parental human capital below the threshold value* $\boldsymbol{h}$ *monotonically converges to the positive child labor equilibrium. A country with an initial level of human capital above or equal to the threshold value* $\boldsymbol{h}$ *monotonically converges to the no child labor equilibrium.*

Proof: Equation (4) along with equation (9) imply $\bar{e}_T = \frac{\boldsymbol{a}_3(1+a)}{a-\boldsymbol{a}_3} < 1$ by (A2.1) in the low human capital steady state and $\bar{e}_H = 1$ given $\bar{h}_H = A$ in the high human capital steady state. The dynamics follow directly from (P1.1).

<u>Proposition 3.1</u>: *Under the government's policy rule there exists a unique intergenerational transfer* TR^*, *using the pay-as-you-go social security program, sufficient to induce the current working generation to invest enough resources in their child's education to cross the parental human capital threshold value* $\boldsymbol{h}$.

Proof: By (A3.1), (A3.2), and equation (12) the government chooses the transfer that satisfies $h_1(TR) = \boldsymbol{h}$. Existence and uniqueness follow directly from (12) given that $\boldsymbol{h}$ is a constant and greater than zero by assumption, and $h_1'(TR) > 0$ with $h_1(0) > 0$.

<u>Proposition 3.2</u>: *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 and* $s_1(TR^*) \geq 0$. *The feasible range's finite upper bound equals* $TR_{\max} = \frac{a\boldsymbol{a}_2(1+\bar{h}_T + a)}{a - \boldsymbol{a}_2\boldsymbol{a}_3}$, *which satisfies the condition* $s_1(TR_{\max}) = 0$.

Proof: From (C3.1) and next period's working generation savings equation, feasibility implies $\alpha_2(1+h_1+a) \geq TR$. Equation (12) implies $\underbrace{\alpha_2(1+\bar{h}_T+a)+\frac{\alpha_2\alpha_3}{a}TR}_{h(TR)} \geq TR$ and that there exists a unique maximum $TR_{\max} = \frac{a\alpha_2(1+\bar{h}_T+a)}{a-\alpha_2\alpha_3} > 0$ given $\alpha_2, \alpha_3 \in (0,1)$ and $a > \alpha_3$ (by A2.1). More formally, since $h'(TR) \in (0,1)$ and $h(0) > 0$ the right-hand side of the inequality crosses the 45° line only once.

Proposition 3.3: *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.*

Proof: From (A3.4) $TR^* \in [0, TR_{\max}]$. 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 the government's budget constraint $TR^* = T^*$ next period's working generation is strictly better off (See equations (5'), (6'), and (4)). This implies all future generations are also strictly better because the sequence of human capital satisfies the condition $h_{t+1} > h_t > \cdots > h_1 > h_0$ 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 and $s_t(TR) = \alpha_2(1+h_t+a) - TR^*$.

Proposition 4.1: *There exists a minimum level of confidence in government $q^{\min}$ where the pay-as-you-go social security program is no longer feasible if $q < q^{\min}$.*

Proof: From equation (21) we have $\eta = h_1^* = e_0(s_0^*)$. Using this result, along with equation (20), we can pin down the necessary size of the transfer with uncertainty $\frac{(1-\alpha_2)}{1+\bar{h}_T+a-s_0^*} = \frac{\alpha_2 q}{s_0^*+TR^N} + \frac{\alpha_2(1-q)}{s_0^*}$ for a given q. By the implicit function theorem, after totally differentiating equation (20) with respect to TR^N and q, we find $\frac{dTR^N}{dq} = -\left[\frac{(s_0^*+TR^N)TR^N}{qs_0^*}\right]$. In the limit as $q \to 0$ we have $\frac{dTR^N}{dq} \to -\infty$ which implies $TR^N \to \infty$ as $q \to 0$ given $TR^* > 0$ when $q = 1$. From (P3.2) we know there exists a $0 < TR_{\max} < \infty$. This implies there must be some value $q^{\min}$ satisfying $\frac{(1-\alpha_2)}{1+\bar{h}_T+a-s_0} = \frac{\alpha_2 q^{\min}}{s_0+TR_{\max}} + \frac{\alpha_2(1-q^{\min})}{s_0}$ with $q^{\min} \in (0,1)$. Below $q^{\min}$ we have $TR^N > TR_{\max}$, thus the policy is not feasible.

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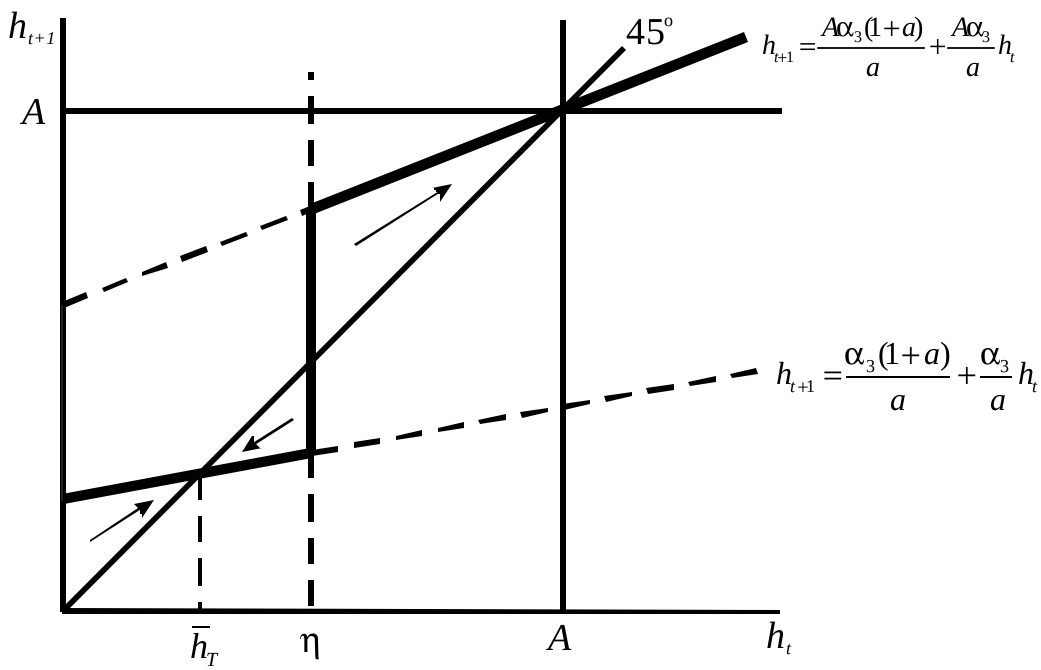

Figure 1: Human Capital Dynamics in a Deterministic Setting

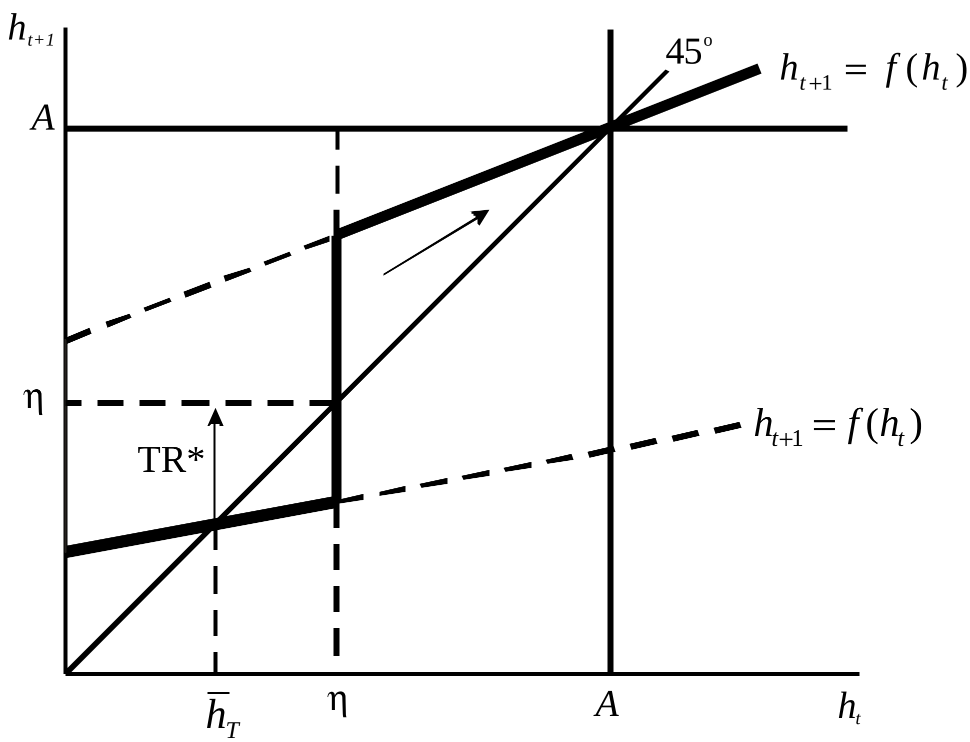

Figure 2: Minimal Effective Transfer

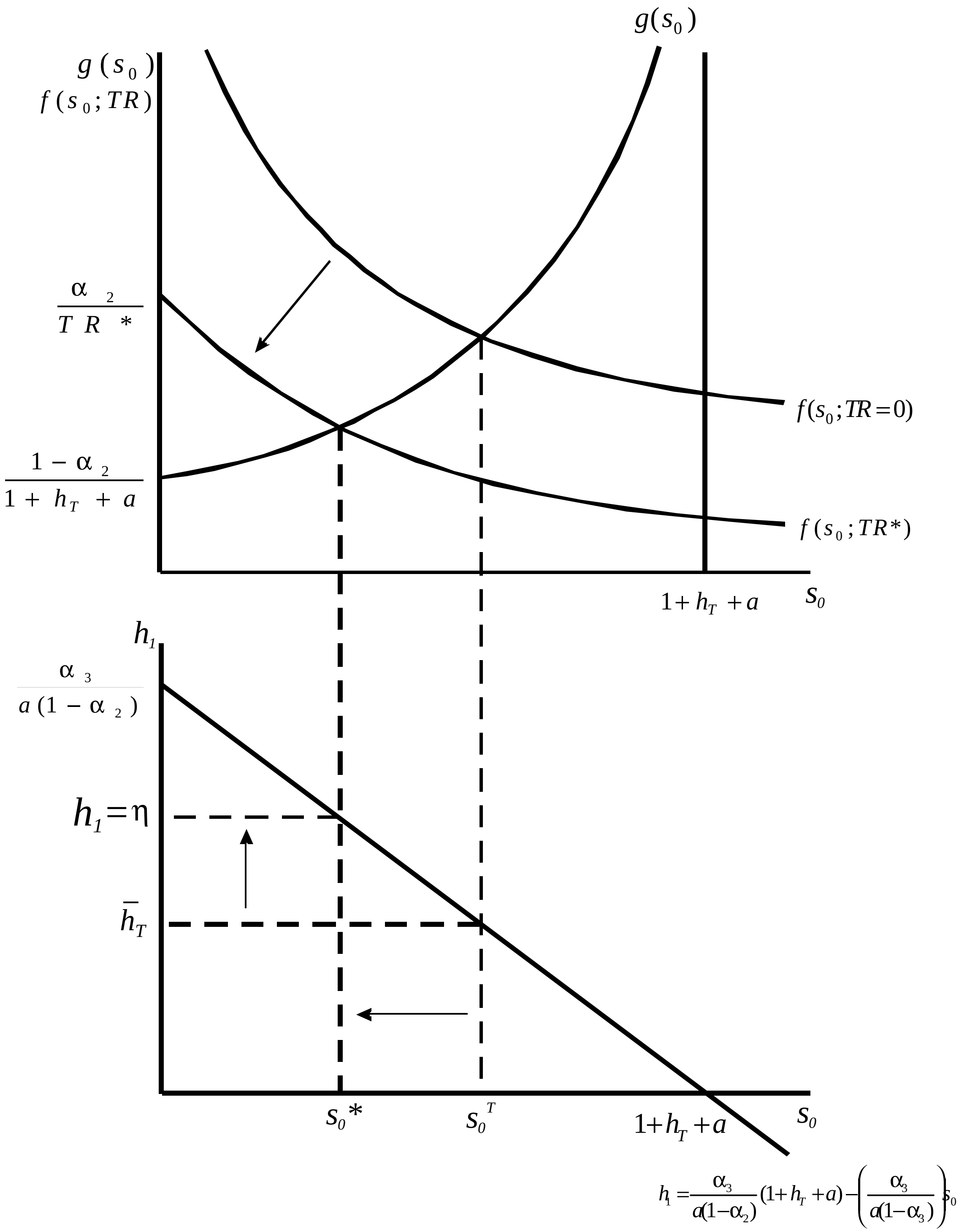

Figure 3: The Effect of Transfers on Savings

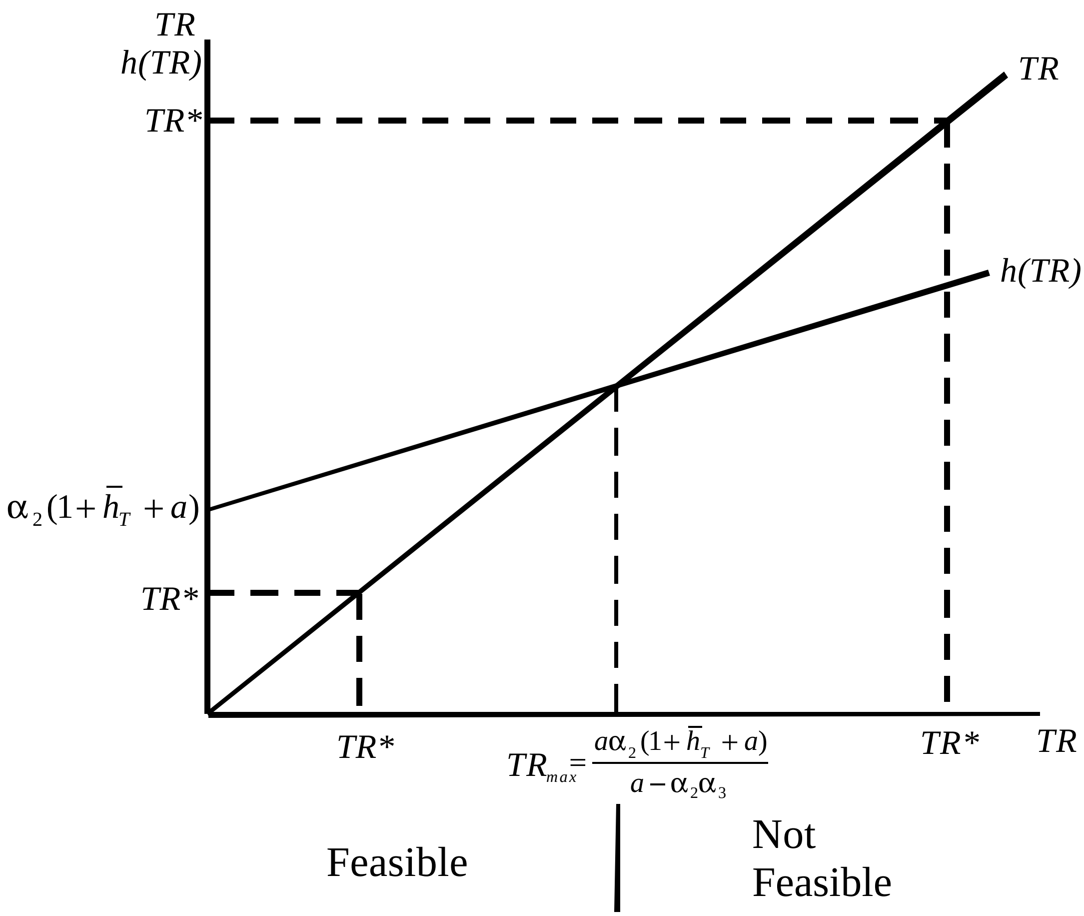

Figure 4: Feasible and Infeasible Transfers

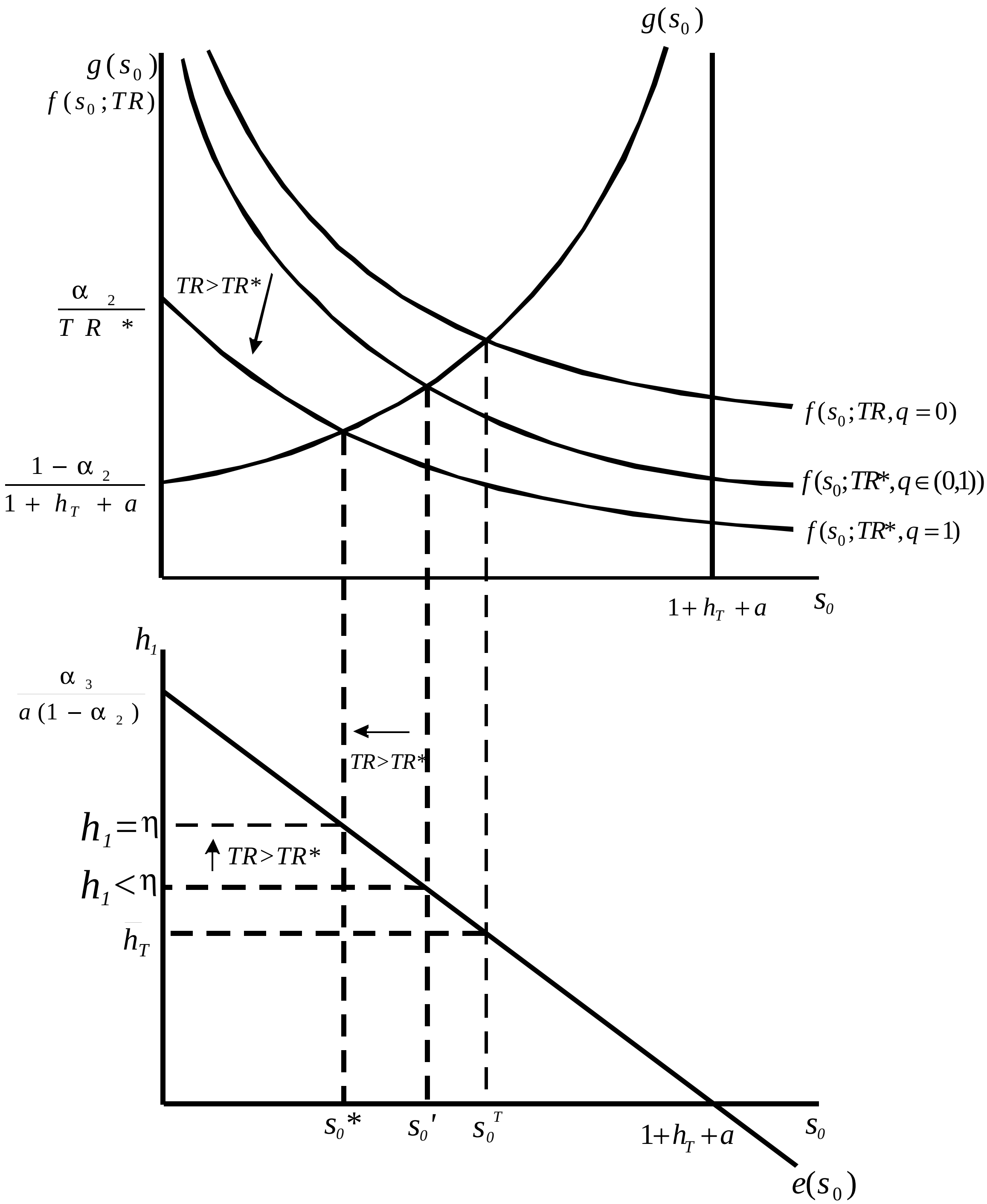

Figure 5: The Effect of Transfers on Savings with Uncertianty

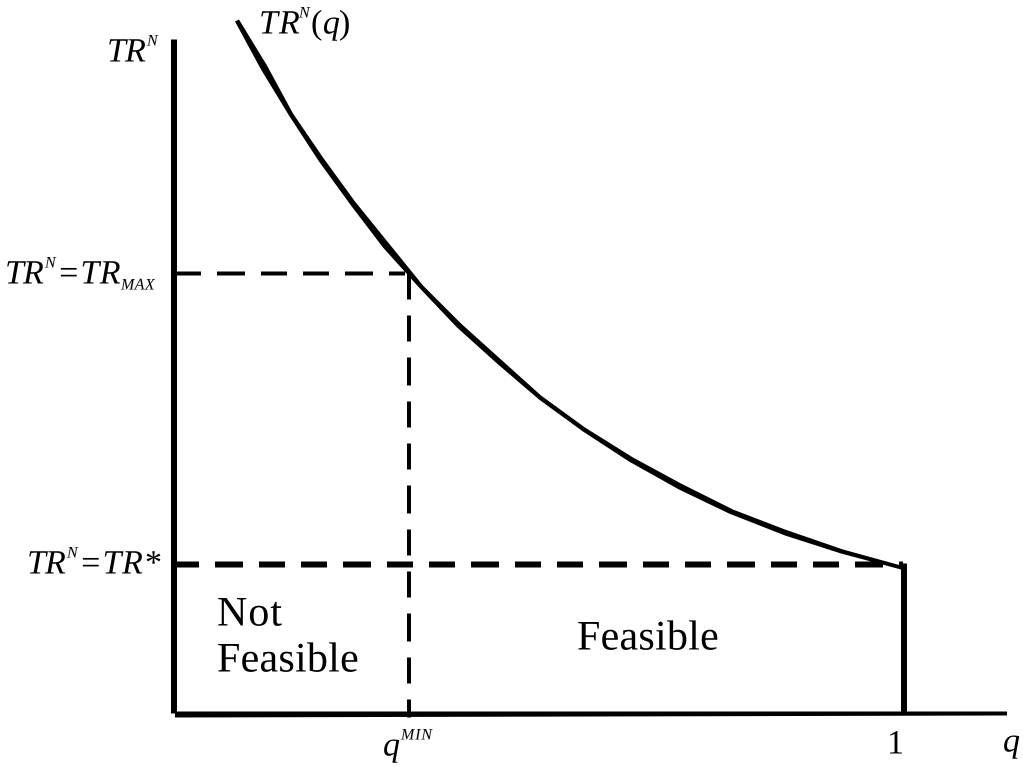

Figure 6: Feasibility and Infeasibility with Uncertainty