Endogenous Mobility and the Emergence of Mandatory Education [1]

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Abstract

This paper offers a positive theory of the emergence of mandatory education. When poverty keeps a sufficiently high number of children at work rather than in school, the availability of forms of child labor that provide skill-enhancing learning-by-doing, can be essential for compulsory education laws to be supported as a steady state equilibrium. In poor countries where a large proportion of poor children are involved in forms of child labor that provide no learning-by-doing, such laws may fail to win popular political support thereby causing the economy to fall into a poverty trap. This paper supports the view that if child labor is to be tolerated, such tolerance should be restricted to forms that provide opportunities for learning-by-doing.

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1 Introduction

Until a little more than 150 years ago, child labor was a common practice in most countries, including the United States and Great Britain. Today, many countries have laws banning or restricting child labor. The ILO convention C138 against child labor has been ratified by 89 countries, indicating opposition to child labor generally among these countries. Yet it is not clear from the current state of economic theory what forces drive the emergence of laws restricting children participation in the labor force.

A simple explanation is based upon the general perception that child labor hinders children's education which many believe is in the best interest, not only of children's own lives, but also of the society as a whole, in terms of the quality of its future labor force. While this is understood, opposition to child labor, however, is yet to become the norm in many developing countries. Available evidence suggests that education/child labor laws are not really initiators of economic changes, but that such changes may have to take place before support for legislative intervention against child labor is to gain momentum.[1]

[1] Morocco, for example, made education compulsory in 1963. But 40 years on, government authorities admit that 2.5 million children are out of school, implying a failure to enforce this law. To explain their tolerance for this phenomenon these authorities argue that child labor is the lesser of two evils in a country where the current education system produces 100,000 jobless graduates a year (see *The Economist*, Oct 5th 2000).

Another example is Equador, the main exporter of banana in the world. Banana-industry officials

In support of this evidence, there is also the observation that even for countries which have now adopted child labor/education laws with great success (Great Britain and the United States, are a few examples), support for these laws took years, perhaps decades before it finally outweighed its opposition.[2] If this is true, what then is the nature of economic forces likely to transform anti-child labor movements, over time, into a winning political coalition to end child labor? Addressing this question is extremely important, given the general perception that child labor should be tolerated in today's poor countries (Basu and Van 1998), even though this may deprive children with the opportunity to escape intergenerational transmission of poverty.

In this paper, we develop a theory of the emergence of mandatory education that uncovers sufficient conditions for opposition to such legislation to decline over time.

admit that about 3% of the industry's farm workforce (or 7,500 people) is under the legal working age of 14 mainly because lack of better alternative draws children into economic activities, as a means to survive. (See *The Economist*, april 2002.)

[2] Moehling (1999) gives an extensive account of the history of child labor laws in the United States from the first half of the nineteenth century to the early twentieth century. Legislative progress, she argues, only came in the last few decades of the nineteenth century, after social pressure for child labor legislation had developed into a well-organized social movement, including a number of labor unions. Likewise, Grootaert and Kanbur (1995) show that only after the incidence of child labor had already begun to decline, in 1833, a time when 36.6 % of boys aged 10-14 were working, did Britain pass legislation restricting child labor. This, as well as the observation by Goldin (1979) that higher wages for fathers in Philadelphia in the late nineteenth century reduced the probability of child labor, suggest that economic changes which took place over time must have brought about the emergence of education/child labor laws.

The emphasis on the role played by time in bringing about support for such laws is one of our important contributions, and is consistent with historical evidence. We use a dynamic heterogeneous-agents general equilibrium model that draws from Basu and Van's (1998) labor-market-based explanation for the incentive to restrict children participation in the labor market. If work and education are the only competing claims on children's time, and there are no direct education costs, then a mandatory education law and a ban on child labor coincide in effects. Our model assumes this coincidence, and focuses on sufficient conditions for mandatory education to be supported as a steady state political-economic equilibrium.

In our model, altruistic parents make child labor-education decisions individually, while they collectively decide, by way of majority voting, on whether or not to restrict children's participation in the labor market by making education mandatory for all children. This creates a tradeoff between individual and collective interests. On one hand, a parent may need the income contribution of his child in order to help fight poverty. On the other hand, parents as adult workers may collectively want to eliminate competitors using cheap child labor, through their labor union for example. The elimination of such competitors may cause the adult wage to rise, thus reducing the need for children's economic contribution. We formalize the tradeoff between the individual interest (income from child labor sources) and the collective interest (better adult wages) as the driving force of the opposition to child labor/education laws. In particular, opponents are poorer parent-workers who stand to face a welfare loss in

the event that they are forced by law to give up income from child labor sources. For this group of parents, even though they may each know that mandatory education and the removal of children from the labor force may raise the value of their own labor, they may still decide to oppose it, if the wage gain from restricting child labor is lower than the forgone income from child labor sources.

We use this model to study the emergence of mandatory education in an environment where formal education and on-the-job learning-by-doing are two potential sources of social mobility-enhancing skill acquisition. We argue that such an environment presents all the characteristics of a system wherein mandatory education can emerge endogenously over time.

2 Some Stylized Facts

In this section, we provide empirical evidence for three key assumptions of this paper. Two of these assumptions are captured by the aggregate production function postulated in this paper, while the other is a feature of the state transition matrix characterizing intergenerational social mobility.

A. Sources of Social Pressure against Child Labor

It is well-understood that pressure for the elimination of child labor can have either a domestic source or a foreign source. Domestically, in many countries including the nineteenth century US, social movements of various origins have emerged in defense of children's rights (Moehling 1999). In the international arena, several inter-

national organizations (the *International Labor Organization* and the *World Trade Organization* are examples) have joined hands to combat child labor, often with the support of rich countries. In our paper, we focus on domestic sources by emphasizing that worker-parents vote on a legislative proposal to restrict children's participation in the labor force. We hypothesize that worker-parents channel their pressure through their labor unions. These parents workers, through their labor unions for example, may want to eliminate competitors using cheap child labor, because eliminating this competition may cause their wage to rise. There exists some empirical evidence supporting this motive for social pressure against child labor. Moehling (1999) reveals that social pressure for child labor legislation in nineteenth century US only became a well-organized social movement with the participation of organized labor unions such as the American Federation of Labor, which sought to eliminate competition from cheaper sources of labor. Child labor for these firms was a means to cut down on costs, by replacing more costly adult workers with children. In support to this idea of cheap child labor, Deborah Levison et al. (1998) reveal that in India, for example, children in general were paid about half of the adult wage, even for identical productivity.

B. Substitutability between Adult Labor and Child Labor

To capture the feature that child labor crowds out adult employment, child labor and adult labor are modeled as being perfectly substitutable, at least at the aggregate level. Basu and Van (1998) make a similar assumption. Opponent of this view have

put forward a number of arguments. The most remarkable one is perhaps the so-called "nimble-finger" argument. According to this argument, children and adults differ in work characteristics which lead to market segmentation. However, Levison et al. (1998) reject this "nimble finger" argument based upon a case study of the handnotted carpet industry in the Indian state of Uttar Pradesh. They argue that child labor was not really necessary in the Indian carpet industry, and that its existence only succeeded in creating high levels of adult unemployment and/or under-employment. They also conclude, based upon that case study, that developing countries's tolerance of child labor could only come at the expense of adult jobs.

In our model therefore, the aggregate production function exhibits decreasing returns to scale to labor measured in efficiency units, which is the sum across all households of the effective labor supply of parents and children. For each worker (child or adult), his supply of labor in efficiency units is his endowment of human capital times the time spect delivering it to the firms.

C. Education and Learning-by-doing as Sources of Skill Acquisition

A distinguishing feature of our paper is that both education and child labor are potential sources of skill-acquisition. There are a significant number of studies that formalize education as a mechanism of skill accumulation. Lucas (1988) and Kremer and Chen (2000) are only a few examples. According to the World Bank, countries with the highest levels of average educational attainment are also the richest (see for example *World Development Report 2002*), thus providing evidence of the key role

played by education as a skill-enhancing mechanism.

Evidence that child labor entails learning-by-doing is somewhat mixed in the existing literature. Some empirical studies (for example, Galbi 1997) lend support to this assumption.[3] Others, in contrast, reject the learning-by-doing hypothesis based upon the view that working children in developing countries are usually involved in hazardous labor activities such as drug-dealing, street-begging, child prostitution and pornography which provide virtually no basis for learning valuable productive skills (see for example Lim 1998). What this literature really suggests, however, is that not all forms of child labor entail learning-by-doing. One cannot imagine child prostitution or pornography as an activity that teaches valuable skills to children; nor can one hope to see such skills acquired by a child involved in street-begging or drug-dealings. However, it is generally accepted that, in the case of manufactory employment, child labor, if done under appropriate conditions, can help a child acquire valuable experience in the operation of modern industrial technology. The case of the industrial revolution in England (Galbi 1997) and that of the nineteenth century United States (Goldin and Sokoloff 1982) offer support for this theory.[4] We argue, in

[3] Galbi (1997) reveals that in the beginning of the industrial revolution in Britain, children were preferred to adults for manufacturing employment. However, as early cohorts of children laborers gained more experience in the use of modern technology and became skilled adults, this led to a decline, over time, in the use of child labor in that industry.

[4] Goldin and Sokoloff (1982) reveal that in the United States, child labor was an important component of the manufacturing workforce in the first half of the nineteenth century. They estimated that children accounted for over 20% of manufacturing employment in the Northeast in 1820.

this paper, that where a sufficiently high proportion of working children has access to forms of child labor that provide opportunities for learning-by-doing, the economy will converge to a steady state where mandatory education can be supported as a political-economic equilibrium.

3 Literature Review

Recent theories of child labor in the literature include Glomm (1997), Dessy (2000), and Ranjan (2001) but these models do not imply a theory of the emergence of child-labor laws. Other approaches to analyzing child labor however could also yield a theory of child-labor laws. For instance Basu and Van (1998), rely on the hypothesis of multiple equilibria in the market for unskilled labor to explain why in some countries banning child-labor could be welfare-enhancing. To the extent that child labor and adult labor are substitutes, a poverty-induced massive participation of children in the labor force may contribute to a decline in adult wages, thus maintaining in place the forces that perpetuate poverty and child labor. It is not clear what the empirical implications for child labor laws would be of such an approach. In particular, when and how a country that initially opposes restrictions on children's participation in the labor force, can eventually transform into one where support for banning child-labor emerges has no answer with that approach. So an explanation of the forces that drives down opposition to child labor laws would be required. This is also a difficulty for Baland and Robinson (2000), who argue that child labor laws can reduce inefficiency

in inter-generational allocations, but not why some countries fail to ban child labor.

Dessy and Pallage (2001) build a model in which coordination failures lead to inefficient child labor. Their model explains tolerance of child labor for countries that are too poor to afford the costs associated with the creation of a modern industrial sector (for example, the costs of building development infrastructures). However, the model which is static in nature, begs the question of how decades of development aid did not succeed in breaking down opposition to child labor laws in poor countries.

Dessy and Vencatachellum (2002) proposes a standard externality model that differentiate between countries that adopt child labor laws and those that do not. In their model, either poverty or inequality are to blame for lack of support for compulsory education laws. However, since their model is static, it does not explain the process that can lead to a decline in the incidence of poverty, and eventually to the emergence of education/child labor laws in initially poor countries; nor does it discuss the feasibility of income redistribution. In our model, education and learning-by-doing combine as two potential engines of poverty and inequality-reducing social mobility, and may lead to the emergence of compulsory education laws over time in a country that initially face a stiff opposition to the adoption of such laws.

More closely related to our paper are works by Dirk Krueger and Jessica Tjornhom (2001) and Matthias Doepke and Fabrizio Zilibotti (2002). Krueger and Tjornhom (2001) use a quantitative model to assess the welfare effect of child labor/education laws on different groups of the population in an environment where there are human

capital externalities in the production process. In their models, even the poorest parents benefit from compulsory education, which seems to suggest that even poor countries can benefit from this legislation. Their model therefore cannot explain opposition to education/child labor in poor countries, given that such opposition comes mostly from the poorest households, as in the case of Morocco for example. In our paper, there are three skill levels: low-skill or unskilled, intermediate skill, and high skill. Low-skill parents oppose mandatory education because the wage gain from supporting this legislation is less than the forgone income from child labor sources. Whereas the other two gain from supporting it. We argue that if low-skill parents initially form the majority in the workforce, labor mouvements may fail to become established as a winning political coalition against child labor.

Doepke and Zilibotti (2002) develop a theory of child labor restrictions (CLR) that emphasizes endogenous fertility, and parental investment in education. In their model, poorer parents with few children have little to gain from child labor and are therefore likely to favor CLR, while poorer parents with many working children would be expected to oppose CLR. Unlike Doepke and Zilibotti, we explicitly derive and discuss sufficient conditions for child labor/education laws to emerge in a steady state. Since in our model the unskilled parents always oppose compulsory education laws, and do not send their children to school, it is important that a sufficiently high proportion of children born of these parents have access to forms of child labor that provide opportunities for social-mobility-enhancing learning-by-doing, otherwise this

group of parents will continue to form the political majority that opposes mandatory education. Because of its emphasis on forces driving the emergence of education/child labor laws, our theory also sheds some light on the issue of good versus worst forms of child labor. In fact, our paper support the view that if child labor is to be tolerated, such tolerance must however be restricted to forms of child labor that provide opportunities for learning-by-doing.

4 The Model

Assume that there is a continuum of agents who live for three periods. In the first period they are children, in the next period there are working parents, with one child each, and in the final period they are retired. Parents supply one unit of labor inelastically in the second period, while children's time in the second period is allocated between education and labor. Parents are distinguished by their skill levels, h, which depend on the level of skill they acquire the first period of their lives. There are three possible levels of skills corresponding to three social classes: a low or unskilled class (class u), a middle or intermediate skill class (class m), and an upper or high-skill class (class s). We denote the skill levels as h_u, h_m, and h_s, respectively, with $h_u < h_m < h_s$. In the beginning of the first period of adult-hood (period 2), adults individuals vote over the child-labor law that will obtain in the period, then they each have a child, and decide on household effective labor supply to firms. The law takes the form of a minimum time children must spend in school.

A. Final Output Production

There is a unique final good which is entirely allocated to household consumption. Aggregate output is given by

$$Y = AL^{\xi}, \qquad A > 0, \qquad 0 < \xi < 1, \tag{1}$$

where A is a scale factor measuring the level of technology used, and ξ is a labor-productivity parameter. The above technology exhibits diminishing marginal productivity of labor at the aggregate level. This formulation is designed to capture the empirical evidence that firms using cheap child labor create a pressure for adult-underemployment at the aggregate level. The total quantity of labor, L, demanded by the aggregate of the firms in this economy equals the sum across all households of the effective labor supply of parents and children :

$$L = \sum_{i} \mu_i \left[h_i + (1 - e_i)\, h_0 \right], \tag{2}$$

where $1 - e_i$ denotes child's time allocated to work, μ_i denotes the number of parent-workers with skill levels in the class i $(i = m, s, u)$, and h_0 denotes each child's endowment of human capital. The production environment as described by (1) and (2) exhibits four of the standard features of existing exogenous fertility models of parental investment (e.g. Basu and Van 1998). First, adult effective labor supply is inelastic: each adult individual i allocates his entire time endowment to the delivery of human capital to firms so that his effective labor supply is h_i. Second, the effective labor supply of a child is endogenous: it is equal to the child's human capital endowment

(h_0) times the time $(1 - e_i)$ the child spends delivering it to firms. This latter time allocation is the object of parental decision (Glomm 1997, Basu and Van 1998, Dessy 2000). Third, adult labor and child labor are substitutable (Basu and Van 1998). Fourth, the aggregate production function exhibits diminishing marginal productivity of labor. Combined with perfect competition, the third and fourth features together imply that reducing children participation in the labor force will cause a rise in adults' labor income which is equal to ωh_i. Under perfect competition, the market wage, ω, for effective labor is given by

$$\omega = \xi A \left[\sum_i \mu_i \left[h_i + (1 - e_i) h_0 \right] \right]^{\xi - 1}. \tag{3}$$

Because of this wage effect of law restricting children participation in the labor force, adult workers, through their labor unions for example, have the incentive to collectively push for the adoption of such law in order to drive out of the market all competitors using child labor. Whether this incentive will materialize depends upon, as we show below, on whether for a majority of parents, the gain from a wage increase outweighs the lost due to forgone income from child labor sources.

B. Preferences and Budget Constraint

Parents are expected lifetime utility maximizers with cardinal utility over consumption, c, and the skill realization of their child, $h^c \in \{h_u, h_m, h_s\}$:

$$u(c) + \beta E\left[\nu\left(h^c\right)\right], \qquad 0 < \beta < 1 \tag{4}$$

where β denotes the intergenerational time-discounting factor. The functions u and

ν are strictly increasing, strictly concave and satisfy the Inada conditions.

Without loss of generality, we normalize direct education costs to zero, so that the budget constraint faced by a parent with skill level h_i is given by

$$c_i \leq y\left(h_i, e_i, \omega\right), \tag{5}$$

where $y\left(h_i, e_i, \omega\right)$ denotes household income as specified in (6). The problem faced by each parent of type i is to maximize (4) subject to (5).

Household income depends on the parental skill level $h_j \in \{h_u, h_m, h_s\}$, and the labor supply $(1-e)$ of the child, where e is time spent in education. Per unit time, the quantity of labor supplied equals h_0 for child workers, and equals the skill level h_i for parents. We assume that h_0 is constant across children. Thus for a given wage ω, the household income for a parent with skill h_i and whose child has education e is given by:

$$y\left(h_i, e_i, \omega\right) = \left[h_i + h_0\left(1 - e_i\right)\right]\omega. \tag{6}$$

C. Skill Acquisition and Social Mobility

At the beginning of the third period of life, the child becomes a parent and learns his realization of skill. The transition probabilities of a child whose parent has skill level h_i are given by $\pi_{i,j}\left(e\right) \equiv \Pr(h_j \mid h_i, e)$, where $\pi_{i,j}\left(e\right)$ denotes the probability of a child transiting to a state j, given that his parent is in state i, and a fraction e of his time-endowment has been allocated to schooling. An agent is said to have transited to state j $(j = m, s, u)$ if his skill realization is $h_j \in \{h_u, h_m, h_s\}$.

Assume the transition probabilities are all linear in the education decisions, this probability distribution gives rise to the following 3×3 state transition matrix:

$$\Pi = \begin{bmatrix} \pi_{\mathrm{u}\,u}(e_u) & \pi_{mu}(e_m) & \pi_{su}(e_s) \\ \pi_{um}(e_u) & \pi_{mm}(e_m) & \pi_{sm}(e_s) \\ \pi_{us}(e_u) & \pi_{ms}(e_m) & \pi_{ss}(e_s) \end{bmatrix}, \tag{7}$$

where

$$\pi_{\mathrm{u}\,u}(e_u) = 1 - (1 - e_u) r_u - p_u e_u \tag{8}$$

$$\pi_{um}(e_u) = [(1 - e_u) r_u + p_u e_u] q_u \tag{9}$$

$$\pi_{us}(e_u) = [(1 - e_u) r_u + p_u e_u] (1 - q_u) \tag{10}$$

$$\pi_{mu}(e_m) = [1 - (1 - e_m) r_m - p_m e_m] (1 - q_m) \tag{11}$$

$$\pi_{mm}(e_m) = [1 - (1 - e_m) r_m - p_m e_m] q_m \tag{12}$$

$$\pi_{ms}(e_m) = (1 - e_m) r_m + p_m e_m \tag{13}$$

$$\pi_{su}(e_s) = [1 - (1 - e_s) r_s - p_s e_s] (1 - q_s) \tag{14}$$

$$\pi_{sm}(e_s) = [1 - (1 - e_s) r_s - p_s e_s] q_s \tag{15}$$

$$\pi_{ss}(e_s) = (1 - e_s) r_s + p_s e_s \tag{16}$$

and r_i, p_i, q_i are positive parameters each of which takes values in the closed interval $[0, 1]$. The interested reader can use (8)-(16) to verify that for all i $(i = m, s, u)$

$$\sum_{j=m,s,u} \pi_{ij}(e_i) = 1.$$

Since school and child labor are the only competing claims on child's time, $(1 - e_i)$ denotes child's time allocated to labor. The state transition probabilities in (8)-(16)

therefore capture the nature of forces that determine intergenerational social mobility in this environment. In particular, upward social mobility has two competing sources: one is on-the-job learning-by-doing (the term r_i) and the other is formal schooling (the term p_i). A straightforward inspection of the structure of transition probabilities in (8)-(16) reveal an important feature of our model: whether or not schooling is a more viable option for children's time use depends at least in part, upon the marginal productivity differential $(p_i - r_i)$ between formal schooling and child labor as skill-acquisition mechanisms. In particular, if $p_i - r_i < 0$, work will be preferred to schooling no matter the effect on the adult wage. Therefore, a necessary condition for schooling to be a viable option for children's time use is that $p_i - r_i > 0$.

The parameter p_i can be interpreted as a measure of the marginal productivity of formal schooling as a mechanism for social-mobility-enhancing skill-acquisition for children whose parents have skill level is the class i $(i = m, s, u)$. We impose the following condition:

A.1 $p_s > p_m > p_u$.

This assumption can be justified as follows. First, available evidence suggests that returns to education for poor children are relatively low due in large part to poor school quality and availability (Anker 2000). In contrast, children from richer families usually have access to better schools and are provided with a better learning environment at home. This is particularly true in countries where there are community or regional differences in levels of school-financing. Children living in poor communities

or regions may face poor school quality, for example in terms of pupil/teacher ratio, teachers' quality, and/or school curricula.[5] Finally, anecdotal evidence also suggests that assumption $A.1$ may simply be justified by the fact that more educated parents may be better at cultivating good learning habits in their children.

By analogy to the parameter p_i, the parameter r_i can be interpreted as a measure of the marginal productivity of learning-by-doing as a mechanism of upward social mobility. This explains why the term r_i is multiplied by the time a child spends working: $(1 - e_i)$. When $r_i = 0$, the type of work performed by the child simply does not entail learning-by-doing. In contrast, as long as $r_i > 0$, working (i.e., $1 - e_i > 0$) entails the acquisition of social mobility-enhancing skills. For the remainder of this paper, we assume the following.

A.2 $p_i - r_i > 0$, all $i = m, s, u$.

Assumption $A.2$ simply states that education is more effective than on-the-job learning as a mechanism of upward social mobility.

A final feature captured by the above transition matrix is that, due to the ranking between classes, social mobility has class-specific features. For children whose parents are in the unskilled group, social mobility, when it occurs, is solely an upward movement toward higher classes (intermediate-skill group or high-skill group). For these children, whether leapfrogging to the high-skill group (class s) will occur depends

[5] Doepke (2001) reveals that although Brazil instituted compulsory education as early as 1930, in rural areas, there were either no schools available or the quality was simply too low.

upon the level of the parameter q_u. This parameter measures the extent to which social mobility for these children is biased toward the intermediate-skill group. In particular, the higher q_u the smaller the likelihood that children whose parents are in the low-skill group will leapfrog to the high-skill group (see 8)-(10) above.

For children whose parents are in the intermediate-skill group, social mobility has two possible directions: it can be downward towards class u with probability $[1-(1-e_m)\,r_m - e_m p_m]\,(1-q_m)$, or upward toward the high-skill group, with probability $(1-e_m)\,r_m + p_m e_m$. Whether mobility is biased upward or downward is determined by the level of q_m.

For children whose parents are in the high-skill group, social mobility is exclusively a downward movement: with probability $[1-(1-e_s)\,r_s - pe_s]\,q_s$, these children can drop to the intermediate-skill group (class m), while with probability $[1-(1-e_s)\,r_s - p_s e_s]\,(1-q_s)$ the drop will be deeper and into the low-skill category. Whether the drop will be shorter (middle class) or deeper (low class) again depends upon the parameter q_s. The higher q_s the smaller the likelihood of a deep drop to the low class. Since theory puts no restriction on a parameter such as q_i, for the remainder of this study, and without loss of generality, we restrict attention to an environment characterized by the following assumption:

A.3 Social mobility is only possible between two adjacent skill groups: $q_u = q_s = 1$.

Assumption $A.3$ is made for purely technical reasons, in order to keep the analysis

tractable enough. With this assumption, the state-transition matrix becomes:

$$\Pi = \begin{bmatrix} 1-(1-e_u)\,r_u - p_u e_u & [1-(1-e_m)\,r_m - p_m e_m]\,(1-q_m) & 0 \\ (1-e_u)\,r_u + p_u e_u & [1-(1-e_m)\,r_m - p_m e_m]\,q_m & 1-(1-e_s)\,r_s - p_s e_s \\ 0 & (1-e_m)\,r_m + p_m e_m & (1-e_s)\,r_s + p_s e_s \end{bmatrix} \quad (17)$$

Assumption $A.3$ implies that no poor family child can leap-frog into the high class, nor can a high-class child drops down to the lower-class.

C. Education Decisions

Laws restricting child labor take the form of minimum-education requirements: $\underline{e} \geq 0$. We assume that such laws cannot be made conditional upon the education of the parents. The state of the economy is a vector: $\mu = \{\mu_u, \mu_m, \mu_s\} \in M$, that gives the distribution of voting-age parents over skill levels. We assume that parents choose their minimum education law proposal by anticipating the effect this choice will have on their allocation of child's time between school and work. This allows us to solve the parents problem using backward induction.

Combining (6), (4), and (5), the parent's problem in the second period is:

$$\max_{e_i} \left\{ u\left(w\left[h_i + h_0\left(1-e_i\right)\right]\right) + \beta \sum_j \pi\left(h_j \mid h_i, e_i\right) \nu\left(h_j\right) \right\} \quad (18)$$

$$\text{s.t.} \quad e_i \geq \underline{e}.$$

For a logarithmic specification of utility functions u and ν, the first-order condition for an interior solution is

$$\frac{h_0}{h_i + (1-e_i)\,h_0} = \beta W_i, \qquad i = m, s, u \quad (19)$$

where

$$W_u = (p_u - r_u)\left[\ln h_m - \ln h_u\right]. \tag{20}$$

$$W_m = (p_m - r_m)\left[\ln h_s - q_m \ln h_m - (1 - q_m)\ln h_u\right] \tag{21}$$

$$W_s = (p_s - r_s)\left[\ln h_s - \ln h_m\right]. \tag{22}$$

Condition (19) states that the optimal education policy for a parent with skill level in class i is the level of child's time allocated to schooling that equates the (marginal) utility loss from reducing household consumption to educate the child (the term in the left-hand side) to the (marginal) utility gain from raising a child who transits to a higher-skill class when adult (the term in the right-hand side). Clearly, the lower the productivity differential $(p_i - r_i)$ the lower the utility gain from educating the child. For children whose parents are in the unskilled group, for example, the utility gain from educating the child is higher the higher the income gap between the intermediate-skill group and the unskilled group, as determined by the gap $\ln h_m - \ln h_u$. [6]

5 Equilibrium Dynamics

We distinguish between a competitive equilibrium and a political equilibrium. In a competitive equilibrium, parents are individual decision makers who treat the wage, ω, and the current child labor legislation, $\underline{e}$, as given. This guarantees that equilibrium education decisions are independent of the wage rate, at least for logarithmic

[6] Note however that this utility gain may still be too small to tip the balance in favor of schooling if $p_u - r_u$ is too small.

preferences. We define a political equilibrium to be a situation where the minimum education law voted for reflects the preferences of the majority in a market equilibrium. In that context each parent knows that his minimum-education requirement proposal, if passed, will restrict other parents' child's time allocation decision and hence the total supply of effective labor. In other words, each parent has perfect foresight over the effects of the collective decision on child labor regulation. Parents make their minimum-education requirement proposal with this effect in mind, and will support the imposition of a mandatory minimum education level if and only if, from an individual perspective, the gain from withdrawing all children from the labor force exceeds its cost.

A. A Competitive Equilibrium

Given the current child labor legislation, $\underline{e}$, a competitive equilibrium for the economy in state μ consists of decision rules for education $g(h_i; \underline{e})$, $i = m, s, u$, an aggregate demand for labor, L, a wage function ω, and a law of motion T for μ, such that for all i:

- $g(h_i; \underline{e})$ solves (19), given ω and $\underline{e}$.
- The goods and labor markets clear:

$$\omega = \xi A L^{\xi-1}; \qquad L = \sum_i \mu_i \left[h_i + (1 - e_i) h_0\right].$$

- The skill distribution next period is given by: $\mu' = T\mu = \prod(\underline{e})\,\mu$, where μ' denotes next period state that gives the distribution of voting-age parents over skill levels.

Existence of a market equilibrium is trivial under the assumptions made; we know that for any wage rate the decision rule is single-valued and continuous in the wage (with log utility for consumption, it is independent of the current wage). Labor supply is bounded above and below, and is increasing in ω. Since the wage function is decreasing in L, there must exist a unique $\omega > 0$ such that the labor market clears. A *steady-state* competitive equilibrium is one in which the skill distribution μ is constant over time: $\mu^* = \prod(\underline{e})\,\mu^*$.

A direct implication of a market equilibrium is that the wage function in (3) becomes

$$\omega = \xi A\left[\phi(\underline{e})\right]^{-1} \tag{23}$$

where

$$\phi(\underline{e}) = \left[\sum_i \mu_i\left(h_i + \left[1 - g(h_i;\underline{e})\right]h_0\right)\right]^{1-\xi}. \tag{24}$$

Using (23), and again assuming logarithmic preferences, we can write the market equilibrium value of being a parent with skill-status h_i as

$$\begin{aligned} V(h_i;\underline{e}) &= \ln\left(h_i + h_0\left[1 - g(h_i;\underline{e})\right]\right) - \ln\phi(\underline{e}) + \ln\xi A \\ &\quad + \beta\sum_j \pi\left[h_j \mid h_i, g(h_i;\underline{e})\right]\ln(h_j) \end{aligned} \tag{25}$$

Because of the negative externality the economy-wide incidence of child labor has on the labor wage, and hence on the equilibrium value for being a parent (see 25), it becomes important to ask which parent will benefit from constraining other parents decision on their children's time use through voting on the level of $\underline{e}$. We address this question further below.

B. Political Equilibrium

Consider voting over the education laws which require $e \geq \underline{e}$. Voting is restricted to parents. Parents are called upon, in the beginning of their adulthood, and prior to having children, to submit their proposal for a mandatory minimum-education requirement, $\underline{e}$, for all children. Each parent knows that his proposal, if adopted, will constrain his own future education decisions, as well as that of other parents. Consequently, each parent votes for the law that maximizes his future value for being a parent.

To simplify the analysis of the dynamics of the economy, we assume throughout the remainder of this study that voters must choose between two law proposals: either $\underline{e} = 0$ or $\underline{e} = 1$. That is, the choice is whether or not to make education compulsory.

We denote the law by $\mathbf{e}(\underline{e}) \in \{0, 1\}$, and by $\Gamma[\mathbf{e}(\underline{e})]$ we denote the set of skill levels such that parents with skill levels in that set are the decisive voters, in the sense that the law adopted reflects their preferred choice. Using the definition of state transition probabilities, we can rewrite the equilibrium value of being a parent

with skill level h_i when the adopted law is $\mathbf{e}(\underline{e})$ as follows:

$$V[h_i; \mathbf{e}(\underline{e})] = \ln[h_i + (1 - g[h_i; \mathbf{e}(\underline{e})])h_0] - \ln\phi[\mathbf{e}(\underline{e})] + \overline{\beta_i} g[h_i; \mathbf{e}(\underline{e})] + R_i \quad (26)$$

where $\overline{\beta_i} = \beta W_i$, $g[h_i; \mathbf{e}(\underline{e})]$ denotes the equilibrium education decision taken by a parent with skill level h_i when the adopted law is $\mathbf{e}(\underline{e})$, and

$$\begin{aligned} R_m &= (1 - r_m)(1 - q_m)\ln h_u + (1 - r_m) q_m \ln h_m + r_m \ln h_s + \ln \xi A \\ R_s &= (1 - r_s)\ln h_m + r_s \ln h_s + \ln \xi A \\ R_u &= (1 - r_u)\ln h_u + r_u \ln h_m + \ln \xi A \end{aligned}$$

Therefore, for all parents with a skill level $h_i \in \Gamma[\mathbf{e}(\underline{e})]$, it must be that

$$V[h_i; \mathbf{e}(\underline{e})] \geq V(h_i; 0), \qquad \text{all } \mathbf{e}(\underline{e}) \in \{0, 1\};$$

while for those whose skill level is $h_i \notin \Gamma[\mathbf{e}(\underline{e})]$,

$$V[h_i; \mathbf{e}(\underline{e})] < V(h_i; 0), \qquad \text{all } \mathbf{e}(\underline{e}) \in \{0, 1\}.$$

A *political equilibrium* is an education law, $\mathbf{e}(\underline{e})$, and a distribution of voters $\hat{\mu}$ such that $\sum_i \hat{\mu}(h_i) > 1/2$ for all $h_i \in \Gamma[\mathbf{e}(\underline{e})]$ and $\sum_{i=m,s,u} \hat{\mu}(h_i) = 1$. The function $\hat{\mu}$ associates to each skill level h_i, the total number of adult individuals with that skill level.

To keep the analysis simple and focus on the nature of forces that govern the emergence of child labor/education laws, we characterize the system's dynamics when law restricting child labor can emerge only in the steady state. We begin our discussion with the characterization of equilibrium policies.

C. Equilibrium Allocation of Children's Time Use

Let the education of each class of parents be denoted by $\mathbf{e} = [g(h_m; \underline{e}), g(h_s; \underline{e}), g(h_u; \underline{e})]$. We are now ready to state and prove the following proposition:

Proposition 1 *Suppose that*

$$W_m = W_s = W_u = \bar{W}. \tag{27}$$

Then

$$g(h_i; \underline{e}) = \begin{cases} \underline{e} & h_i < \underline{h}(\underline{e}) \\ \frac{h_i}{h_0} - 1 - \frac{1}{\overline{\beta}} & h_i \in (\underline{h}(\underline{e}), \bar{h}) \\ 1 & h_i > \bar{h} \end{cases} . \tag{28}$$

where $\overline{\beta} = \beta \bar{W}$, *and*

$$\underline{h}(\underline{e}) = \left[1 + \underline{e} + \frac{1}{\overline{\beta}}\right] h_0 \tag{29}$$

$$\bar{h} = \left[2 + \frac{1}{\overline{\beta}}\right] h_0 \tag{30}$$

Proof. The results follow from solving the first order condition in (19) making use of condition (27). ■

Note that by construction, since $\underline{e} \in [0, 1]$, $\underline{h}(\underline{e}) \leq \bar{h}$, with equality only if $\underline{e} = 1$. Condition (27) implies that the marginal utility gain from educating a child is the same across skill-groups. This condition is imposed simply for analytical tractability; and since $p_u < p_m < p_s$, one can always choose r_i, h_i, p_i, and q_m such that this condition easily obtains. Before we proceed with the characterization of the political equilibrium, we impose the following additional assumption:

A.4 The skill groups boundaries are characterized as follows: (i) $h_u \leq \underline{h}(0)$, (ii) $h_m \in \left(\underline{h}(0), \bar{h}\right)$, and (iii) $h_s > \bar{h}$.

Note that one can always choose the parameters r_i, p_i and h_0 such that assumption $A.4$ easily obtains.

Proposition 2 *Let conditions (27) hold. Then, under assumption A.4,*

$$g\left[h_u; \mathbf{e}\left(\underline{e}\right)\right] = \mathbf{e}\left(\underline{e}\right), \quad \textit{for all } \mathbf{e}\left(\underline{e}\right) \tag{31}$$

$$g\left[h_m; \mathbf{e}\left(\underline{e}\right)\right] = \begin{cases} g\left(h_m; 0\right) \in (0,1) & \textit{if} \quad \mathbf{e}\left(\underline{e}\right) = 0 \\ 1 & \textit{if} \quad \mathbf{e}\left(\underline{e}\right) = 1 \end{cases} \tag{32}$$

$$g\left[h_s; \mathbf{e}\left(\underline{e}\right)\right] = 1, \quad \textit{for all } \mathbf{e}\left(\underline{e}\right). \tag{33}$$

Proof. The result follows from proposition 1 combined with assumption $A.4$. ■

Proposition 2 describes the distribution of educational attainments among children from different family backgrounds. When education is not compulsory (i.e., $\mathbf{e}\left(\underline{e}\right) = 0$), children whose parents are in the low-skill group always receive no education $g\left[h_u; 0\right] = 0$. Only when education is made compulsory by law do these children attend school (see expression 31). In contrast, children whose parents are in the intermediate skill-group combine schooling with child labor as their childhood activities when there are no mandatory education (see expression 32). As expected, there is never child labor among children from high-skill parents, whatever the law on education (see expression 33). Given this distribution of educational attainments, the key analytical question is which skill-group benefit from supporting mandatory education.

D. Agents' Preferred Education Law

We now discuss each group of agents' most preferred education law. First, define $\Delta(h_i) \equiv V(h_i;1) - V(h_i;0)$, where $\Delta(h_i)$ denotes the net welfare benefit a parent with skill level h_i derives from supporting a ban on child labor (we assume that such a ban is implemented by compulsory education). If we normalize h_u, h_0, and $\bar{h}$ such that

$$\bar{h} = h_u + h_0, \tag{34}$$

then (28), (30), (26) and (24) can be combined to establish that

$$\Delta(h_s) = (1-\xi)\ln\left[\frac{\phi(0)}{\phi(1)}\right] \tag{35}$$

$$\Delta(h_m) = (1-\xi)\ln\left[\frac{\phi(0)}{\phi(1)}\right] + \left(\frac{\bar{h}-h_m}{h_0}\right)\bar{\beta} - \ln\left(\frac{\bar{h}}{h_m}\right) \tag{36}$$

$$\Delta(h_u) = (1-\xi)\ln\left[\frac{\phi(0)}{\phi(1)}\right] + \bar{\beta} - \ln\left(\frac{\bar{h}}{h_u}\right), \tag{37}$$

where

$$\phi(0) = \left[\mu_s h_s + (\mu_u + \mu_m)\bar{h}\right]$$

$$\phi(1) = \left[\mu_s h_s + \mu_u h_u + \mu_m h_m\right].$$

Note that given μ_i one can easily verify that $\phi(0) > \phi(1)$ since $h_u < h_m < \bar{h}$, by assumption $A.4$. This in turn implies that $\Delta(h_s) > 0$. In other words, parents in the high-skill group always benefit from supporting a ban on child labor. This a

consequence of our assumption that firms using cheap child labor represent an unfair competition to firms using more costly adult labor. This provides an incentive for labor unions representing adult workers to activate in favor of laws banning child labor. However, labor unions representing adult workers will not act unless they have the support of the majority of workers. We will characterize the determinants of majority support further below.

Proposition 3 *Let condition (34) hold and suppose*

$$h_0 \geq \bar{\beta}\frac{\bar{h}-h_m}{\ln\bar{h}-\ln h_m} \tag{38}$$

and

$$\frac{\bar{h}-h_m}{h_m-h_u} > \frac{\ln\bar{h}-\ln h_m}{\ln h_m-\ln h_u}. \tag{39}$$

Then, $\Delta(h_s) \geq \Delta(h_m) > \Delta(h_u)$.

Proof. There are two claims:(i) $\Delta(h_s) \geq \Delta(h_m)$ is true; and (ii) $\Delta(h_m) > \Delta(h_u)$ is also true. We begin with claim (i).

Claim (i): $\Delta(h_s) \geq \Delta(h_m)$. To prove this claim, it suffices to establish that

$$\left(\frac{\bar{h}-h_m}{h_0}\right)\bar{\beta}-\ln\left(\frac{\bar{h}}{h_m}\right) \geq 0.$$

Clearly, the result follows from condition (38) hold.

Claim (ii): $\Delta(h_m) > \Delta(h_u)$. To prove this claim, it suffices to show that

$$\left(\frac{\bar{h}-h_m}{h_0}\right)\bar{\beta}-\ln\left(\frac{\bar{h}}{h_m}\right) > \bar{\beta}+\ln\left(\frac{\bar{h}}{h_u}\right)$$

At the expense of straightforward algebraic manipulations, it can be easily established that the above inequality reduces to

$$h_0 > \bar{\beta}\frac{h_m - h_u}{\ln h_m - \ln h_u}.$$

Conditions (38) and (39) together ensures that this inequality always holds. hence the result. ■

Condition (38) states that children's innate skills are not negligible. Condition (39) is a simple technicality and can easily obtain with a suitable normalization of h_i and h_0 for $i = m, s$. Proposition 3 states that welfare gains from the imposition of mandatory education are non-decreasing in the skill level of the parent. While it is clear that high-skill parents always benefit from supporting mandatory education, the preferred choice of the other two skill groups is not clear. In the special case where condition (38) holds with equality, $\Delta(h_m) = \Delta(h_s) > 0$, implying that parents in the intermediate-skill group and those in the high-skill group benefit equally from supporting mandatory education. That both these groups of parents benefit from supporting such legislation can be explained as follows. Mandatory education reduces the total supply of effective labor. This will significantly raise the equilibrium market wage ω, only if children are sufficiently productive in the sense of condition (38) for example.[7] This in turn enables parents in the high-skill group and the intermediate

[7] Levision *et al.* (1998) report that in India, children in general earn about half of the adult labor wage which support the hypothesis that income from child labor sources can play a significant role in the fight against poverty.

skill group to both benefit from the enforcement of these laws.

Proposition 4 *Suppose (38) holds with equality. Then, if*

$$\xi > \bar{\xi}, \tag{40}$$

where

$$\bar{\xi} = 1 - \frac{1}{\ln h_s - \ln h_u} \left[\left(\ln \bar{h} - \ln h_u \right) - \bar{\beta} \right],$$

labor unions representing adult workers will never have the support of low-skill workers to seek the adoption of child labor laws.

Proof. The proof is straightforward and proceeds by construction. It suffices to that $\Delta(h_u) < 0$, when condition (40). First, observe that condition (40) can be rewritten as follows

$$\begin{aligned} 0 &> (1-\xi) \ln \left(\frac{h_s}{h_u} \right) + \bar{\beta} - \ln \left(\frac{\bar{h}}{h_u} \right) \\ &= \ln \left(\frac{h_s}{h_u} \right)^{1-\xi} + \bar{\beta} - \ln \left(\frac{\bar{h}}{h_u} \right) \\ &\geq \ln \left(\frac{\mu_{st} h_s + (\mu_{ut} + \mu_{mt}) \bar{h}}{\mu_{st} h_s + \mu_{ut} h_u + \mu_{mt} h_m} \right)^{1-\xi} + \bar{\beta} - \ln \left(\frac{\bar{h}}{h_u} \right) \end{aligned}$$

since $h_s > h_m > h_u$ and $\mu_i \in [0,1]$. It then suffices to note that

$$\ln \left(\frac{\mu_s h_s + (\mu_u + \mu_m) \bar{h}}{\mu_s h_s + \mu_u h_u + \mu_m h_m} \right)^{1-\xi} = \ln \left[\frac{\phi(0)}{\phi(1)} \right]$$

by definition. Hence the result. ■

Note that the term $\bar{\xi}$ is strictly less than 1 since $h_s > \bar{h} > h_m > h_u$. Therefore condition (40) can easily obtain for a suitable choice of h_i and h_0. Condition (40)

implies that labor in efficiency units is essential for production. Combined with condition (38), this condition implies that for low-skill parents, the income gain from the complete withdrawal of children from the labor force is less than the forgone income from child labor. As a result, banning child labor imposes a welfare loss to this category of parents. Hence parents in that skill group will vote against any proposed resolution to eliminate competitors using cheap child labor.

D. Social Mobility Dynamics and Mandatory Education

In this subsection, we characterize sufficient conditions for mandatory education to be supported as a political equilibrium. For simplicity we specialize the analysis to the steady state. By focusing on the steady state alone, we implicitly assume that laws restricting children's participation in the labor market do not emerge during the economy's transition to a steady state. We then ask under what conditions such laws can emerge in the steady-state.

Note from proposition 4 above that when the adopted law is $\mathbf{e}(\underline{e}) = 0$, the set of skill levels such that parents with skill levels in that set are the decisive voters is a singleton: $\Gamma(0) = \{h_u\}$. This implies that $\mu_u > .5$ during the transition to the steady state. In such an environment, the unskilled parents choose not to educate their children ($e_u = 0$), middle class parents choose $e_m = g(h_m; 0) \in (0, 1)$, while high skill parents choose $e_s = 1$. It is therefore clear that as long as $\mu_s < 1$ in the steady state, child labor will exists unless a law banning it is voted for by the majority.

Since the transition matrix is time-invariant, the equilibrium law of motion for

the skill distribution is given by $\mu' = \Pi(0)\,\mu$, where

$$\Pi(0) = \begin{bmatrix} 1-r_u & [1-[1-g(h_m;0)]\,r_m - p_m g(h_m;0)]\,(1-q_m) & 0 \\ r_u & [1-[1-g(h_m;0)]\,r_m - p_m g(h_m;0)]\,q_m & 1-p_s \\ 0 & [1-g(h_m;0)]\,r_m + p_m g(h_m;0) & p_s \end{bmatrix} \tag{41}$$

and μ' denotes next period skill distribution of agents. Children with parents in the lowest class (class u) have some probability $\bar{r}$ of becoming middle state parents, even if they receive zero education ($e_u = 0$). The higher r_u the higher the productivity of learning-by-doing as a skill-imparting mechanism for low-income family children. Children from middle class (class m) can become members of any class depending upon the amount education they receive, as measured by e_m. Children of the top class (class s) have some probability $1-p_s$ of falling to the middle class even if they receive full education ($e_s = 1$). Rewriting the system using the fact that $\mu_s = 1 - \mu_m - \mu_u$, leads to the following system dynamics:

$$\begin{bmatrix} \mu'_u \\ \mu'_m \end{bmatrix} = \begin{bmatrix} 1-r_u & [1-(1-e^*_m)\,r_m - p_m e^*_m]\,(1-q_m) \\ p_s + r_u - 1 & [1-(1-e^*_m)\,r_m - p_m e^*_m]\,q_m - (1-p_s) \end{bmatrix} \begin{bmatrix} \mu_u \\ \mu_m \end{bmatrix} + \begin{bmatrix} 0 \\ 1-p_s \end{bmatrix} \tag{42}$$

where $e^*_m = g(h_m, \underline{e})$.

The steady state distribution of skill levels solves

$$\begin{bmatrix} r_u & -\phi(e_m^*) \\ 1-(r_u+p_s) & \psi(e_m^*) \end{bmatrix} \begin{bmatrix} \mu_u^* \\ \mu_m^* \end{bmatrix} = \begin{bmatrix} 0 \\ 1-p_s \end{bmatrix}. \tag{43}$$

where

$$\phi(e_m^*) = [1-(1-e_m^*)r_m - p_m e_m^*](1-q_m) \tag{44}$$

$$\psi(e_m^*) = 2-p_s-[1-(1-e_m^*)r_m - p_m e_m^*]q_m. \tag{45}$$

The 2x2 matrix in (43) admits two eigen values, namely

$$\lambda_1 = \frac{1}{2}\left[\psi(e_m^*)+r_u - \sqrt{(\psi(e_m^*)-r_u)^2 - 4[1-(r_u+p_s)]\phi(e_m^*)}\right] \tag{46}$$

$$\lambda_2 = \frac{1}{2}\left[\psi(e_m^*)+r_u + \sqrt{(\psi(e_m^*)-r_u)^2 - 4[1-(r_u+p_s)]\phi(e_m^*)}\right] \tag{47}$$

where

$$e_m^* = \frac{h_m}{h_0} - 1 - \frac{1}{\overline{\beta}}. \tag{48}$$

One can always normalize choose h_i, p_i, q_i, r_i, and h_0 such that both these eigen values have modulus less than unity. This in turn implies that if a steady state exists, the economy will eventually converge to it.

Given the level of the parameters p_i, q_i, and r_i, the unique steady state distribution of skill levels in this economy is characterized by

$$\begin{bmatrix} \mu_u^* \\ \mu_m^* \end{bmatrix} = \frac{(1-p_s)}{D}\begin{bmatrix} \phi(e_m^*) \\ r_u \end{bmatrix} \tag{49}$$

$$\mu_s^* = 1-\mu_u^*-\mu_m^*, \tag{50}$$

where

$$D = \phi\left(e_m^*\right)\left(1 - p_s\right) + \left[1 - p_s + r_m + \left(p_m - r_m\right) e_m^*\right] r_u > 0$$

and $\phi\left(e_m^*\right) \in (0, 1)$.

Remark 1. *If child labor performed by poor family children does not entail skill-enhancing learning-by-doing (i.e., $r_u = 0$), the system converges to a poverty trap where all individuals are unskilled.*

This is because when $r_u = 0$, $\mu_u^* = 1$, as implied by (49). The intuition behind this result is that since poor family children do not receive any formal schooling (i.e., $e_u^* = 0$), unless child labor entails learning-by-doing (i.e., $r_u > 0$), these children will never experience upward social mobility. And as long as there is a positive probability of downward mobility for children whose parents are in the intermediate and the high skill groups, the economy's transition to the steady state will be characterized by increasing downward mobility toward the unskilled class.

Remark 2. *If $r_u > 0$ and there is no downward mobility for children whose parents are in the high-skill group (i.e., $p_s = 1$), then the system converges to a steady state where all individuals are highly skilled: $\mu_s^* = 1$.*

Remark 3. *Therefore, as long as $r_u > 0$ and $p_s < 1$, the system converges to steady state with the coexistence of three different skill groups: $\mu_i^* \in (0, 1)$ for all $i = m, s, u$.*

A key question at this point of the analysis is under what condition(s) laws mandating compulsory education for all children emerge in the steady state. Under the conditions of proposition 4, and under a majority voting rule, a sufficient condition for laws to emerge in the steady state is that $\mu_u^* < .5$.

Proposition 5 *Let conditions (34), (38), (39) and (40) hold. If in addition*

$$r_u \geq \frac{(1-p_s)(1-r_m)(1-q_m)}{1-p_s+r_m}, \tag{51}$$

then laws mandating compulsory education will emerge in the steady state.

Proof. It suffices to show that $\mu_u^* < .5$ whenever condition (51) is satisfied. Using the definition of μ_u^* in (49), this result follows from the fact that the function $\phi(e_m^*)$ is strictly decreasing in e_m^*. ■

Since $r_u \in (0,1)$, condition (51) gives a sufficient condition for laws mandating compulsory education to emerge in the steady state. Since μ_u denotes the total population of poor parents, and given that children born of these parents do not receive formal education, by the law of large numbers, $r_u\mu_u$ can be interpreted as the proportion of poor family children who have access to a form of child labor that provides opportunities for learning-by-doing; and $(1-r_u)\mu_u$ denotes the proportion these children who do not have access to such child labor and thus will fail to experience upward social mobility upon reaching adulthood. Condition (51) therefore implies that in order for laws mandating compulsory education to emerge in the steady state, a sufficiently high proportion of poor family children must have access

to a form of child labor that provides valuable learning-by-doing. An immediate implication is that in poor countries where a large majority of poor children are involved in the forms of child labor that provide too little or no learning-by-doing, child labor may persist causing the economy to fall into a poverty trap.

What are the implications for the highly debated issue of economic sanctions against countries that tolerate child labor? Consider countries where the proportion of poor family children who have access to a form of child labor with learning-by-doing is too small. While general, indiscriminate economic sanctions against these countries will clearly fail to raise social welfare, such sanctions when appropriately targeted at forms of child labor that do not provide opportunities for learning-by-doing, can actually allow poor family children to enroll only in the forms of child labor that provide learning-by-doing, which will promote high social mobility among children belonging to this group, and eventually lead to the emergence of compulsory education laws. Such targeted sanctions may be desirable because in many poor countries, forms of child labor that do not provide opportunities for learning-by-doing (e.g., prostitution, drug-dealing, deep-sea fishing) tend to pay higher wages than good forms of child labor, which makes the former more attractive to poor family children (Rialp 1993).

6 Concluding Remarks

In this paper, we have developed a positive theory of the emergence of compulsory education laws. Our theory uncovers sufficient conditions for political support for the introduction of compulsory education laws to outweigh opposition to these laws in a steady state. One such condition is that a sufficiently high proportion of poor family children (for whom work is the only viable option) must have access to forms of child labor that provide valuable learning-by-doing. Our theory is therefore consistent with historical evidence, with respect to forces that led to the adoption of child labor laws in Britain and the United States for example. In both these countries, a significant proportion of child labor occurred in manufacturing employment which provides more opportunities for learning-by-doing (Galbi 1997 and Goldin and Sokholoff 1982). View from this angle, our paper differs from Doepke and Zilibotti (2002) in that unlike ours, theirs does not explain the forces that lead to the imposition of education/child labor laws in the first place.

Central to our result is the assumption that laws when they emerge, do so only in the steady state. This assumption was made only for technical reasons, as characterizing transitional dynamics in the case where laws can emerge during the economy's transition to the steady state is rather a complicated task, given the richness of the model at hand.

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