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Growth and Inverted U in Child Labour: A Dual Economy Approach

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Abstract

While it is commonly accepted that the main cause of child labour is poverty, empirical observations suggest that economic growth is not always associated with the reduction in child labour. We show, in a dual economy framework, that the effect of productivity growth upon child labour may be positive or negative. In particular, changes in the productivity gap between the modern and the traditional sectors, due to the technological progress, can generate an increase in child labour. In a dynamic version of the model we also investigate how this effect depends on the quality of schooling.

1 Introduction

International evidence indicates that the labour participation rates of children have decreased across the world between 1950 and 2000, bringing the world average down from 27.6% in 1950 to 11.3% in 2000; in Europe, the fall has brought the child labour participation rate down to 0.04% and in India child labour participation rates decreased from 35.43% to 12.07% during this period (ILO, 2004). According to Hagemann et al. (2006), the proportion of children between ages 5 and 14 involved in productive activities, including unpaid household work, fell from 17.6% in 2000 to 15.8% in 2004. While this trend is observed simultaneously with economic growth in less developed countries, whether, and how, economic growth is causing the decrease in the number of working children is still unclear. With child labour being popularly considered to result from poverty, many policy makers, reviewing such international evidence, argue that the best panacea for child labour is economic growth (see

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Weiner (1991) for the context in which this argument is put forward in India). However, few studies have explicitly analysed the way in which growth might decrease child labour. There is therefore very little information regarding the length of time that it may take for growth to have an effect or even the channels through which it may operate. Thus, growth may decrease child work directly by increasing household incomes but it may also influence the infrastructure and the environment in which the child lives. At the same time, growth may shift the demand for labour, including child labour, and the overall effect may, in fact, be an increase in the amount of child labour employed.

In this paper we present a model of child labour in a dual economy and compare its predictions with the observed patterns of child labour across regions in India. Our preliminary analysis, presented in the paper, draws on the Indian National Sample Survey (NSS) data for 3 years – 1983, 1993 and 2004. India provides a good case in which to study these issues because levels of prosperity and rates of growth vary significantly across the country. In addition, the 1983-2004 period was the one in which India undertook considerable reforms of her economy and, hence, these years encompass a range of institutional and economic changes.

Despite the decrease in the number of children working across the world, approximately 12% of 10-14 year olds were working in India in 2000 (ILO, 2004). Child labour affects the level of child schooling as well as the performance of children in school. Schooling, in turn, is an investment good that will influence a child's earning capability as an adult and therefore will determine inter-generational economic and social mobility.

The unofficial position in India with regard to child labour is that growth will filter down into employment and incomes, and this will reduce the necessity for the poor to send children to work (Weiner, 1991, p.13). However, the observed patterns suggest that this does not always happen, and even if it does, the process takes a long time. If growth lifts the employment constraints on households, it might make the incidence of child labour more likely. Growth can also result in disproportionate changes across sectors, with the result that the pervasiveness of child labour increases in low-skill sectors and among low-income households. Finally, it is possible that children work not because their parents are poor but because schools are not good enough, so that parents see no benefit from education for their children. Identifying which of these factors prevails is important because it will determine which policy is likely to achieve a decrease in child work.

1.1 Literature

The influence of macroeconomic performance on child labour and schooling has attracted considerable attention in the literature (Grootaert and Patrinos, 1999; Swaminathan, 1998; Neri and Thomas, 2001; Kak, 2004; Weiner, 1991). There is also a large historical literature which accepts that 'the early phase of industrialisation, during the 18th and 19th centuries, brought an increased reliance on child labour' (Heywood, 1988; p.132) though trend was subsequently reversed.

The relationship between child labour and growth has also been studied in various theoretical frameworks. Hussain and Maskus (2003), for instance, relate the dynamics of child labour to human capital accumulation through schooling. Strulik (2004) includes fertility choice and child survival thus relating economic growth and child labour to a demographic transition. Hazan and Berdugo (2002) modelling child labour and fertility decisions in the context of economic growth argue that in the early stages of development, the economy is in a 'development trap' in which child labour is abundant, fertility is high and output per capita is low. With technological progress, adult wages increase relative to child wages and the resultant income and substitution effects induce parents to send children to school instead of work and therefore also to decrease the number of children they have. This leads to further economic growth and further decreases in child work. Chaudhuri and Dwibedi (2007) use a dual economy approach to investigate the effect on child labour of an expansion of foreign capital investment, as well as the effect of taxes and education subsidies. Recently, Basu and Bar (2009) examined the effect of an increase in a household's land ownership on child labor. They showed that increases in land initially lead to increased child labor, but as land continues to increase child labor declines. The possibility of an inverted-U relationship between land holdings and child labor was also explored theoretically and tested empirically in Basu, Das, and Dutta (2009).

In addition, there have been empirical studies that have considered this relationship in different countries across the world. Edmonds and Pavcnik (2002), considering the impact of trade liberalisation on child labour in Vietnam, find large reductions in child labour associated with increases in the relative price of rice, the major component of Vietnam's exports. Swaminathan (1998) in a study of a prosperous and fast growing region of India – Gujarat - finds that growth is associated with an increase in child labour. Torres (2003) finds that while per capita GDP is negatively correlated with child labour there is no correlation between growth performance and changes in child labour. Thus, economic growth does not automatically reduce children's participation in labour force. Further analysis of the role of education in reducing child labour shows that the quality of education matters more than the quantity.

Kambhampati and Rajan (2005) find that there is some evidence of a quadratic relationship between the probability of a child being employed and regional economic growth in India in 1993. They found, for example, that Bihar (at a very low level of development) and Kerala (at a relatively high level of development) had similarly low levels of child work, though in Kerala this was accompanied by very high levels of child schooling. Thus, Bihar seemed to be a 'low' opportunity state, while Kerala seemed to be a 'high' opportunity state. The analysis of the 2004 data shows that child labour is negatively correlated with the adult unemployment, which also suggest that more children is employed in the regions with higher economic opportunities. Kak (2004), in a study of child labour in India, tries to explain the 'persistence of child labour in a period when unemployment levels for adult workers are increasing'. He argues that the demand for children in the labour market occurs not because of labour shortages but because of the characteristics of the labour market which is segmented by caste, gender and class divisions 'which provide distinct spheres for participation of children in the labour force' (Kak, 2004, p.46). Basu et al (2003) argue that 'the demand side factors (of child labour) are not observable and have earlier been ignored' so that 'all the data available to us as well as those used in earlier empirical studies on this topic relate to the supply side of child labour' (Basu et al, 2003, p.11). The authors correct for this by including village level fixed effects which proxy for the impact of regional prosperity on household incomes, infrastructure and on opportunities for employment.

Overall, there seems to be strong evidence in the current literature that economic growth does not necessarily reduce child labour. The traditional notion that economic growth will decrease child labour highlights the impact that such growth will have on household incomes and therefore on the supply of child workers. However, growth may also influence many of the above factors, either directly or indirectly. Thus, while economic growth decreases the supply of child workers, it also increases the demand for child workers, at least in the short run. The overall effect is ambiguous. In this paper we demostrate how in a dual economy framework growth in productivity can generate an increase in child labour in equilibrium because the effect of the demand side of the economy dominates that of the supply side.

1.2 Child labour trends in India

Studies done on the 1993 NSS concluded that though child work was relatively low (about 5-8%) on average in India, it was increasing with growth instead of decreasing (Kambhampati and Rajan, 2006). In addition to this, a number of studies found that the category of children who were recorded as not doing anything i.e. the 'idle' category was very high across states in India. In most cases, it was the second largest category – after child schooling. This led to many writers to conjecture that these children were simply waiting for jobs (i.e. were being rationed on the job front) or did not have schools to go to. If this were true, then child work would increase with growth over time and across regions and the 'none' category would become smaller.

Analysing data from 2 rounds of the National Sample Survey of India - 1993 and 2004, we find that there has been a large increase in the proportion of children in work between 1993 and 2004 (see Tables 1 and 2). The tables are based on two activity status variables:

- Usual Principal Activity Status which indicates the main activity that the person is engaged in;
- Usual Subsidiary Activity Status, which indicates whether children are doing more than one activity;
  - Work (for those who are primarily engaged in work),
  - School (for those who are primarily engaged in schooling),

- Chores (for those who are mainly engaged in doing household chores),
- SCHWRK (those who state their main activity as schooling and subsidiary activity as work)and
- None (those who are not identified as doing any of these activities).

In many states like Assam, Haryana and Himachal Pradesh, this proportion has increased more than 12 times. In addition, there has been a significant increase in the proportion of children doing chores (from less than 1-2% in 1993 to more than 10% by 2004). Finally, the proportion of children primarily going to school but also working has seen a very large increase from less than 1% in 1993 to over 10% in 2004. There has also been a significant and concomitant decrease in the proportion of children in school in most states. This is surprising given that other studies indicated that schooling figures in India have improved considerably. To check whether there was a problem, we reconsidered our definitions of variables.

We found that that between 61-90% (across different states) attended school in 1993 but this increased to above 92% in all states by 2004 if we look at a different schooling variable (current attendance). This variable includes children who are studying part-time, by postal tuition etc., and not only those who state their principal activity as being schooling. On the other hand, the Schooling status variable (which is reported in the table) only includes those who state that their main activity is going to school. The change in trends over the decade therefore seems to indicate that while fewer children state their principal activity status as schooling, the vast majority of children are obtaining an education of some sort. This could be because in a growing economy employment opportunities increase and poor households cannot afford to ignore these opportunities. The numbers of children who are involved in both school and work (multi-tasking) have increased.

	1993 - Girls					2004 - Girls				
	Work	School	Chores	None	Schwrk	Work	school	chores	none	schwrk
Andhra	8.85	57.79	11.46	21.90	0.34	34.20	49.87	9.94	6.00	16.29
Arunachal	4.92	58.37	6.76	29.95	0.61	39.16	40.96	9.49	10.39	2.20
Assam	0.95	73.59	5.04	20.42	0.60	23.81	50.09	19.40	6.70	21.07
Bihar	1.04	43.56	14.82	40.59	0.02	19.74	38.55	23.37	18.35	14.32
Gujarat	1.80	60.98	15.19	22.03	0.50	27.92	43.65	20.57	7.87	20.83
Haryana	0.50	67.63	10.83	21.03	0.38	22.52	45.32	21.53	10.63	23.61
Himachal	5.37	82.04	2.99	9.59	12.74	33.56	51.20	8.95	6.28	29.00
J&K	4.30	67.88	11.09	16.72	0.99	24.46	46.23	22.00	7.31	29.23
Karnataka	5.90	67.30	11.81	14.99	1.18	33.54	46.24	13.25	6.97	13.87
Kerala	0.52	94.33	1.57	3.58	0.15	18.09	51.43	19.07	11.41	16.87
Madhya	4.18	47.35	12.56	35.91	0.71	30.66	44.32	14.73	10.29	14.90
Maharastra	3.39	76.56	6.47	13.58	0.55	29.86	49.94	12.29	7.92	17.52
Manipur	1.09	85.99	1.90	11.02	0.95	31.90	46.01	16.13	5.96	20.07
Meghalaya	3.99	69.32	7.63	19.06	1.56	42.47	48.10	4.04	5.39	13.34
Mizoram	3.81	87.54	0.00	8.65	0.69	41.57	45.93	10.67	1.83	5.62
Nagaland	0.97	91.73	1.70	5.60	0.00	36.08	53.09	7.41	3.43	38.41
Orissa	3.31	58.79	12.05	25.85	0.30	27.84	41.11	19.78	11.27	18.03
Punjab	0.24	72.25	12.70	14.81	0.08	19.00	42.49	29.82	8.68	25.34
Rajasthan	15.88	35.30	14.63	34.20	0.67	33.74	40.16	16.26	9.84	22.06
Sikkim	2.03	85.77	5.69	6.50	0.00	36.46	49.56	10.44	3.54	19.29
Tamil Nadu	6.36	79.15	7.58	6.91	0.67	29.70	54.29	11.48	4.54	13.32
Tripura	1.31	81.36	4.54	12.78	0.00	22.07	47.60	22.32	8.01	5.43
Uttar	2.28	48.96	17.49	31.28	0.44	25.13	41.65	22.46	10.76	22.08
West Bengal	1.85	63.83	10.39	23.93	0.35	22.41	41.33	26.34	9.92	16.38

Table 1: Occupational choices for girls (Source: NSS 1993 and 2004)

	1993 - Boys					2004 - Boys				
State_name	Childwrk	school	chores	none	scwrk	Childwr	School	chores	none	Scwrk
Andhra	11.95	73.69	0.41	13.96	1.35	34.20	49.57	10.05	6.18	14.95
Arunachal Pr.	3.81	66.57	5.64	23.98	0.42	36.75	43.87	9.35	10.02	2.48
Assam	2.87	78.28	0.39	18.46	1.30	27.52	46.89	19.60	5.99	18.55
Bihar	3.40	64.35	1.82	30.43	0.31	21.34	41.32	22.50	14.85	14.85
Gujarat	4.06	77.20	0.33	18.41	0.52	28.97	47.04	18.36	5.63	17.19
Haryana	2.19	83.17	0.11	14.54	0.33	25.18	44.42	21.22	9.18	22.17
Himachal Pr	2.29	91.31	0.24	6.16	15.48	37.94	48.26	8.46	5.35	26.95
J&K	5.12	82.68	0.30	11.90	2.71	24.89	45.93	23.45	5.73	29.19
Karnataka	8.16	78.39	0.63	12.82	2.82	31.93	47.66	13.03	7.38	14.48
Kerala	0.44	94.04	0.15	5.37	0.07	19.07	49.38	19.14	12.42	20.31
Madhya Pradesh	7.88	66.07	0.93	25.12	2.08	30.44	43.21	15.41	10.93	13.09
Maharastra	3.66	86.18	0.11	10.06	1.16	34.13	49.28	9.96	6.63	17.43
Manipur	0.69	88.38	0.14	10.79	1.24	29.98	48.85	16.72	4.45	22.09
Meghalaya	5.43	72.50	2.72	19.35	1.02	45.39	47.47	3.23	3.92	15.21
Mizoram	4.50	81.68	0.60	13.21	0.90	43.78	41.57	10.50	4.14	3.04
Nagaland	1.17	92.31	0.00	6.53	0.47	38.69	51.75	6.41	3.15	35.31
Orissa	7.46	71.22	0.79	20.53	0.60	29.03	39.00	21.95	10.02	16.01
Punjab	4.36	83.04	0.14	12.46	0.21	21.29	46.32	26.10	6.29	28.99
Rajasthan	8.14	74.25	0.43	17.18	2.26	33.13	42.67	15.89	8.31	23.24
Sikkim	2.11	90.49	0.70	6.69	0.35	38.64	50.16	7.14	4.06	18.02
Tamil Nadu	5.24	86.87	0.28	7.62	0.88	28.89	55.31	11.54	4.26	11.48
Tripura	2.10	83.80	0.30	13.80	0.20	22.32	45.37	23.79	8.53	5.47
Uttar Pradesh	4.98	72.10	0.68	22.25	1.91	25.42	43.75	20.98	9.85	23.15
West Bengal	4.87	72.10	0.58	22.45	1.16	22.69	41.11	26.29	9.92	16.47

Table 2: Occupational choices for boys (Source: NSS 1993 and 2004)

The tables also indicate that the highest proportion of children working in 2004 is in the North East states of Arunachal, Meghalaya and Mizoram. In all these states, there was between 36% and 46% of children working. This region also has the highest percentage of children in school, with 52% of boys and 53% of girls attending school in Nagaland. In other states in the region, it was above 45% for girls and above 44% for boys. The highest proportion of boys and girls doing chores are in Punjab (26% for boys and 29% for girls), Bihar (22% for boys and 23% for girls), Bengal, UP and Tripura. The largest proportion of children doing nothing is in Bihar (15% of boys and 18% of girls). Nagaland has the highest proportion of children (38% of girls and 35% of boys) going to school and also working (SCHWORK). Thus, the North East seems to be the region where there is more work and more schooling. The state of Bihar continues to lag behind in having a very high proportion of children neither at work nor at school.

These patterns of increasing children's time both at school and at work associated with economic growth is the main focus of our theoretical model. We show how these patterns can be generated by increasing demand for child labour as well as increasing return to education that affects the productivity of children as adult workers in the future.

2 Child labour in a dual economy

In this section we present a model of child labour in a dual economy. The dual economy framework in the growth literature was pioneered by Arthur Lewis (1954) and Simon Kuznets (1955), and has been extensively developed in many directions (see Temple (2005) for a recent discussion). We follow the conventional setup and model the economic growth as an exogenous increase in total factor productivity, or the technological progress (thus abstracting from the endogenous sources of growth). While we use a static framework, it still allows to model the effect of economic growth on child labour by analyzing how the equilibrium amount of child labour changes when the productivity increases due to technological changes.

Our model economy consists of a production sector that produces a homogenous good with labour as an only input, and a representative household that supplies labour to the production sector and consumes the output. The household consists of adults and children. The preferences of the household are described by the utility function, $U(X, l_A, l_C)$, where X is the aggregate consumption, and $l_{A,C}$ is the amount of leisure enjoyed by the adult members of the household and the children, respectively.

The production side is inhabited by firms of two types, modern and traditional. For simplicity we assume that there is only one firm of each type; extending the analysis to many firms will not affect the main result. The modern firm employs only the adult labour, - perhaps, because the the modern production process is too hazardous, or because there is a ban on children employment in the industrialized sector. The traditional firm can employ both adults and children. The adult workers are perfectly mobile between the two sectors and are more efficient than child workers. The production technology has constant returns to scale, and the firms are owned by the household.

2.1 Producers

The modern (M) and the traditional (T) firms take the wages of adult workers, w_A (per unit efficiency), and the wages of child workers, w_C, as given and compete in quantities. We assume the following for the production technology in this sector:

$$q_M = A_M S N_M, \quad q_T = A_T \left[\alpha \left(S N_A\right)^{\rho} + (1-\alpha) N_C^{\rho}\right]^{1/\rho}, \ \rho \leq 1$$

with $A_T < A_M$. Parameters A_T and A_M reflect the level of technology in each sector. An alternative interpretation is that both firms use a fixed capital input, with the level of capital being higher in the modern firm. Parameter $S > 1$ reflects the efficiency of adult labour input relative to the child labour input. Larger ρ corresponds to the higher degree of substitutability between the adult labour and the child labour inputs in the traditional sector ($\rho = 0$ gives the Cobb-Douglas production function), and α $(1-\alpha)$ is the share of adult (child) labour in this sector. Here we assume the relative efficiency of the adult labour exogenously fixed; in the next section it will be determined endogenously, as an outcome of the investment in education.

The interior solution to the cost minimization problem gives the demand for labour and the unit cost function for each firm:

$$N_C = \frac{q_T}{A_T}\left[(1-\alpha)\,\phi\right]^{-1/\rho}, \tag{1}$$

$$N_A = \frac{\phi-1}{S\omega}N_C, \quad N_M = \frac{q_M}{SA_M} \tag{2}$$

$$c_T = \frac{w_C}{A_T}\frac{\phi}{\left[(1-\alpha)\,\phi\right]^{1/\rho}}, \quad c_M = \frac{w_A}{A_M}, \tag{3}$$

where

$$\phi = 1 + \left(\frac{1-\alpha}{\alpha}\omega\right)^{1/(\rho-1)}\omega, \quad \omega \equiv w_A/w_C. \tag{4}$$

Solving the standard Cournot competition problem gives

$$\frac{p-c_i}{-Qp'(Q)} = \frac{q_i}{Q}, \ i = T, M, \tag{5}$$

where $Q = q_T + q_M$ is the total output, and p is the price.

2.2 Household

Assume that the utility function of the household has the following form:

$$U(X, l_A, l_C) = \ln X + \theta \ln l_C + (1-\theta)\ln l_A. \tag{6}$$

The total income of the household is

$$I = w_A S L_A + w_C L_C + \pi_T + \pi_M, \tag{7}$$

where $L_{A,C}$ is the labour supply of the adults and children, respectively, and $\pi_{T,M}$ is the profit of the traditional and the modern sector. Normalizing the total time endowment of the adults and that of children to unity, and focussing on the interior solution to the household's optimization problem,

$$\max U(X, l_A, l_C) \text{ s.t. } pX \leq I, \ l_{A,C} + L_{A,C} \leq 1$$

one obtains for the consumption demand and for the labour supply the following expressions:

$$pX = I, \ L_C = 1 - \frac{\theta}{w_C}I, \ L_A = 1 - \frac{1-\theta}{Sw_A}I. \tag{8}$$

2.3 Equilibrium with child labour

In this section we assume that the parameters are such that the optimal solution is in the interior. For the equilibrium amount of child labour we obtain the following expression:

$$L_C^* = \frac{1}{1 + \theta \left(1 + \psi\right)^2 \phi/\psi}. \tag{9}$$

where $\xi \equiv \dfrac{A_T}{A_M}$, $\psi \equiv \dfrac{c_M}{c_T}$, (ϕ, ω) are defined in (4), and (ψ, ω) solve

$$\psi = \frac{\omega\xi}{\phi} \left[\left(1 - \alpha\right) \phi\right]^{1/\rho}, \tag{10}$$

$$S\omega = \frac{\left(1 - \theta\right) \left(1 + \psi\right)^2 + \psi(2 - 1/\phi)}{\theta \left(1 + \psi\right)^2 + \psi/\phi} \tag{11}$$

The details are provided in the Appendix. In general, the solution cannot be written in an analytical form, even for the Cobb-Douglas case.

2.4 Growth and child labour

We model economic growth as an increase in the total factor productivity. We consider the case when the productivity in the traditional sector remains constant whereas the productivity in the modern sector grows, i.e. ξ increases. The results of numerical simulations are shown in Fig. 1 below, with $\xi \equiv \dfrac{A_T}{A_M}$ on the horizontal axis and L_C^* on the vertical axis. In all simulations $\alpha = \theta = 1/2$. The results are robust to the changes in the parameter values in a fairly wide range.

Thus, when the technological progress results in a shrinking productivity gap between the traditional and the modern sector the equilibrium amount of child labour grows. A positive relationship between child labour and growth can be caused by the improvement of technology and productivity in the traditional sector growing faster relative to that in the modern sector. Conversely, if the productivity in the modern sector grows faster, the equlibrium child labour falls. This illustrates that the relationship between growth induced by technological progress and the child labour is ambiguous, with the sign of the effect driven by the labour demand. Note that possible reversals in the response of child labour to economic growth iare driven by the demand and do not rely on a backward-bending labour supply curve, as in the luxury axiom explanation.

In this model we imposed the difference in the efficiencies between the adult and the child labour and have abstracted from the role of education and the effect of economic growth on the returns to education. The analysis of the role of education in skill formation and the choice between sending children to work or to school is undertaken in the next section.

3 Education and child labour

We now extend our model by introducing time and an alternative use of the adults' and children's time, apart from leisure and paid work. Specifically, we consider a two-period overlapping generations economy where in every period adults and children spend part of their time not in paid work on "skill production". One can think of a child's time in skill production as merely growing up and developing basic skills, or time spent at school, with either of these affecting the child's labour productivity as an adult in the future. An adult's time in skill production can be viewed as the aggregate time cost of parenting, teaching basic skills to the child, helping with school work,etc. An alternative interpretation of the skill production is possible, – this could be production of necessities, such as basic food, within the household, and not for sale in the market. The output is consumed entirely by the members of the household, and higher levels of this consumption results in higher productivity of children when they grow up, as an effect, say, of better nutrition (similar to the approach in Genicot, 2005.)

A household in time period t consists of an adult, or a parent, born in the beginning of period $t-1$, and a child born in the beginning of period t. The adult cares about the future wellbeing of the child; we model this as a non-paternalistic altruism, so that the adult's preferences are described by the utility function of the form

$$W_t = U_t + \beta W_{t+1} = \sum_{i=0}^{\infty} \beta^i U_{t+1},$$

where the instantaneous utility function is similar to (6),

$$U_t = U\left(X_t, l_{At}, l_{Ct}\right) = \ln X_t + \theta \ln l_{Ct} + (1-\theta) \ln l_{At}.$$

The parent decides how much of his own time and his child's time will be invested in paid work (L_{At} and L_{Ct})and in skill production (E_{At} and E_{Ct}). The future productivity of the child as an adult worker at time $t+1$ is proportional to the level of skill, $S_{t,}$ produced using their own time and their parents' time, $E_{A,C}$. There is no direct cost of skill production, the only cost is in terms of the foregone leisure and paid income. For analytical tractability we further assume

$$S_t = A_S E_{At}^{\delta} E_{Ct}^{1-\delta},\ 0 < \delta < 1. \tag{12}$$

The scale factor A_S captures the efficiency of the skill production, or the school quality: higher school quality results in a higher skill level achieved with the same input of time. With this modification the production technology in the traditional and in the modern sectors is now

$$q_{Tt} = A_T \left[\alpha \left(S_{t-1} N_{At}\right)^{\rho} + (1-\alpha) N_{Ct}^{\rho}\right]^{1/\rho}, \quad q_M = A_M S_{t-1} N_{Mt},$$

and the household income is

$$I_t = w_{At} S_{t-1} L_{At} + w_{Ct} L_{Ct} + \pi_{Tt} + \pi_{Mt}.$$

The solution procedure is straightforward (see Appendix for the details). We focus on the interior long-run, or steady-state equilibrium. In this equilibrium the amount of paid child labour and child schooling time are now described by

$$L_C^* = \frac{1}{1+\theta\left(1+\psi\right)^2\phi/\psi+\beta\left(1-\delta\right)\left(2\phi-1\right)},$$

$$E_C^* = \beta\left(1-\delta\right)\left(2\phi-1\right)L_C^*,$$

where

$$S\omega = \frac{\left(1-\theta\right)\left(1+\psi\right)^2+\left(1+\beta\delta\right)\left(2-1/\phi\right)\psi}{\theta\left(1+\psi\right)^2+\left(1+\left(1+\beta\delta\right)\left(2-1/\phi\right)\right)\psi/\phi} \equiv \varsigma$$

solves

$$\varsigma^{1+\delta} = \frac{A_S\beta\left(1-\delta\right)\omega(2-1/\phi)\psi}{\theta\left(1+\psi\right)^2+\left(1+\left(1+\beta\delta\right)\left(2-1/\phi\right)\right)\psi/\phi},$$

and all other notations are the same as before.

The figures below show how the amount of child labour (Fig. 2), schooling (Fig. 3), and leisure (Fig. 4) change with ξ, for different levels of schooling quality; child labour without schooling is also shown for comparison. In the presence of endogenous skill formation productivity growth causes an inverted U-shape response in child labour. As the productivity gap between the traditional and the modern sectors shrinks (ξ increases) the amount of child labour first increases and then drops. A similar pattern is observed in children's time invested in schooling. Thus, the initial productivity growth in the traditional sector results in a simultaneous increase in child labour and schooling compared to the benchmark case without schooling. A higher school quality shifts the turning point in both child labour and schooling toward the higher values of ξ. For the values of ξ close to zero an increase in school quality results in more child labour and less schooling, i.e.the income effect of the productivity growth dominates. For larger values of ξ the substitution effect dominates, and an increase in school quality causes child labour to drop and schooling time increase. The results are shown for $\delta = \beta = 1/2$; similar patterns hold for a wide range of parameter values.

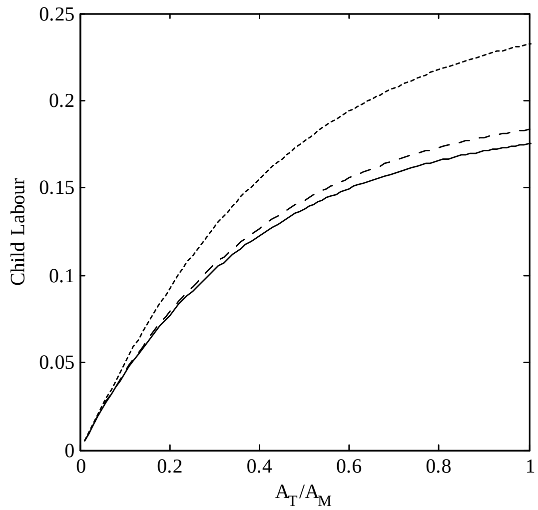

Fig.1. Child labour without schooling, for $\rho = -1$ (solid), $-1/4$ (dash), and $3/4$ (dot).

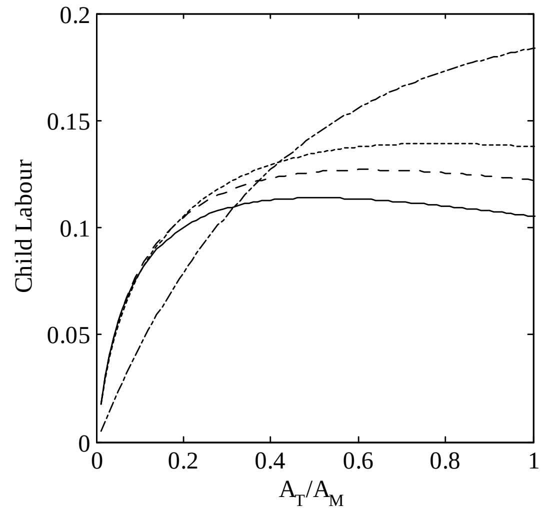

Fig. 2. Child labour with schooling, for $A_S = 1/4$ (solid), $1/2$ (dash), and $3/4$ (dot), and without schooling (dash-dot), for $\rho = -1/4$.

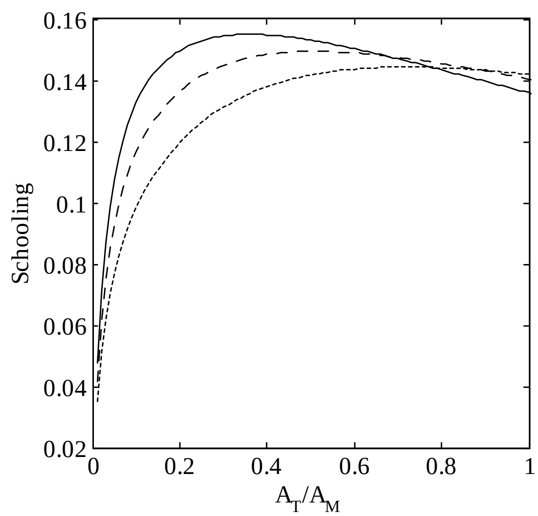

Fig. 3. Child time in schooling, for $A_S = 1/4$ (solid), $1/2$ (dash), and $3/4$ (dot) for $\rho = -1/4$.

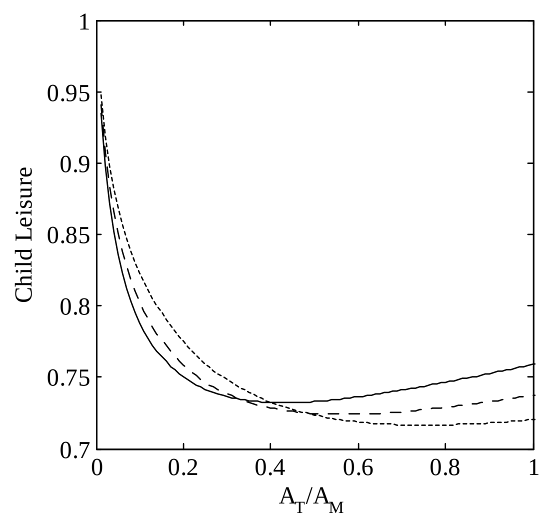

Fig. 4. Child leisure, for $A_S = 1/4$ (solid), $1/2$ (dash), and $3/4$ (dot) for $\rho = -1/4$.

4 Conclusions

Persistence of child labour in the developing countries, together with the commonly accepted view on poverty as its main cause, suggests that child labour will be eliminated with economic growth and development. There is, however, empirical evidence of child labour being positively associated with economic growth. In this paper we demonstrate, in a dual economy framework, how technological advancements in production can generate growth in the response of child labour, and thus show that at least in the short run growth and development can result in an increase in child labour. This has an important policy implications: introduction of new technologies in the traditional sector, that results in productivity and income growth, may at the same time cause an increase in the number of children at work, by driving up the demand for child labour. We also show, in the model with endogenous skill formation, that an increase in schooling quality does reduce children's time at work to some extent, by making the future returns from education higher, but most of the increase in schooling time occurs on the account of leisure: the model predicts that both child labour and schooling may increase with productivity growth. Our results are qualitatively consistent with the empirically observed patterns in the relationship between the amount of child labour and economic growth. In terms of policy, the model suggests that measures towards increasing productivity in either sector may bring about an undesired increase in child labour, and therefore must be complemented by measures towards improving the availability and quality of schooling, to mitigate the possibility of this effect.

In the model borrowing and lending are assumed away. One straightforward extension would be to introduce a possibility of borrowing by a household, at an exogenously fixed interest rate, that would allow to invest more time in education and pay back the debt from the higher future earnings. Alternatively, one could think of education having higher social than private returns, – say, by affecting the total factor productivity, – and a relevant tax and subsidy policy that would improve efficiency in this situation. Also, higher future labour productivity in our model is solely due to schooling, while it is possible that working as a child means accumulating skills and experience that increase future labour productivity as well. Varying the degree of complementarity of such learning-by-doing and schooling can produce interesting predictions with regards to the effect of policies towards reducing child labour. Another possible extension is to consider an endogenous choice of innovation or a production technology by entrepreneurs, and to explore in what conditions an entrepreneur would never choose a technology that involves employing children.

A word of caution must be said about trying to take the model directly to the data. The patterns in child labour across countries and regions and its dynamics over time involves a vast range of factors, often unmeasureable or not represented in the data, interacting in complicated ways. Our model is deliberately stripped off many important factors, with the purpose of focussing on the ambiguous effect of growth and development on child labour. The result obtains even in this parsimonious setting, but should not be interpreted too literally. The main message to be taken is that new economic opportunities, created by growth-enhancing policies, must be complemented by improvements in schools quality, grants and subsidies to families with school-age children, and other such measures policies encouraging education and preventing the growth in child labour even in the short run.

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A Appendix

A.1 Equilibrium without schooling

We focus on the set of the model parameters for which the equilibrium solution is in the interior for each variable. In equilibrium the total output of the modern and the traditional sectors equals the demand for the consumption good, so the inverse demand is $p = \dfrac{I}{Q}$. Upon substitution into (5) and rearrangement we obtain for the price and the quantities produced by each firm

$$\begin{aligned} p &= c_T + c_M, && (13) \\ q_{T(M)} &= I\frac{c_{M(T)}}{\left(c_T + c_M\right)^2}, && (14) \end{aligned}$$

where the latter can also be rewritten as

$$q_T c_T = q_M c_M = I\frac{\psi}{\left(1+\psi\right)^2}, \quad \psi = \frac{c_M}{c_T}.$$

We can use these to obtain the following expressions for the labour demand,

$$\begin{aligned} N_A &= \frac{I}{Sw_A}\frac{\psi}{\left(1+\psi\right)^2}\frac{\phi-1}{\phi}, \quad N_C = \frac{I}{w_C}\frac{\psi}{\left(1+\psi\right)^2\phi}, && (15) \\ N_M &= \frac{I}{Sw_A}\frac{\psi}{\left(1+\psi\right)^2}. && (16) \end{aligned}$$

and for the profits of the firms,

$$\pi_T = \psi^2 \pi_M = I\frac{\psi^2}{\left(1+\psi\right)^2}. \qquad (17)$$

In the equilibrium the labour market for both adult and child labour clears:

$$\begin{aligned} N_A + N_M &= L_A^*, && (18) \\ N_C &= L_C^*. && (19) \end{aligned}$$

Using expressions in (15) and (16) we obtain, upon obvious rearrangement,

$$L_A^* = \frac{I}{Sw_A}\frac{\psi\left(2-1/\phi\right)}{\left(1+\psi\right)^2}, \; L_C^* = \frac{I}{w_C}\frac{\psi}{\left(1+\psi\right)^2\phi}, \qquad (20)$$

and using (8),

$$w_C = I\left[\theta + \frac{\psi}{\left(1+\psi\right)^2\phi}\right], \; Sw_A = I\left[1-\theta+\frac{\psi\left(2-1/\phi\right)}{\left(1+\psi\right)^2}\right]$$

which imply

$$\begin{aligned} L_C^* &= \frac{1}{1+\theta\left(1+\psi\right)^2\phi/\psi} \\ S\omega &= \frac{\left(1-\theta\right)\left(1+\psi\right)^2 + \psi\left(2-1/\phi\right)}{\theta\left(1+\psi\right)^2+\psi/\phi}. \end{aligned}$$

A.2 Equilibrium with both child labour and schooling

The Lagrangean for the household's optimization problem can be written as

$$\begin{aligned}\mathcal{L} &= \sum_{t=0}^{\infty} \beta^t \left[U_t + \lambda_t \left(I_t - p_t X_t \right) \right. \\ &\quad \left. + \mu_t \left(1 - \ell_{At} - L_{At} - L_{A,Et} \right) + \nu_t \left(1 - \ell_{Ct} - L_{Ct} - L_{C,Et} \right) \right],\end{aligned}$$

and the first order conditions take the form

$$\frac{\partial U_t}{\partial X_t} - \lambda_t p_t \leq 0$$

$$-\frac{\partial U_t}{\partial \ell_{At}} + \lambda_t p_t w_{At} E_{t-1} - \mu_t \leq 0 \qquad -\frac{\partial U_t}{\partial \ell_{At}} + \beta \lambda_{t+1} p_{t+1} w_{At+1} L_{At+1} \frac{\partial E_t}{\partial L_{A,Et}} - \beta \mu_{t+1} \leq 0$$

$$-\frac{\partial U_t}{\partial \ell_{Ct}} + \lambda_t p_t w_{Ct} - \nu_t \leq 0 \qquad -\frac{\partial U_t}{\partial \ell_{Ct}} + \beta \lambda_{t+1} p_{t+1} w_{At+1} L_{At+1} \frac{\partial E_t}{\partial L_{C,Et}} - \beta \nu_{t+1} \leq 0$$

with complementary slackness conditions. We are interested in the interior equilibrim solution, which is described by the following system of equations:

$$\frac{\partial U_t / \partial \ell_{At}}{\partial U_t / \partial X_t} = w_{At} E_{t-1} \qquad \frac{\partial U_t / \partial X_t}{\partial U_t / \partial X_{t+1}} = \beta \frac{w_{At+1} L_{At+1}}{w_{At} E_{t-1}} \frac{\partial E_t}{\partial L_{A,Et}}$$

$$\frac{\partial U_t / \partial \ell_{Ct}}{\partial U_t / \partial X_t} = w_{Ct} \qquad \frac{\partial U_t / \partial X_t}{\partial U_t / \partial X_{t+1}} = \beta \frac{w_{At+1} L_{At+1}}{w_{Ct}} \frac{\partial E_t}{\partial L_{C,Et}}$$

For the production sector the optimization problem is static. Solving the cost minimization problem we obtain for the labour demand expressions similar to (1)-(2):

$$\begin{aligned} N_{Ct} &= \frac{q_{Tt}}{A_T} \left[(1-\alpha) \phi_t \right]^{-1/\rho}, \\ N_{At} &= \frac{\phi_t - 1}{S_{t-1} \omega_t} N_{Ct}, \quad N_{Mt} = \frac{q_{Mt}}{S_{t-1} A_M}, \end{aligned}$$

and for the per unit cost of production,

$$c_{Tt} = \frac{w_{Ct}}{A_T} \frac{\phi_t}{\left[(1-\alpha) \phi_t \right]^{1/\rho}}, \quad c_{Mt} = \frac{w_{At}}{A_M},$$

where

$$\phi_t = 1 + \left(\frac{1-\alpha}{\alpha} \omega_t \right)^{1/(\rho-1)} \omega_t, \quad \omega_t \equiv \frac{w_{At}}{w_{Ct}} = \frac{\xi \psi_t \phi_t}{\left[(1-\alpha) \phi_t \right]^{1/\rho}}, \tag{21}$$

and $\psi_t \equiv c_{Mt}/c_{Tt}$. In the steady-state equilibrium wages and outputs grow at the same constant rate, so that their ratios are constant, and the labour inputs are constant. From now on we drop the time index.

The first order conditions of the household optimization problem together with the budget constraint can be rewritten as

$$\begin{aligned} 1-L_C-E_C &= \frac{\theta I}{w_C}, & w_C &= \beta w_A L_A \frac{\partial S}{\partial E_C}, \\ 1-L_A-E_A &= \frac{(1-\theta) I}{S w_A}, & S &= \beta L_A \frac{\partial S}{\partial E_A}, \\ & & pX &= I, \end{aligned} \tag{22}$$

In equilibrium labour market clears,

$$N_A + N_M = L_A,\ N_C = L_C,$$

from which it is easy to obtain

$$SL_A = \frac{I}{w_A}\frac{\psi(2-1/\phi)}{(1+\psi)^2},\ L_C = \frac{I}{w_C}\frac{1}{\phi(1+\psi)^2}. \tag{23}$$

Combining these with (22) and using

$$\frac{\partial S}{\partial E_C} = (1-\delta)\frac{W}{E_C},\ \frac{\partial S}{\partial E_E} = \delta\frac{S}{E_A},$$

we obtain, upon obvious rearrangements,

$$w_A S = I\left[1-\theta+\frac{\psi(1+\beta\delta)(2\phi-1)}{\phi(1+\psi)^2}\right], \tag{24}$$

$$w_C = I\left[\theta+\frac{\psi(1+\beta(1-\delta)(2\phi-1))}{\phi(1+\psi)^2}\right]. \tag{25}$$

For S we use (22) in (12),

$$S = A_S E_A\left(\frac{E_C}{E_A}\right)^{1-\delta} = A_S\beta\delta L_A\left(\frac{1-\delta}{\delta}\omega S\right)^{1-\delta}$$

and upon collecting the terms and using (23) and (24),

$$S^\delta = A_S\beta\delta^\delta(1-\delta)^{1-\delta}\omega^{1-\delta}\frac{\psi^2+1/(1-\phi)}{(1-\theta)(1+\psi)^2+(1+\beta\delta)\left[\psi^2+1/(1-\phi)\right]}.$$

Using the notation $\varsigma = \omega S$ the last expression can be rewritten as

$$\varsigma^\delta = \frac{A_S\beta\delta^\delta(1-\delta)^{1-\delta}\omega\left[\psi^2+1/(1-\phi)\right]}{(1-\theta)(1+\psi)^2+(1+\beta\delta)\left[\psi^2+1/(1-\phi)\right]},$$

where ω is defined in (21), and from (24)-(25)

$$\varsigma = \frac{(1-\theta)(1+\psi)^2+(1+\beta\delta)\left[\psi^2+1/(1-\phi)\right]}{\theta(1+\psi)^2+1/\phi+\beta(1-\delta)}.$$