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### **The worst forms of child labour: dynamic model and policy implication**

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#### **Abstract**

This note analyzes an overlapping generations model including the worst forms of child labour based on Dessy and Pallage's (2005) study. We demonstrate the human capital dynamics and show the possibility of the emergences of a poverty trap given the worst forms of child labour, the high incidence of working children and the low level of human capital. The note concludes with some implications for child labour policy.

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## 1. Introduction

The description of worst forms of child labour<sup>1</sup> has suggested two possible tasks for theoretical research: (1) explaining how worst forms of child labour can co-exist with no-worst forms, and (2) providing policy analysis that has new implications about actions that are meant to eliminate the worst forms child labour. In previous works for these two tasks, Dessy and Pallage (2005) develop a static model including the worst forms of child labour and obtain interesting and beneficial results. They conclude that a ban on child labour leads to a deterioration in welfare because the wages of child labour play an important role in family incomes in poor economies.<sup>2</sup>

In this note, we augment Dessy and Pallage's (2005) study by conducting a dynamic analysis with human capital. Child labour has negative effects on educational achievement because it actually imposes psychological, physical and temporal burdens. For example, Jensen and Nielsen (1997) provide evidence of a trade off between child labour and educational level in Africa. Psacharopoulos (1997) and Patrinos and Psacharopoulos (1997) provide similar evidence for Latin America. In this manner, the worse types and high levels of child labour impede economic growth. Therefore, we should consider a dynamic model using human capital theory to confirm in more detail of above two tasks. In the result, we mainly find two subjects: the worst forms of child labour trap in dynamic analysis as adding the first task<sup>3</sup>: and the regulation of child labour on firms or the trade sanctions as adding the second task.

This note analyzes how the level of human capital in the economy decides the incidence and types of child labour by using a two-period overlapping generations model. Each parent makes decisions on family consumption and their children's activities, either the enforcement of labour or the taking of education. The main findings of the analysis are as follows. In an economy with a low level of human capital, the worst forms of child labour emerge, the incidence of child labour is high, and the level of schooling is low. In an economy with a sufficiently high level of human capital, the worst forms of child labour vanish, the incidence of child labour is low, and the level of education is high. We also demonstrate the multiple equilibria are history-dependent: the first is a steady state with a low level of human capital, named a poverty trap, and the second is a steady state with a high level of human capital. Finally, we show that the policy decreasing in child labour wages in its worst forms (the regulations of firms or the trade sanctions) converts children into general forms of child labour. In addition, there is the probability that these policies have the effect of pushing some countries into a poverty trap.

<sup>1</sup>Currently, policy discussion of child labour in some developing countries has changed from one of incidence to the types of child labour. This is especially because the ILO banned the worst forms of child labour in 1999 in Convention 182 as follows. "The term *the worst forms of child labour* comprises:(a) all forms of slavery or practices similar to slavery, such as the sale and trafficking of children, debt bondage and serfdom and forced or compulsory labour, including forced or compulsory recruitment of children for use in armed conflict; (b) the use, procuring or offering of a child for prostitution, for the production of pornography or for pornographic performances; (c) the use, procuring or offering of a child for illicit activities, in particular for the production and trafficking of drugs as defined in the relevant international treaties; (d) work which, by its nature or the circumstances in which it is carried out, is likely to harm the health, safety or morals of children."

<sup>2</sup>Basu and Chau (2004) analyze debt bondage included in the ILO Convention 182 in some developing countries. Rogers and Swinnerton (2008) propose the analysis of exploitative child labour. They show that the policy intervention of observing and controlling firms exploiting children has a Pareto improving effect.

<sup>3</sup>See Dessy (2000), Hazan-Berdugo (2002), Strulik (2005), Sugawara (2009) for dynamic analysis of child labour.

This note is organized as follows. Section 2 develops the model and characterizes the equilibrium of the incidence and choice of the types of child labour given the level of human capital. Section 3 analyzes the human capital dynamics. Section 4 provides the policy implications and Section 5 concludes.

## 2. The Model

Consider a two-period overlapping generations model in which a continuum of one unit of identical agents is born in every period. The population in the economy is constant and each household consists of one child and one parent. An agent born in period  $t$ , referred to as generation  $t$ , lives for two periods: childhood for period  $t$  and adulthood for period  $t + 1$ . Generation  $t$  is endowed with one unit of time in childhood for period  $t$ . Their parents, generation  $t - 1$ , allocate this time endowment between work,  $l_t^Z$ , and education,  $\tau_t$ , that enables the accumulation of human capital,  $h_{t+1}$ . We assume that children can work in either a general form that is non-harmful to them,  $l_t^A$  or the worst forms that are harmful to them,  $l_t^B$ . Therefore, the time constraint in childhood is given by:

$$1 = l_t^Z + \tau_t, \quad Z = A, B. \quad (1)$$

The above equation shows the trade off between child labour and education during childhood. Generation  $t$  is also endowed with one unit of time in adulthood for period  $t + 1$ . We assume that the parents spend all of their time in labour supply given their accumulated human capital.

We consider the firms as perfectly competitive profit maximizers. We assume that the firms are separated into two sectors: a general sector,  $Y_A$ , and a sector of the worst forms of child labour,  $Y_B$ . The former sector produces goods by using both child labour in its good form and adult labour. However, while the children use only unskilled labour, the adult generations use human capital. The latter sector produces goods by using child labour in the worst forms. We assume that both sectors have linear production functions in which the constant productivity of each production factor is  $w_A$  and  $w_B$ . We also assume that child labour draws higher wages in the worst forms sector than in the general sector,  $w_A < w_B$ .<sup>4</sup> The production function of these firms is expressed by:

$$Y_A = w_A(l_t^A + h_t), \quad (2)$$

$$Y_B = w_B l_t^B. \quad (3)$$

In this model, the human capital level,  $h_{t+1}$ , that generation  $t$  uses to produce goods in adulthood is predetermined in period  $t$ . Following Dessy and Pallage (2005), we assume that not only education but also child labour promotes the level of human capital because of learning-by-doing. To simplify the analysis, we assume that the human capital accumulation function is specified by:

$$h_{t+1} = \phi^Z l_t^Z + \eta \tau_t + 1, \quad Z = A, B, \quad (4)$$

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<sup>4</sup>Rialp (1993) and Dessy and Pallage (2005) provide a well-informed survey on the phenomenon that the enormously high wages of prostitution, deep-sea fishing and criminal activity compel children to work in these worst forms of child labour. For example, girls aged 14–16 years engaged in prostitution can earn a median income of about US 53 in Republic of the Philippines while the wages of young prostitutes in Jamaica are between 40 and 150 times higher than the hourly wage rate in blue-collar manufacturing employment.

where  $\phi^Z$  and  $\eta$  express the levels of learning-by-doing and an educational time, respectively. The third term on the right-hand side, the constant number one, represents the adjusted innate ability of human beings.<sup>5</sup> We make the following assumption about the effect on accumulation of children's human capital by working in each form:

**Assumption 1.**

$$\phi^B < \phi^A < \eta.$$

Boyden et al. (1998) provides some evidences that some kinds of child labour have the effect of raising human capital through learning-by-doing. However, child labour in its worst forms disturbs educational achievement owing to the psychological and physical harm it impacts on children.<sup>6</sup> The first inequality indicates that child labour in its worst forms deteriorates the level of human capital accumulation more than in the general form. The second inequality shows that schooling is more productive in human capital accumulation than learning-by-doing.

The consumption of parents born in period  $t$ ,  $c_{t+1}^P$ , is based on their own wage income that they earn in firms using their human capital,  $w_A h_{t+1}$ , and their children's wage income, which they earn in either the general sector or the worst sector,  $w_Z l_{t+1}^Z$ . Thus, the budget constraint for parents is given by:

$$c_{t+1}^P = w_A h_{t+1} + w_Z l_{t+1}^Z. \quad (5)$$

We assume that the parental utility is derived from consumption,  $c_{t+1}^P$ , and the altruism of children indicated by the observable human capital level of children,  $\eta\tau_t + 1$ . The altruism consists of this form for the reason that parents in the period  $t + 1$  (generation  $t$ ) cannot observe the adulthood consumption of children,  $c_{t+2}^P$  and the human capital appended by the externality of learning-by-doing,  $\phi^Z l_t^Z$ . We also assume that each agent has a utility function of a logarithmic form. Thus, the utility function of parents born in period  $t$  is:

$$U_{t+1}^P = \log c_{t+1}^P + \beta \log(\eta\tau_{t+1} + 1), \quad 0 < \beta < 1, \quad (6)$$

where  $\beta$  expresses as the degree of altruism for human capital level of their children.

Parents make decisions about their children's activity that encompasses each type of child labour or schooling in childhood. Therefore, parents born in period  $t$  choose each variable of family behavior to maximize their own utility in period  $t + 1$ . They make decisions about the activity of their children,  $l_{t+1}^Z$ , because parents determine family behavior as a whole. Thus, the optimization problem of parents becomes:

$$\begin{aligned} \max_{c_{t+1}^P, l_{t+1}^Z} U_{t+1}^P &= \log c_{t+1}^P + \beta \log[\eta(1 - l_{t+1}^Z) + 1], \\ \text{s.t. } c_{t+1}^P &= w_A h_{t+1} + w_Z l_{t+1}^Z \quad 0 \leq l_{t+1}^Z \leq 1. \end{aligned}$$

first-order condition with respect to  $l_{t+1}^Z$  is given by:

$$\frac{w_Z}{w_A h_{t+1} + w_Z l_{t+1}^Z} - \frac{\beta\eta}{\eta(1 - l_{t+1}^Z) + 1} \begin{matrix} \leq \\ \geq \end{matrix} 0 \quad (\text{with equality if } 0 < l_{t+1}^Z < 1). \quad (7)$$

<sup>5</sup>We assume that agents in childhood use one unit of innate human capital when they work in the general sector.

<sup>6</sup>For example, ILO (2002) reports the worst forms of child labour.

Next, we characterize the equilibrium choices of the parents under a given level of human capital. In particular, we analyze the type of child labour parents choose. When the human capital level is sufficiently low, and the incidence of child labour reaches its upper bound of 1, we obtain the following inequality using (7):

$$h_{t+1} < \frac{w_Z(1 - \beta\eta)}{\eta\beta w_A} \equiv \hat{h}_Z. \tag{8}$$

In this case,<sup>7</sup> child labour reaches its upper bound because parents cannot afford to send their children to school and family income depends crucially on the wage income of their children because of the low parental income. On the other hand, when the human capital level is sufficiently high, and the family income does not need to depend on child labour, then we obtain the following inequality by using (7):

$$h_{t+1} > \frac{w_Z(1 + \eta)}{\eta\beta w_A} \equiv \bar{h}_Z. \tag{9}$$

We can obtain the supply function of child labour depending on the parental human capital by using (7), (8), (9):

$$l_{t+1}^Z \begin{cases} = 1 & \text{if } h_{t+1} \leq \hat{h}_Z. \\ = \frac{w_Z(\eta + 1) - \eta\beta w_A h_{t+1}}{\eta(1 + \beta)w_Z} & \text{if } \hat{h}_Z < h_{t+1} \leq \bar{h}_Z. \\ = 0 & \text{if } \bar{h}_Z < h_{t+1}. \end{cases} \tag{10}$$

Figure 1 depicts the equilibrium values of child labour given the level of human capital.

We derive the incidence of each type of child labour given the level of human capital. In which types of child labour do parents engage their children under a given human capital level? To explore this choice, we compare the utility levels of the two types of child labour. To obtain the indirect utility function, we first calculate the consumption level of each family using (5) and (10):

$$c_{t+1}^P = w_A h_{t+1} + l_{t+1}^Z w^Z = \frac{1}{(1 + \beta)} \left[ w_A h_{t+1} + \frac{w_Z(\eta + 1)}{\eta} \right]. \tag{11}$$

This shows that consumption of the parents increases with the human capital level and the wages of both sectors. We can next obtain the following indirect utility function of parents using (6), (10), and (11):

$$V_Z^P = (1 + \beta) \log \left( w_A h_{t+1} + \frac{w_Z(\eta + 1)}{\eta} \right) - \beta \log w_Z - R, \quad R \equiv \beta \log \beta \eta - (1 + \beta) \log \beta(1 + \beta). \tag{12}$$

Let the difference in the utility levels of parents be  $\Phi(h_{t+1})$ :

$$\Phi(h_{t+1}) \equiv V_A^P - V_B^P, \quad \Phi(\tilde{h}) = 0. \tag{13}$$

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<sup>7</sup>This border value,  $\hat{h}_Z$ , increases with a decrease in each of two factors. The first factor consists of the proportion of the productivity of each child labour to the productivity of the adult human capital. The second factor consists of the degree of altruism for the child and the efficiency of education. The greater this border value, the slower the incidence of child labour takes off from the upper bound.

Each family engages their children in the general sector if  $\Phi(h_{t+1})$  takes a positive value, and engages their in the worst forms if  $\Phi(h_{t+1})$  takes a negative value.  $\Phi(h_{t+1})$  becomes the following:

$$\Phi(h_{t+1}) \equiv V_A^P - V_B^P = (1 + \beta) \log\left[\frac{w_A h_{t+1} + w_A \frac{(\eta+1)}{\eta}}{w_A h_{t+1} + w_B \frac{(\eta+1)}{\eta}}\right] - \beta \log\left[\frac{w_A}{w_B}\right]. \quad (14)$$

Hence, this model proposes that the wage differentiate between both sectors,  $\frac{w_A}{w_B}$ , is an essential factor of emergence of child labour in the worst forms, as in the above function.

Firstly, there exists a level of human capital at which parents become indifferent between the two types of child labour. We denote this level as  $\tilde{h}$ :

$$\Phi(\tilde{h}) = (1 + \beta) \log\left[\frac{w_A \tilde{h} + w_A \frac{(\eta+1)}{\eta}}{w_A \tilde{h} + w_B \frac{(\eta+1)}{\eta}}\right] - \beta \log\left[\frac{w_A}{w_B}\right] = 0. \quad (15)$$

We can easily solve  $\tilde{h}$  as follows:

$$\tilde{h} \equiv \frac{\frac{(\eta+1)}{\eta} \left( \left( \frac{w_A}{w_B} \right)^{-\frac{1}{1+\beta}} - 1 \right)}{\left( 1 - \left( \frac{w_A}{w_B} \right)^{\frac{\beta}{1+\beta}} \right)}. \quad (16)$$

Differencing  $\Phi(h_{t+1})$  with respect to  $h_{t+1}$  results in:

$$\frac{\partial \Phi}{\partial h_{t+1}} = (1 + \beta) \left[ \frac{w_A}{w_A h_{t+1} + w_A \frac{(\eta+1)}{\eta}} - \frac{w_A}{w_A h_{t+1} + w_B \frac{(\eta+1)}{\eta}} \right] > 0, \quad \frac{\partial^2 \Phi}{\partial h_{t+1}^2} < 0. \quad (17)$$

The worst forms of child labour emerge if parental human capital is low,  $h_{t+1} < \tilde{h}$ . But they disappear if parental human capital is sufficiently high,  $h_{t+1} > \tilde{h}$ . Furthermore, two factors induce parents to engage their children in the worst forms of child labour. First, when the relative wage,  $\frac{w_A}{w_B}$  is higher, the greater the incentive for parents to force their children to work in the worst forms of child labour.<sup>8</sup> The second factor is the educational efficiency parameter,  $\eta$ . If  $\eta$  increases, the opportunity cost of child labour increases more in its worst forms than in the general forms because  $\eta$  represents the opportunity cost of child labour, and wages of the worst forms are higher than the general forms,  $w_A < w_B$ . Fig 2 depicts the  $\Phi(h_{t+1})$  function and the shift resulting from the increase in the relative wage,  $\frac{w_A}{w_B}$ , and  $\eta$ .

<sup>8</sup>We can confirm this feature with the following derivation:

$$\frac{\partial \tilde{h}}{\partial \frac{w_A}{w_B}} = \frac{\frac{(\eta+1)}{\eta} \left[ -\frac{1}{1+\beta} \left( \frac{w_A}{w_B} \right)^{-\frac{2-\beta}{1+\beta}} \left( 1 - \frac{w_A}{w_B} \right)^{-\frac{1}{1+\beta}} + \frac{1}{1+\beta} \left( \frac{w_A}{w_B} \right)^{-\frac{1}{1+\beta}} \left( \left( \frac{w_A}{w_B} \right)^{-\frac{1}{1+\beta}} - 1 \right) \right]}{\left( 1 - \left( \frac{w_A}{w_B} \right)^{\frac{\beta}{1+\beta}} \right)^2}.$$

As arranging the denominator on the right-hand side of above function, we can express the following inequality:

$$\left( \frac{w_A}{w_B} \right)^{-\frac{2}{1+\beta}} \left[ (1 + \beta) \left( 1 - \left( \frac{w_A}{w_B} \right)^{-\frac{\beta}{1+\beta}} \right) - \beta \frac{w_A}{w_B} \right] < 0.$$

### 3. The dynamics of human capital

In this section, we examine the dynamics of human capital and the dynamic transition of child labour. In this model, the level of adult human capital is decided by two factors: the educational level during childhood and learning-by-doing through child labour.

We can obtain the dynamics of human capital by using the accumulation function of human capital (4) and the equilibrium value of  $l_{t+1}^Z$ , as derived from section 2 .

$$h_{t+1} \begin{cases} = \phi^Z + 1 & \text{if } h_t \leq \hat{h}_Z. \\ = \frac{(\phi^Z + \beta)w_Z(\eta + 1) + \eta\beta w_A h_t(\eta - \phi^Z)}{\eta(1 + \beta)w_Z} & \text{if } \hat{h}_Z < h_t \leq \bar{h}_Z. \\ = \eta + 1 & \text{if } \bar{h}_Z < h_t. \end{cases} \quad (18)$$

We draw the phase diagram of human capital in the same dimensions as Figures 3 and 4. We define the steady state of the level of human capital as  $h_B$  when parents engage children in the worst forms of child labour. Figure 3 demonstrates the case of a unique steady state. If  $h_B < \tilde{h}$ , parents engage their children to work in the general forms of child labour even at the relatively low level of parental human capital. On the other hand, Figure 4 demonstrates the case of multiple steady states. This argument provides the following proposition about a dynamic analyses.

#### Proposition 1.

1. *If  $h_B < \tilde{h}$ , there is a unique steady state with a high human capital level. When the economy remains in a steady state with a high human capital level, child labour vanishes, and the educational level reaches its upper bound.*
2. *If  $h_B > \tilde{h}$ , there are multiple steady states with high or low human capital levels. On the one hand, if the economy starts from a low human capital level,  $h_B > \tilde{h}$ , the economy converges to a steady state with a low human capital level that represents a poverty trap in which parents engage their children in the worst forms of child labour and the educational level reaches its lower bound. On the other hand, if the economy begins from a high enough human capital level,  $h > h_B$ , the economy converges to a steady state with a high human capital level.*

### 4. Policy Analyses

We now discuss policies that can restrain the worst forms of child labour. In this section, we analyze the regulation of firms employing children in the worst forms and the trade sanctions against products produced using the worst forms. The standard policy for restraining child labour is that governments impose a fine on firms employing children.<sup>9</sup> We assume that  $p$  represents the probability that the government detects firms employing children in its worst forms and  $F(l_t^B)$  represents the amount of the fine given the incidence of child labour, respectively. We also assume that the government transfers the fine to households as lump-sum subsidies,  $T_t = pF(l_t^B)$ . The profit

<sup>9</sup>For example, the Indian government charges a fine between Rs 10,000 and Rs 20,000 on firms (Basu (2005)). Similarly, the Thai government charges a fine of 200,000 baht or less or below 1-year sentence or less for any person or firm employing children aged less than 15 years.

maximization problem for the sector employing the worst forms of child labour is given by:

$$\max_{l_t^B} \Pi_B = Y_B - \bar{w}_B l_t^B - pF(l_t^B). \quad (19)$$

The first-order condition with  $l_t^B$  is given by:

$$\frac{\partial \Pi_B}{\partial l_t^B} = w_B - \bar{w}_B - pF'(l_t^B) = 0, \quad (20)$$

where  $\bar{w}_B$  represents the wage rate in the child labour market for the worst forms.

We investigate the market for the worst forms of child labour to examine the effect of governmental regulation in the case where the worst forms of child labour exist before government policy. Fig 5 depicts the labour market equilibrium and the effect of governmental regulation. The labour supply curve is represented by  $SCBAS$ , along with the given level of human capital,  $h_{t+1}$ , and the wages of the general sector,  $w_A$ , before the government imposes the fine by using the above function (10) that represents the incidence of child labour engaged by the households and the function (14) that represents the choice of types in child labour. The labour supply curve contains three segments. The first segment,  $SC$ , referred to as *regime A*, shows that the worst forms of child labour vanish with a certain level of wages because families shift the children from the worst sector to the general sector. The second segment,  $BA$ , shows that the incidence of labour increases with an increase in the wage. The third segment,  $AS$ , depicted as the vertical line, indicates that the incidence of labour reaches its upper bound, 1, because the wages are very high. On the other hand, the labour demand curve is readily depicted by the horizontal line,  $DD$ , because we assume that the productivity of the firm is linear. The labour market equilibrium of wages and the incidence, dot  $E$  in fig5, is decided by the crossing point of these two curves.

Now, we examine the effect of governmental regulation in Figure 5. The labour supply curve does not change after the government imposes the fine. However, the labour demand curve bends downward,  $\bar{w}_B = w_B - pF'(l_t^B)$  by using (20). The fine makes the marginal productivity of firms fall with an increase in the incidence of labour. This curve is depicted as  $DD'$ . Therefore, the labour market equilibrium of wages and the incidence changes from dot  $E$  to dot  $E'$ . Most probably, the possibility exists that the worst forms of child labour vanish in economies with a sufficiently high level of human capital because the wage level reaches Regime A. Thus, both the possibility of detecting child labour,  $p$ , and the amount of the fine,  $F$ , reduce the wages of child labour in its worst forms. Furthermore, these regulations lower the level of human capital where the worst forms of child labour emerge,  $\tilde{h}$ , as in function (14). For the same reason, a trade sanction against goods produced using the worst forms of child labour also brings down wages because firms shift the excrement costs of trade sanctions (e.g. taxes or escaping checks) to the wages of children.

## 5. Conclusion

This paper analyzes the cause of the worst forms of child labour in an overlapping generations model. The incidences of child labour increase with a decrease of parental human capital. Additionally, parents with a low level of human capital engage children in the worst forms of child labour. Therefore, human capital stays at a low level and a poverty trap emerges. Thus, we construct a model of an actual condition in which



some poor families in developing countries have no choice but to engage children in the worst forms of child labour. We also find that important factors bringing about the worst forms of child labour are wage differentiation and the efficiency of education. These factors play an important role in the policy implications for the worst forms of child labour. We conclude that some countries in poverty traps need to be pushed out using policies such as fining the use of child labour. However, the government has to take care not to starve the peoples more at the same time.<sup>10</sup>

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<sup>10</sup>Ranjan (2001) and Jafarey and Lahiri (2002) discuss the trade sanctions. The both papers contradict the trade sanction. They say that children work more according to a decrease of wages by trade sanction because the child labour wages play an important role in their family incomes.

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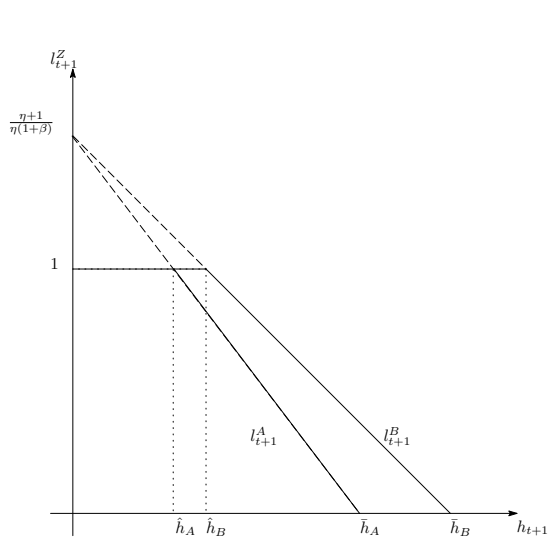


Figure 1: The incidence of each type of child labour.

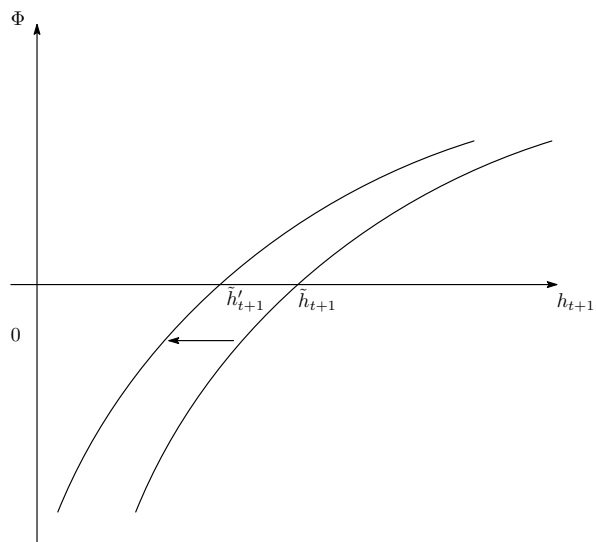


Figure 2: The  $\Phi(h_{t+1})$  function and increases in the relative wage,  $\frac{w_A}{w_B}$ , and  $\eta$ .

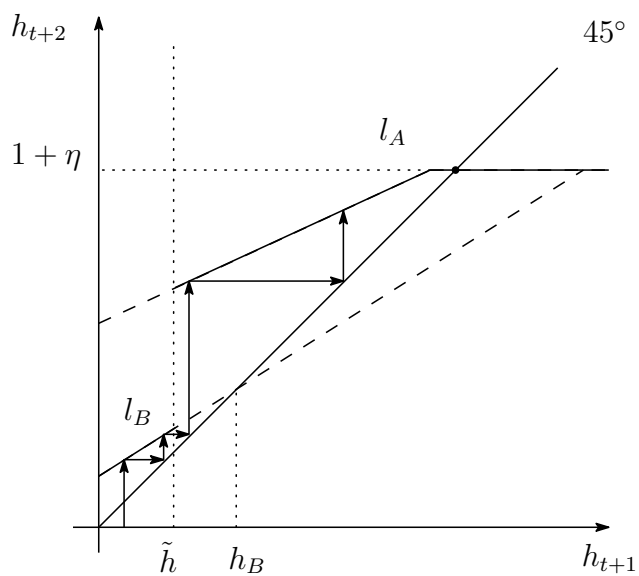


Figure 3: The phase diagram in the case of  $\tilde{h} < h_B$

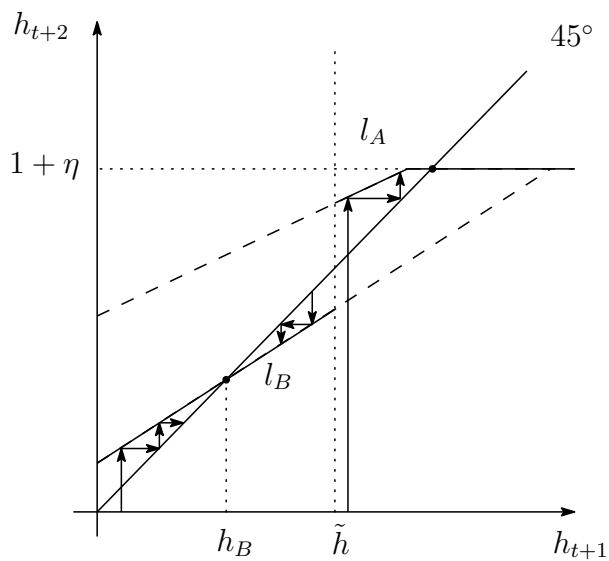


Figure 4: The phase diagram in the case of  $\tilde{h} > h_B$

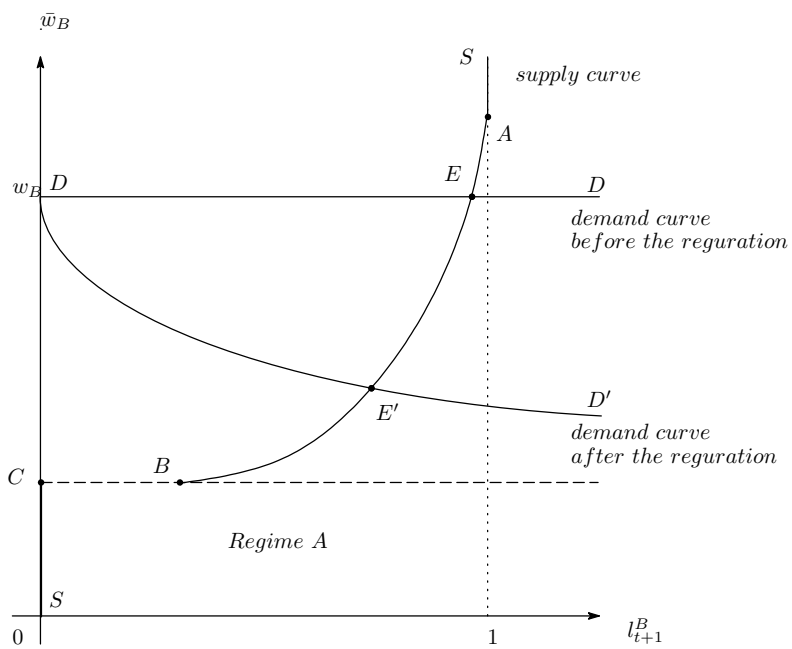


Figure 5: The market for the worst forms of child labour