

ONLINE APPENDIX
PERVERSE CONSEQUENCES OF WELL-INTENTIONED REGULATION: EVIDENCE FROM
INDIA'S CHILD LABOR BAN

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1. CHILD LABOR LAWS IN INDIA

This is an extended version of what appears in the text under Section 2

The issue of child labor is not new in the Indian context. Since independence in 1947, the Government of India has taken various measures to stamp out child labor. The constitution, written in 1950, bluntly states, "no child below the age of fourteen years shall be employed to work in any factory or mine or engaged in any other hazardous employment" (Weiner 1991). While children were first recognized as being part of the labor force in the Factories Act of 1881 (Das 1933), weak enforcement meant constant updates and revisions to the procedures that were aimed at tamping down the incidence and harmful effects of child labor. Most of these laws targeted towards curbing child labor were passed in the 1950s and 1960s were aimed at specific industries and each law had slightly different minimum age restrictions and penalties. For example:

"The Plantations Labour Act of 1951 prohibited the employment of children below twelve, and adolescents between the ages of twelve and eighteen were required to obtain a certificate of fitness. Both laws prohibited night work for children. The Mines Act of 1952, and especially since 1984, has categorically rejected the employment of persons below the age of eighteen years, with the exception of apprentices under the Apprentices Act of 1961, or other trainees under proper supervision who may be as young as sixteen years. The Merchant Shipping Act of 1958 prohibits employment of children under fourteen. The Motor Transport Workers Act of 1961 prohibits employment of children below fifteen "in any capacity in any motor transport undertaking." The

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Apprentices Act of 1961 disqualifies a person less than fourteen years from being engaged as an apprentice.” (Ramanathan (2009))

The impetus for the 1986 law¹ came from various reports from Government committees that suggested weak implementation of these laws (see descriptions of these committee reports, the Sanat Mehta Committee of 1986, and the Gurupadaswamy Committee on Child Labor of 1979, in Ramanathan (2009)). Hence, the major draw of the 1986 law was uniformity of the minimum age restriction (people up to age 14 were defined as children and therefore ineligible to work in certain industries and occupations). The law clearly provides a list of occupations where children below the age of 14 are prohibited from working (subsequent additions to this list were made at various points between 1989-2008).

The main occupations which were banned from hiring child labor after 1986 and before 1993 (the periods of data we examine) were occupations that involved transport of passengers, catering establishments at railway stations, ports, foundries, handling of toxic or inflammable substances, handloom or power loom industry and mines among many others. The list of “processes” that are banned for children are perhaps more exhaustive, including beedi (hand rolled cigarette) making, manufacturing of various kinds (matches, explosives, shellac, soap etc), construction, automobile repairs, production of garments etc.² The *major* caveat to these bans was that children were permitted to work in family run businesses and agriculture is not included as a sector that is banned from hiring child labor.

However, despite these two important caveats, the 1986 law places various regulations on how many hours and when children can work, regardless of industry/process (as long as they were not explicitly banned from working in such industries). For example, Section III of the law states that for every three hours of work, a child would get an hour of rest; no child shall work between

¹The entire Act of 1986 is available easily online and also from the authors.

²While these provisions came into effect immediately after the law was passed, a section of the law allowed for state specific introduction of regulations for child labor in sectors that were not explicitly banned. In this paper we concern ourselves only with the impact of the centrally enacted law. Using state level variation in implementing the regulations component of the law is left for another time as this analysis will be complicated by which states select into adopting these regulations earlier etc. We think that if the state level component was the most critical component of the law, then our current estimates are biased downwards.

8pm and 7am; and no child shall be permitted or required to work over time. These laws apply to all industries and sectors as long as the operation is not family run.

The law also clearly states the role of inspectors and forms that need to be filled out to get permission to hire child labor in adherence to these laws. The law appears quite detailed in this case going so far as to address the possibility of age disputes. “If any question arises between an Inspector and an occupier as to the age of any child who is employed or is permitted to work by him in an establishment, the question shall, in the absence of a certificate as to the age of such child granted by the prescribed medical authority, be referred by the Inspector for decision to the prescribed medical authority.” Other provisions in the law pertain to the health and safety of the children if employed. For example, the law states the workplace should have drinking water, should be free from dust and fume, have latrines and urinals et cetera.

Finally, the law clearly states what the penalties would be if firms banned from hiring children were caught doing so: “(1) Whoever employs any child or permits any child to work in contravention of the provisions of section 3 [section detailing banned occupations] shall be punishable with imprisonment for a term which shall not be less than three months but which may extend to one year or with fine which shall not be less than ten thousand rupees but which may extend to twenty thousand rupees or with both. (2) Whoever, having been convicted of an offense under section 3, commits a like offense afterwards, he shall be punishable with imprisonment for a term which shall not be less than six months but which may extend to two years.” Smaller fines are levied for failing to comply with some of the provisions that regulate the conditions under which children can work in approved occupations.

While enforcement of the 1986 law has been largely weak, it does appear that employers were aware of this law. According to a report by Human Rights Watch, it seems that employers were quite aware of the law as they found loopholes to work around it. For example, the report provides anecdotal evidence on factories contracting with adults to take their work home and employ their children on it since work at home was allowed under the law:

“...factory owners contract with or bond adults for work to be done in their homes. The adults then use their own children or bond other children to help with the work, claiming, if inspected, that the bonded children are their own. This has happened in the silk industry in Varanasi; the match and beedi industries in Tamil Nadu are other well-known examples. Labor inspectors told researchers at the National Labour Institute: “Most of the employers claim the child workers as their family members, while the child workers’ physical appearance such as tattered clothes, undernourished and underdeveloped physical physique, etc., belie the employers’ claim[s].” (Human Rights Watch 2003)

Similar anecdotal evidence can be found in a Times of India article from 1994: “Employers neutralise the statutory ban on child labour by not showing them on the pay-roll. . . . The local central excise staff of an inspection of home workers employed by a leading beedi company found that the output of a woman worker at Thatchanallur village was recorded in a passbook issued in the name of her husband. In the same village, Pitchammal and her daughter, Prema, had a passbook carrying the name of the Naina Moopnar, who had died years ago.” (‘Appaling plight of TN beedi workers’, Times of India, August 6th, 1995; pg.7)

While hard data on prosecutions regarding child labor is difficult to come by, the Human Rights Watch report cites a Ministry of Labour report in New Delhi, that stated, “in 1996-1997, 13,090 inspections found 509 violations. Of these, 374 were prosecuted and fourteen convictions obtained—a conviction rate of less than 4 percent.” (Human Rights Watch, 2003) The report identifies lack of staff, corruption and caste biases as barriers towards effective implementation of the law. In an earlier report, Human Rights Watch stated, “At the national level, from 1990 to 1993, 537 inspections were carried out under the Child Labour (Prohibition and Regulation) Act. These inspections turned up 1,203 violations. Inexplicably, only seven prosecutions were launched. At the state level, the years 1990 to 1993 produced 60,717 inspections in which 5,060 violations of the act were detected; 772 of these 5,060 violations resulted in convictions.” (Human Rights Watch, 1996) Indeed, by the government’s own admission in an audit report from the state of Gujarat published in 2004, “The Act [1986 Child Labor Act] aimed at relieving the child labourers from hazardous jobs was not implemented in an effective manner.” (Government of Gujarat, 2004)

While overall enforcement might have been weak, it seems entirely plausible that employers were more aware of the possibility of inspections and the consequent fines after the passage of the 1986 Act. Soon after the passage of the Act (in December 1986), in January 1987 in Ferozabad (an important town at the time for bangle manufacturing in the state of Uttar Pradesh) there were a few arrests of employers who were found to be in violation of the law which made national news. This incident was heralded as the "beginning that has to be made somewhere in ending child labour" (Times of India, January 17, 1987; pg.18). The same article goes on to say, "...Ms. Ela Bhatt, one of the MPs and social worker ...acknowledged that the arrest of four employers for offenses under the child labour law would augur well for its implementation." The efforts by the central government to create awareness are echoed in more press articles from the time: "Mr. Sangma [then Minister of Labour] noted that there were already five enactments - the Minimum Wages Act, . . . , and the Child Labour (regulation and prohibition) Act. The issue really was effective implementation and enforcement machinery at the state level, which were mobile and sufficiently supported by the state law. He wanted institutional arrangements for a regular review at the apex level and at the national level to assess the progress on implementation and enforcement." (Times of India, May 21, 1987; pg.9)

If anything we are lead to believe that the Act raised the level of inspections and awareness of the law as the government put renewed effort into enforcing the Act.

2. DERIVATION OF LABOR MARKET EQUILIBRIUM IN THE ONE SECTOR MODEL

There is a representative firm with technology $Y = f(L)$. L represents effective units of labor; for production, child and adult labor are substitutable up to a constant, γ ; each unit of adult labor is equal to 1 unit of effective labor ($L^A = L$) and each unit of child labor is worth only γ units of effective labor ($L^C = \gamma L$). The price of output is normalized to 1. Firms take prices as given; wages are w^A and w^C for adults and children, respectively. There is a partially implemented

ban on child labor; firms found employing child labor are fined an amount D and firms are audited with probability p .³⁴

There are N families, each endowed with 1 unit of adult labor which they supply inelastically and m children who are also endowed with 1 unit of labor each. Households supply child labor only in the case in which adult wages is not sufficient to reach subsistence consumption, s . When they do supply child labor, they do so only to reach the subsistence level.

We will assume that the output market is always in equilibrium where the equilibrium price of output is normalized to 1. In this economy, we define equilibrium as a wage pair (w^{A*}, w^{C*}) such that (i) the adult labor market is in equilibrium ($S^A = D^A$); (ii) the child labor market is in equilibrium ($S^C = D^C$); and (iii) either (a) there are no arbitrage opportunities, i.e. the effective wages of each type of labor are equal (net of the expected fine) $w^C = \gamma w^A - pD$ or (b) adult wages are lower than effective child wages ($w^C > \gamma w^A - pD$) but the demand for total labor exceeds the fixed supply of adult labor.

The firm maximization problem is as follows:

$$(1) \quad \max_L f(L) - C(L; w^A, w^C, p, D)$$

³⁴A more general specification of the ban allows the probability of detection to vary non-linearly with the level of child labor, i.e. where $p(L)$. Since firms are more likely to be detected the more children they hire, $p(L)$ is increasing in the amount of child labor employed. Here we assume a very simple linear form of $p(L)$, i.e. $p(L) = pL$, where p is a constant. When p is large, a linear function may not be a suitable approximation for $p(L)$ as $p(L)$ may exceed 1 when both p and L are large. However, as discussed in the previous section, enforcement of the ban was perceived to be quite weak and thus p was likely to be very low. In this case, a linear specification as an approximation of $p(L)$ is more justifiable, as there is less concern that $p(L) > 1$.

⁴Note that this definition of imperfect enforcement is as in Basu (2005) and differs from that used in Basu and Van (1998), which specifies that the ban is perfectly enforced for a proportion of firms while the remainder of firms are unregulated. While most of the intuition is similar with this alternate definition of enforcement, the perfect enforcement assumption does change some of the predictions of the model. Most importantly, depending on size of labor demand from the perfectly enforced firms relative to the supply of adult labor, N , there are cases in which an imperfectly enforced ban on child labor (of the Basu and Van (1998) type) could increase adult wages and possibly decrease child labor. However, we model the imperfect enforcement as in the Basu (2005) model because we believe that this is more applicable to the way in which the *actual* 1986 ban was enforced and therefore is the most relevant for our empirical work.

where $L = L^A = L^C/\gamma$ and $C(\cdot)$ characterizes the total cost of effective labor. The total cost curve is defined as

$$(2) \quad C(L; w^A, w^C, p, D) = \begin{cases} w^A L & \text{if } L \leq N \text{ and } w^A \leq \frac{w^C + pD}{\gamma} \\ w^A N + \frac{w^C + pD}{\gamma} (L - N) & \text{if } L > N \text{ and } w^A \leq \frac{w^C + pD}{\gamma} \\ \frac{w^C + pD}{\gamma} L & \text{if } w^A > \frac{w^C + pD}{\gamma} \end{cases}$$

which reflects the substitutability between the two types of labor; the firm simply chooses to use the least-cost source of labor except in the case in which the adult labor capacity constraint is reached at which point child labor is used to make up the residual labor demand. This total cost curve yields the following marginal cost curve

$$(3) \quad MC(L; w^A, w^C, p, D) = \begin{cases} \min\{w^A, \frac{w^C + pD}{\gamma}\} & \text{if } L \leq N \\ \frac{w^C + pD}{\gamma} & \text{if } L > N \end{cases}$$

Figure 1 illustrates the marginal cost curve in terms of effective units of labor. When $w^A < \frac{w^C + pD}{\gamma}$, the firm chooses to use the relatively cheap adult labor until capacity is reached at $L^* = N$. After that it must employ any additional units of labor at the effective child wage. When $w^A > \frac{w^C + pD}{\gamma}$, the firm always prefers to use child labor and so marginal cost is constant at $\frac{w^C + pD}{\gamma}$ regardless of the amount of effective labor used.

FIGURE 1. Marginal Cost Curves.

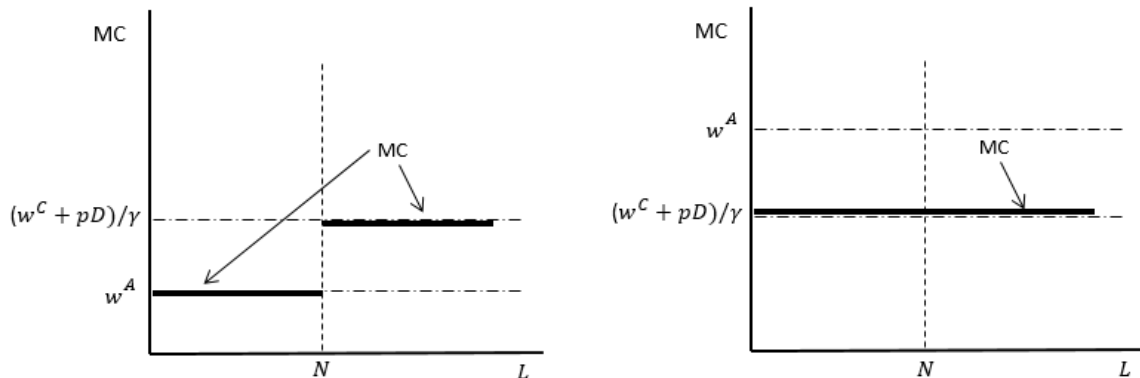
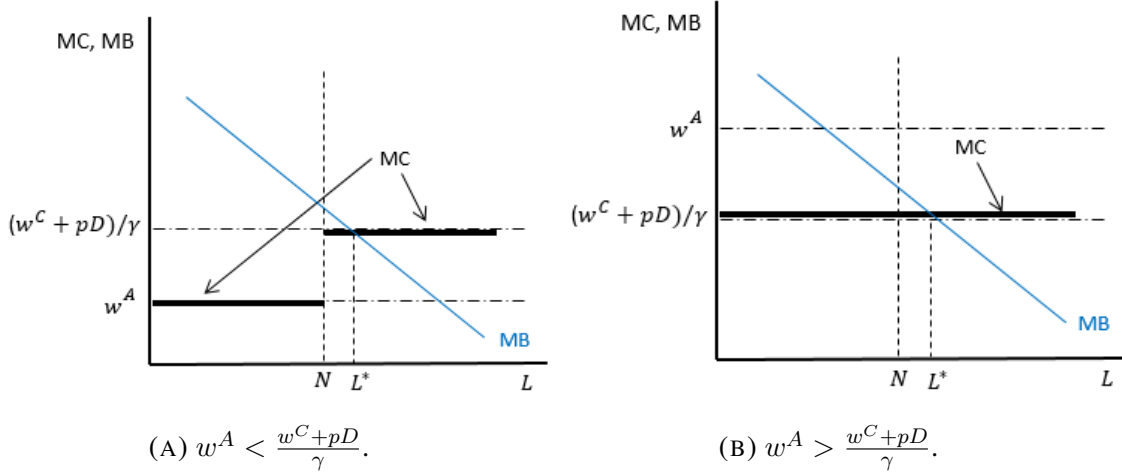


FIGURE 2. Deriving labor demand: These figures illustrate the case when the marginal benefit curve intersects marginal cost curve to the *right* of N , i.e. demand for total labor exceeds the supply of adult labor.



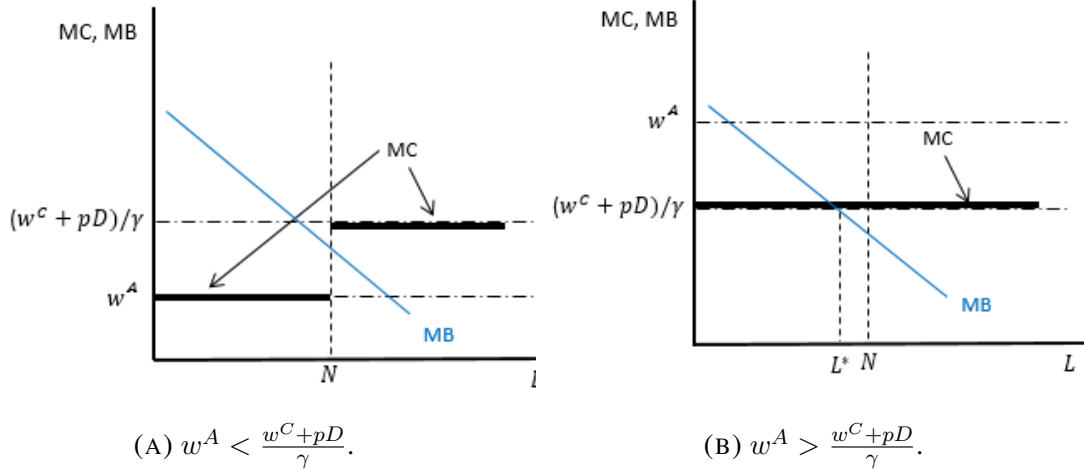
Where the marginal cost curve intersects the marginal benefit curve (defined by $f'(L)$) yields the demand for effective units of labor. Figures 2a and 2b show the case in which the marginal benefit curve intersects the marginal cost curve to the right of N , for both the subcases in which $w^A < \frac{w^C + pD}{\gamma}$ and $w^A > \frac{w^C + pD}{\gamma}$, respectively. In this case, when $w^A < \frac{w^C + pD}{\gamma}$, the firm first uses up all available adult labor at cost w^A and then fills residual demand $(N - L^*)$ with child labor at cost $\frac{w^C + pD}{\gamma}$. When $w^A > \frac{w^C + pD}{\gamma}$, the firm uses only child labor at cost $\frac{w^C + pD}{\gamma}$. In contrast when the marginal benefit curve intersects the marginal cost curve to the left of N and $w^A < \frac{w^C + pD}{\gamma}$, the firm only hires the lower of the entire pool of adult labor N and the amount of labor that satisfies $f'(L^A) = w^A$. This case is displayed in Figure 3a. If the marginal benefit curve intersects the marginal cost curve to the left of N and $w^A > \frac{w^C + pD}{\gamma}$, then again the firm uses only child labor to fulfil labor demand (Figure 3b).

The total demand for effective units of labor is defined by

$$(4) \quad f'(L^*) = MC(L^*; w^A, w^C, p, D)$$

However as shown in Figures 2a - 3b, the demand curves for the individual types of labor are not smooth because of the substitutability between child and adult labor. In particular adult labor

FIGURE 3. Deriving labor demand: These figures illustrate the case when the marginal benefit curve intersects marginal cost curve to the *left* of N , i.e. demand for total labor is below the total supply of adult labor.



demand is given by

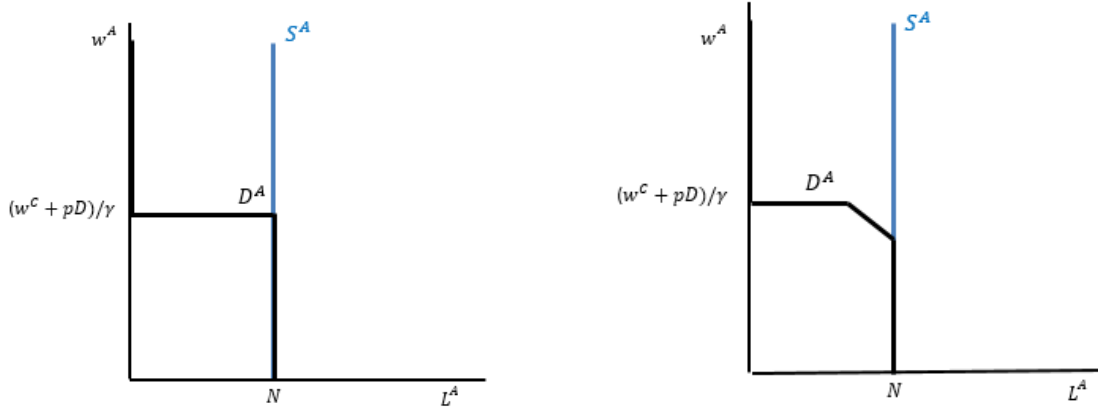
$$(5) \quad D^A(w^A; w^C, p, D) = \begin{cases} 0 & \text{if } w^A > \frac{w^C + pD}{\gamma} \\ \min\{N, \hat{L}^A\} & \text{if } w^A < \frac{w^C + pD}{\gamma} \\ \text{indeterminate} & \text{if } w^A = \frac{w^C + pD}{\gamma} \end{cases}$$

where \hat{L}^A satisfies the first order condition $f'(\hat{L}^A) = w^A$. Demand for child labor is

$$(6) \quad D^C(w^A; w^C, p, D) = \begin{cases} L^{C*} & \text{if } w^A > \frac{w^C + pD}{\gamma}, \\ 0 & \text{if } w^A < \frac{w^C + pD}{\gamma} \text{ and } \hat{L}^A < N \\ \hat{L}^C & \text{if } w^A < \frac{w^C + pD}{\gamma} \text{ and } \hat{L}^A > N \\ \text{indeterminate} & \text{if } w^A = \frac{w^C + pD}{\gamma} \end{cases}$$

where L^{C*} satisfies $f'(L^{C*}/\gamma) = \frac{w^C + pD}{\gamma}$; where \hat{L}^C satisfies both $f'\left(N + \frac{\hat{L}^C}{\gamma}\right) \leq \frac{w^C + pD}{\gamma}$ and $\left[f'\left(N + \frac{\hat{L}^C}{\gamma}\right) - \frac{w^C + pD}{\gamma}\right] \hat{L}^C = 0$; and where \hat{L}^A is defined as above. The intuition behind the curves is that when $w^A > \frac{w^C + pD}{\gamma}$, adult labor is relatively expensive and so only child labor is used. When $w^A < \frac{w^C + pD}{\gamma}$, adult labor is used until demand is satisfied or until capacity is reached, whichever is lower. Child labor is used to fill residual demand for labor by the firm (if any). And

FIGURE 4. Equilibrium in the adult labor market.



(A) Case where the marginal benefit curve intersects to the *right* of N , i.e. demand for total labor exceeds the supply of adult labor.

(B) Case where the marginal benefit curve intersects to the *left* of N , i.e. demand for total labor is less than the supply of adult labor.

when $w^A = \frac{w^C + pD}{\gamma}$, the firm is indifferent between hiring any mix of child and adult labor as long as $L^{A*} + \frac{L^{C*}}{\gamma} = L^*$ and $f'(L^*) = w^A$.

In the adult labor market, supply is always fixed inelastically at N and demand is given as above, depending on the relationship between adult wage and child wage. Figures 4a and 4b display the adult labor market equilibria in the case where the marginal benefit curve intersects the marginal cost curve to the right and to the left of N , respectively. When the marginal benefit curve intersects the marginal cost curve to the right of N , demand for adult labor is zero for any $w^A > \frac{w^C + pD}{\gamma}$ and N for any $w^A < \frac{w^C + pD}{\gamma}$; demand for adult labor is indeterminate when $w^A = \frac{w^C + pD}{\gamma}$. When the marginal benefit curve intersects the marginal cost curve to the left of N , demand for adult labor is zero for any $w^A > \frac{w^C + pD}{\gamma}$. For adult wages that satisfy $w^A < \frac{w^C + pD}{\gamma}$, when the adult wage is sufficiently low, firms hire all available adult labor as illustrated in 4b which is derived from the case in Figure 3a. As the adult wage rises (but remains lower than the effective cost of hiring children) firms hire adult labor until $f'(L^A) = w^A$ where $L^A < N$.

In the child labor market, supply is more nuanced. Recall that households send children to work only when adult wages are below subsistence and then use child labor only to the extent

necessary to reach the target subsistence level. Thus the supply of child labor is given by

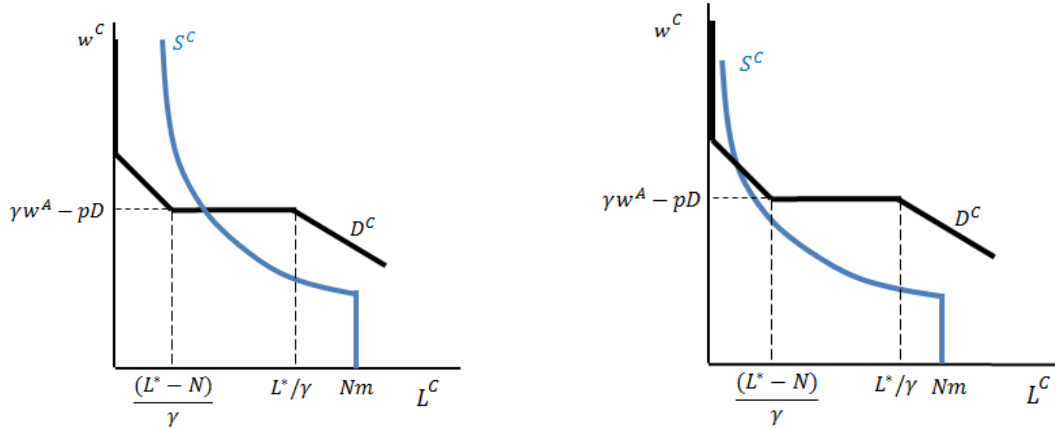
$$(7) \quad S^C = \begin{cases} 0 & \text{if } w^A \geq s \text{ or } w^C \leq 0 \\ \min\{m, \frac{s-w^A}{w^C}\} & \text{otherwise} \end{cases}$$

This set up yields a backward-bending supply curve any time $w^A < s$.⁵ The intuition is that for any given wage $w^A < s$, as the child wage increases, fewer children need to work in order to reach subsistence consumption. The reverse is true as w^C falls; when children earn lower wages the household needs to supply more children to the labor market in order to be able to achieve subsistence. Since households have only a limited number of children, the aggregate child labor supply curve reaches a maximum at Nm .

Figures 5a, 5b and 5c display the possible child labor market equilibria in the case where the marginal benefit curve intersects the marginal cost curve to the right and to the left of N , respectively. When the marginal benefit curve intersects the marginal cost curve to the right of N and $w^A < \frac{w^C+pD}{\gamma}$, demand for child labor is only the residual demand that remains after N units are supplied from adults. When w^A is sufficiently higher than $\frac{w^C+pD}{\gamma}$ the demand for children is zero. Demand for child labor is indeterminate when $w^A = \frac{w^C+pD}{\gamma}$. And when effective child wages are below that of adult wages ($w^A > \frac{w^C+pD}{\gamma}$), only children are hired and fewer children are hired as the cost of hiring them (w^C) rises. Equilibrium can occur either when $w^A = \frac{w^C+pD}{\gamma}$ (horizontal portion of the supply curve) as in Figure 5a or when $w^A < \frac{w^C+pD}{\gamma}$ and $N > L^*$ (on the downward sloping portion of the demand curve where $L^C < \frac{L^*-N}{\gamma}$.) as in Figure 5b. When the marginal benefit curve intersects the marginal cost curve to the left of N , demand for child labor is zero for any $w^A < \frac{w^C+pD}{\gamma}$. Again, demand for child labor is indeterminate when $w^A = \frac{w^C+pD}{\gamma}$. When child labor is relative cheap ($w^A > \frac{w^C+pD}{\gamma}$), there is a standard downward sloping demand for children as illustrated in 5c. Note that the supply curve depicted is the same in all cases, i.e. the difference between the cases is only the shape of the demand curve and where it crosses the supply curve, which depends on whether the marginal benefit curve intersects the marginal cost curve to

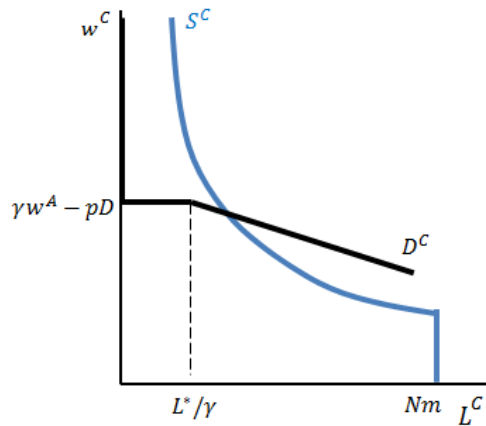
⁵Note that it also assumes that children do not supply labor if their wages are 0. This allows for the possibility of an equilibrium where there is zero child labor.

FIGURE 5. Equilibrium in the child labor market.



(A) Case where the marginal benefit curve intersects to the *right* of N , i.e. demand for total labor exceeds the supply of adult labor and $w^{A*} = \frac{w^{C*} + pD}{\gamma}$.

(B) Case where the marginal benefit curve intersects to the *left* of N , i.e. demand for total labor is less than the supply of adult labor and $w^{A*} < \frac{w^{C*} + pD}{\gamma}$.



(C) Case where the marginal benefit curve intersects to the *left* of N , i.e. demand for total labor is less than the supply of adult labor.

the left or right of N and the relative wages. All figures illustrate cases in which equilibrium is characterized by positive levels of child labor.

Now we limit our attention to the case in which the marginal benefit curve intersects the marginal cost curve to the right of N , i.e. where total labor demand exceeds the supply of adult labor and therefore at least some children are hired.⁶ Since the intention of this model is to study

⁶As in earlier work, this framework allows for multiple equilibria, where an economy can be in either a good equilibrium in which no children work (where $w^A < \frac{w^C + pD}{\gamma}$ and $N > L^*$ and aggregate firm demand is satisfied by aggregate adult labor supply) or a bad one in which children are forced to work (a possibility raised by many previous works such as Basu and Van (1998), Swinnerton and Rogers (1999), and Jafarey and Lahiri (2002)). It is worth noting

the effect of a ban on child labor, we are less concerned with equilibria in which there is no child labor to begin with. As discussed above, general equilibrium exists when there exists a wage pair (w^{A*}, w^{C*}) such that both the adult and child labor markets are in equilibrium and either (a) $w^C = \gamma w^A - pD$ or (b) $w^A < \frac{w^C + pD}{\gamma}$ and $N > L^*$.⁷

Figures 6a and 6b depict an initial equilibrium where $w^{C*} = \gamma w^{A*} - pD$. Consider the effects of increasing the fine levied on firms employing child labor from some initial level, D , to a new higher level D' ; we can even think of the case in which $D=0$ and $D' > 0$; from this point forth, we often refer to the period when the fine is D as the pre-ban period and the period when the fine is D' as the post-ban period. What is the effect of increased fines? Clearly, the demand for child labor will drop as the marginal cost of child labor has increased. In fact, the demand curve will shift down vertically by the increase in expected fines, $p(D' - D)$. As a result, child wages fall by the same amount, as demand for child labor is perfectly elastic on this segment of the demand curve; in other words, children bear the full burden of the increased fines and child wages fall to $w^{C*} - p(D' - D)$. This is a direct consequence of the substitutability between child and adult labor. Since the decline in child wages exactly offsets the increase in expected fines, the total cost of hiring an additional unit of child labor is unchanged for the firm. However, in response to the lower child wages, households must send more children to work. This influx on child labor puts downward pressure on all wages (adult and child). This causes the demand curve to fall in the adult labor market and the reduction in household income coming from adults shifts out supply in the child labor market, from $S(D)$ to $S(D')$. In this new general equilibrium, all wages are lower and more children are working. Although both adult and child wages drop due to the ban, child wages fall proportionally by more than adult wages because they must also internalize the increased labor cost to the firm brought about by the increased fines. The proof for this is in the following section of the appendix.

that when multiple equilibria exist and an economy is in the “bad” equilibrium, a *perfectly* enforced ban on child labor can jolt the economy to the “good” equilibrium, making households better off (see Basu and Van (1998) for details.)

⁷Note that in this model, there is never an equilibrium where $w^A > \frac{w^C + pD}{\gamma}$ because while there may be partial equilibrium in the child labor market under these conditions, the adult labor market will not clear because the supply of adults (N) will exceed demand (0).

FIGURE 6. Effect of an increase in fines on adult and child labor markets. Case 1: Starting from an initial equilibrium where effective wages are equated, $w^{A*} = \frac{w^{C*} + pD}{\gamma}$.

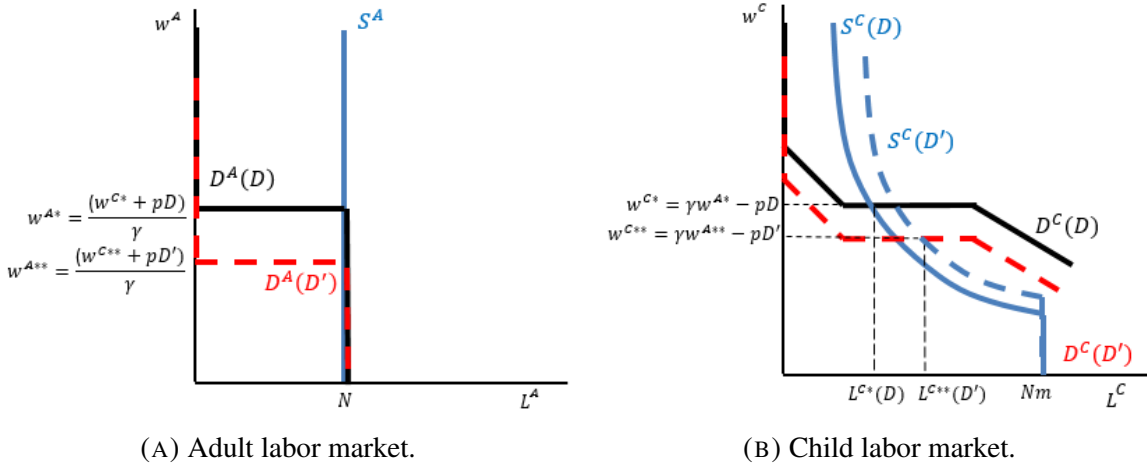
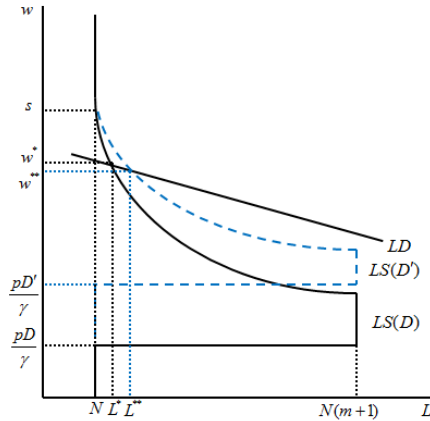


FIGURE 7. General equilibrium representation of the effect of an increase in fines on adult and child labor markets. Case 1: Starting from an initial equilibrium where effective wages are equated, $w^{A*} = \frac{w^{C*} + pD}{\gamma}$.



We can represent the general equilibrium in this model in a single graph if we restrict our attention to equilibria in which wages are equated in effective terms (see Figure 7). Here, the vertical axis represents the wage/marginal cost of an additional unit of labor, w^* ; since we are in the case where $w^{A*} = \frac{w^{C*} + pD}{\gamma}$, this is the same for both children and adults. The horizontal axis represents aggregate effective units of labor. Demand for total labor is smooth and is determined only by the firm's first order condition, $f'(L^*) = w^*$, though the composition of employed labor can be any split of child and adult labor (the firm is indifferent between any mix). Total household labor supply includes an inelastic portion for adult labor (up to N) and then a downward-sloping

portion when child labor is supplied ($L > N$). Here, individual household supply is given by

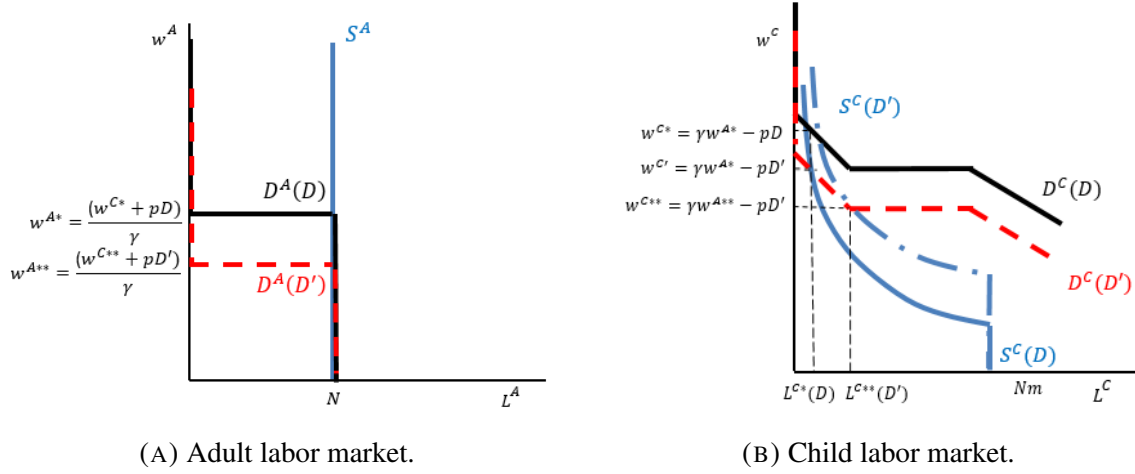
$$(8) \quad S^C(w) = \begin{cases} 0 & \text{if } w \geq s \text{ or } \gamma w - pD \leq 0 \\ \min\{m, \frac{s-w}{\gamma w - pD}\} & \text{otherwise} \end{cases}$$

where we have already restricted ourselves to the case where $w^{C*} = \frac{w^{A*} - pD}{\gamma} = \frac{w^* - pD}{\gamma}$. At the aggregate level, labor supply reaches a maximum at $N(m+1)$. Note that it is possible for effective wages to be low enough that the child wage is 0 or negative. In this case, households do not supply any child labor and so the supply curve reverts to only the inelastic supply of adult labor, N , for any w that implies a negative child wage.

Now we can see that as the fine on child labor increases, the household supply curve shifts outward to $LS(D')$. This is because at every given effective wage, children now earn less and household income is lower so more children must work to achieve subsistence. As more children flow into the market, the effective wage falls from w^* to w^{**} . Initially the increase in fines has no effect on total labor demand because child wages fall to offset the increase in fines. However, as more children enter the workforce, this puts downward pressure on wages, so firms hire more children as represented by the movement downward along the demand curve to the point (w^{**}, L^{**}) . In the new general equilibrium, total labor employed has increased and this increase has come only from children as households were already supply all adult labor.

Next assume that we start from an equilibrium where $w^{A*} < \frac{w^{C*} + pD}{\gamma}$ and $N > L^*$. Note that a single graph representation of general equilibrium is not feasible in this case. Now what is the effect of an increase in the fine D levied on firms employing child labor? Again, the demand for child labor will shift down vertically by the increase in expected fines, $p(D' - D)$ (shown in Figure 8b). However, in this case, demand is not perfectly elastic. In this model, since the child labor supply curve is downward sloping, child wages will initially fall by even more than the increase in expected fines because as child wages fall, more children enter into the market because they must work more to achieve subsistence and this influx of children lowers child wages even further. This means that children bear more the full burden of the increased fines and child wages fall to $w^{C'} < w^{C*} - p(D' - D)$. Since the decline in child wages no longer exactly offsets the

FIGURE 8. Effect of an increase in fines on adult and child labor markets. Case 2: Starting from an initial equilibrium where children are paid more than adults in effective terms, $w^{A*} < \frac{w^{C*} + pD}{\gamma}$ and $N > L^*$.



increase in expected fines, the total cost of hiring an additional unit of child labor has fallen. In a general equilibrium framework, this puts pressure on the adult labor market; adult wages must fall in order for adults to remain competitive with children who now come at a lower cost even after accounting for the increased fines (Figure 8a). As adult wages fall, this in turn affects the child labor supply curve, shifting it outward.⁸ The supply shift results in even lower child wages and more children work, again affecting the adult labor market. The process iterates until supply shifts in the child labor market no longer have effects on child wage (when the supply shifts to curve $S^C(D')$ which meets the new demand curve $D^C(D')$ at the point where it becomes perfectly elastic) and thus there are no more spillover effects in the adult labor market. In the resulting general equilibrium $w^{A**} = \frac{w^{C**} + pD'}{\gamma}$; both adult and child wages have fallen and child labor is higher than before the ban. Child wages have fallen by more than adult wages, as they have not only internalized the increase in expected fines but also the effects of increased competition and resulting drop in household income from adult wages. Another way of putting this is that before the ban, effective child wages were above effective adult wages whereas after the ban the effective wages are equated; thus child wages must fall by more than adult wages in response to the ban.

⁸This general equilibrium labor supply response to the demand shift is formally discussed in Basu et al. (1998).

3. EFFECTS OF A CHILD LABOR BAN IN A MODEL WITH TWO SECTORS

Now, we can consider an extended market in which there are two sectors, agriculture and manufacturing (denoted by lower-case subscripts a and m respectively). Firms in these sectors have representative technologies, $Y_m = f_m(L_m)$ and $Y_a = f_a(L_a)$, where L_i is the effective units of labor in sector i . Child labor and adult labor are perfect substitutes up to a constant, γ , which is the same in both sectors. Furthermore, there is an imperfectly enforced ban on child labor, leading to a fine D being applied with probability p , which only applies to the manufacturing sector. Both firms and households take wages as a given. Normalizing output prices to 1, we can thus say that a firm in sector a is solving

$$\max_{L_a^A, L_a^C} f(L_a^A + \gamma L_a^C) - w_a^A L_a^A - w_a^C L_a^C$$

and a firm in sector m will be solving

$$\max_{L_m^A, L_m^C} f(L_m^A + \gamma L_m^C) - w_m^A L_m^A - (w_m^C + pD)L_m^C.$$

As above, from the first order conditions it can be seen that if both children and adults are working in the agricultural sector, then $w_a^C = \gamma w_a^A$, and if both children and adults are working in the manufacturing sector, then $w_m^C = \gamma w_m^A - pD$.

There are N families in the entire economy, each endowed with 1 unit of adult labor which they supply inelastically, and m children who are endowed with 1 unit of labor. In addition to whatever income is provided by children, adult income in each family is assumed to be the average of the wages in each market.⁹ Households only supply child labor when otherwise below the subsistence level s , and when they do so, they supply only enough labor to reach s .

⁹This assumption is made to make the modeling of labor supply curves simpler. However, all of the qualitative results of the model go through as long as *either* there is at least partial labor mobility so that changes in the manufacturing market have effects on the agricultural market *or* some children who have access to the agricultural market have household income coming from the manufacturing sector. In the pre-ban data, we see that for those employed in agriculture, 23% live in a household where the head of the household works in manufacturing. Therefore it seems likely that a sizeable portion of the agricultural sector will be affected by the wages being paid in the manufacturing even if there were no mobility between sectors.

3.1. Complete Mobility

In the complete mobility case, there are no frictions to switching between the sectors for either children or adults. Thus, adults simply supply labor inelastically to the sector which has a higher equilibrium wage, and labor supply splits appropriately to clear the market if wages are equal. Thus, labor supply of adults in each sector is given by

$$(9) \quad S_m^A(w_m, w_a) = \begin{cases} 1 & \text{if } w_m > w_a \\ q^A & \text{if } w_m = w_a \\ 0 & \text{if } w_m < w_a \end{cases} \quad \text{and} \quad S_a^A(w_m, w_a) = \begin{cases} 1 & \text{if } w_a > w_m \\ 1 - q^A & \text{if } w_a = w_m \\ 0 & \text{if } w_a < w_m \end{cases}$$

where q^A is determined in the equilibrium if wages are equal.

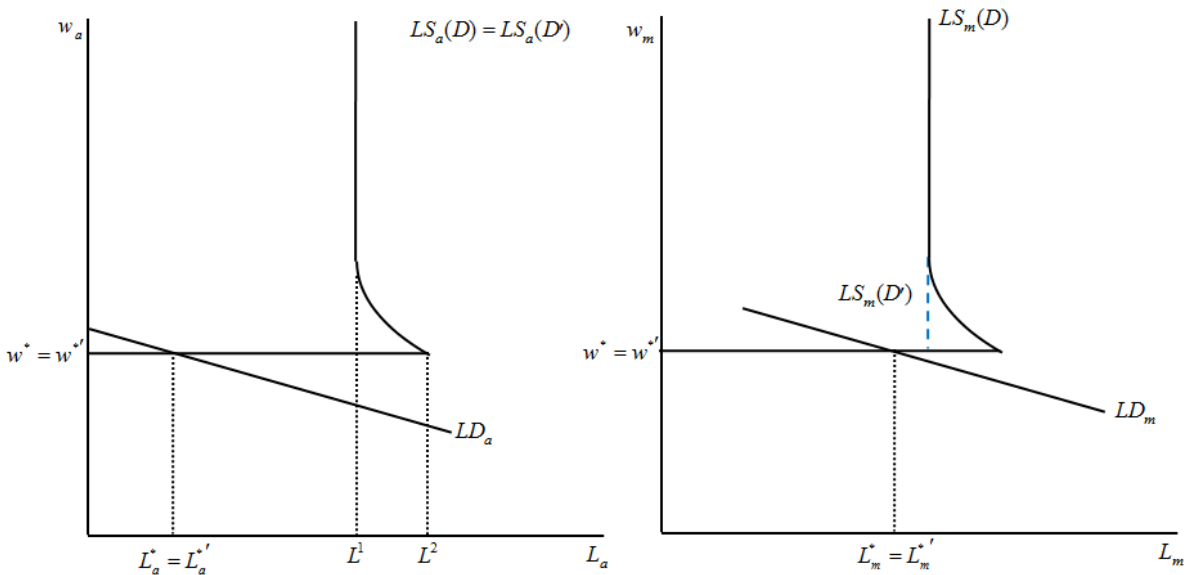
Since children are also fully mobile, and with the above preferences, child labor supply is given by

$$(10) \quad S_m^C(w_m, w_a) = \begin{cases} 0 & \text{if } \frac{1}{2}(w_m + w_a) > s \text{ or } \gamma w_m - pD < \gamma w_a \\ \min \left\{ q^C \cdot \frac{s - \frac{1}{2}(w_m + w_a)}{\gamma w_m - pD}, q^C m \right\} & \text{if } \frac{1}{2}(w_m + w_a) < s \\ & \text{and } \gamma w_m - pD = \gamma w_a \\ \min \left\{ \frac{s - \frac{1}{2}(w_m + w_a)}{\gamma w_m - pD}, m \right\} & \text{if } \frac{1}{2}(w_m + w_a) < s \\ & \text{and } \gamma w_m - pD > \gamma w_a \end{cases}$$

$$(11) \quad S_a^C(w_m, w_a) = \begin{cases} 0 & \text{if } \frac{1}{2}(w_m + w_a) > s \text{ or } \gamma w_a < \gamma w_m - pD \\ \min \left\{ (1 - q^C) \cdot \frac{s - \frac{1}{2}(w_m + w_a)}{\gamma w_a}, (1 - q^C)m \right\} & \text{if } \frac{1}{2}(w_m + w_a) < s \\ & \text{and } \gamma w_a = \gamma w_m - pD \\ \min \left\{ \frac{s - \frac{1}{2}(w_m + w_a)}{\gamma w_a}, m \right\} & \text{if } \frac{1}{2}(w_m + w_a) < s \\ & \text{and } \gamma w_a > \gamma w_m - pD \end{cases}$$

With these supply functions, a child's labor supply will be 0 if equilibrium wages are high enough that their family can reach the subsistence level without the child working. As equilibrium

FIGURE 9. Effect of a ban on child labor in a two sector model assuming perfect labor mobility.



child wages in a given sector fall, but are still above the equilibrium child wage in the other sector, the labor supply curve is downward sloping, and will eventually be vertical, for the same reasons as the one sector case. When child wages are equal between the two sectors, the supply of child labor splits between the two sectors, with a proportion determined in equilibrium. Finally, if child wages in one sector drop below those in the other sector, all children leave the former for the latter.

Since all households are identical, the total labor supply will simply be the sum of all of the individual households' labor supplies. Effective total labor supply in sector i will be given by $S_i(w_m, w_a) = S_i^A(w_m, w_a) + \gamma S_i^C(w_m, w_a)$.

As in the one sector case, we consider the case in which there is already child labor in the pre-ban equilibrium where labor demand elastic enough to generate a unique equilibrium both before and after the ban. A graphical representation of the pre-ban equilibrium can be seen with the solid labor supply curve in Figure 9. The higher vertical portion of the graph corresponds to when wages above subsistence and no children work. As wages fall, children start to enter the labor force, as indicated by the downward sloping portion of the labor supply curve. A key feature of Figure 9, and of all future two-sector graphs, is that the equilibrium in one market affects the

equilibrium in the other market. Thus, given that in equilibrium the wage in agriculture is w^* , no one will work in the manufacturing market if $w_m < w^*$.

In equilibrium, wages will equate between the two sectors. Thus, our market clearing condition simplifies to $S_a(w^*, w^*) + S_m(w^*, w^*) = D_a(w^*) + D_m(w^*)$. It should easily be seen that we have $L_a^* + L_m^* = L^2$. Furthermore, total child labor must be $L^2 - L^1$, since L^1 is the quantity of labor inelastically supplied by adults.

The introduction of the ban in manufacturing pushes all children out of that sector, as can be seen with the dashed line in Figure 9. Intuitively, manufacturing sector wages are either high enough such that no child will want to work because their parents earn enough to reach subsistence, or $\gamma w_a^* > \gamma w_m - pD$, and the children who work do so in agriculture. The total quantity of effective labor supplied in each sector stays the same, but the makeup changes; all of the children who were working in manufacturing move to agriculture, and there is a compensatory shift of adult labor from agriculture to manufacturing. More technically, if for $p = D = 0$ and there exists an equilibrium in which $w_m^* = w_a^* = w^*$, $S_m^C(w^*, w^*) > 0$, $S_a^C(w^*, w^*)$, and $\gamma S_m^C(w^*, w^*) < S_a^A(w^*, w^*)$, then for $p' > 0$ and $D' > 0$, there must exist an equilibrium in which $w_m^{*'} = w_a^{*'} = w^*$, $S_m^{C'}(w^*, w^*) = 0$, $S_a^{C'}(w^*, w^*) = S_a^C(w^*, w^*) + S_m^C(w^*, w^*)$, $S_a^{A'}(w^*, w^*) = S_a^A(w^*, w^*) - \gamma S_m^C(w^*, w^*)$, and $S_m^{A'}(w^*, w^*) = S_m^A(w^*, w^*) + \gamma S_m^C(w^*, w^*)$.

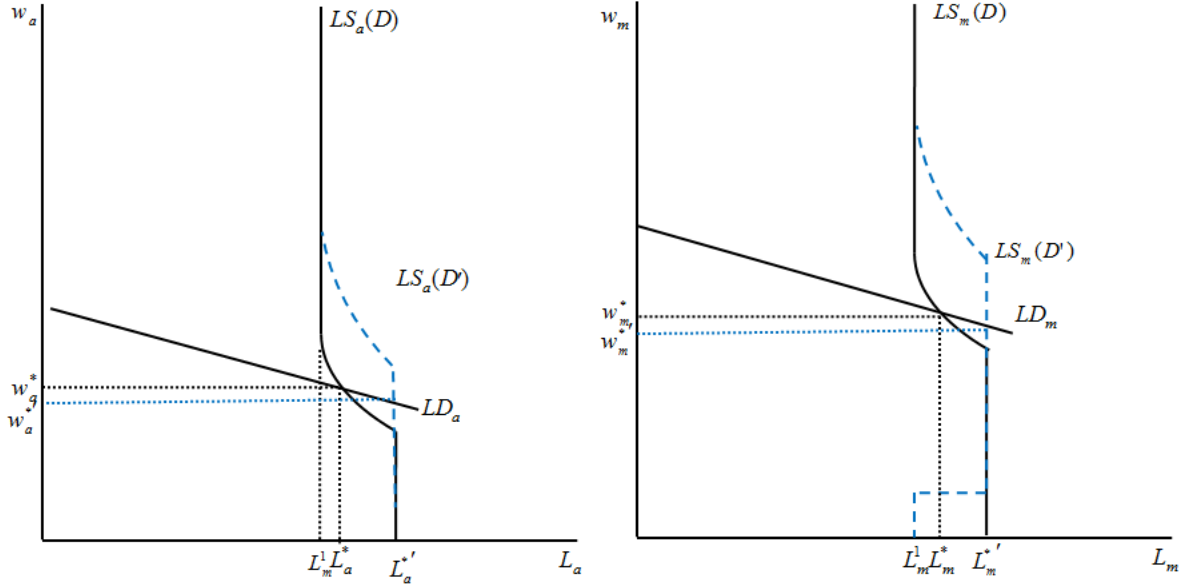
3.2. No Mobility

To move to the case in which we have no mobility, we assume that both children and adults are only able to work in a single sector. The adults still supply labor inelastically, but now only in the sector they have access to, regardless of the wage. Thus, adult labor supply is

$$(12) \quad S_m^A(w_m, w_a) = \begin{cases} 1 & \text{if } k_m^A = 1 \\ 0 & \text{if } k_m^A = 0 \end{cases} \quad \text{and} \quad S_a^A(w_m, w_a) = \begin{cases} 1 & \text{if } k_m^A = 0 \\ 0 & \text{if } k_m^A = 1 \end{cases}$$

where $k_m^A = 1$ if the adult has access to the manufacturing sector, and $k_m^A = 0$ if the adult has access to the agricultural sector. Children face the same incentives as in the complete mobility

FIGURE 10. Effect of a ban on child labor in a two sector model assuming no labor mobility.



case, but now their mobility is also restricted, so

$$(13) \quad S_m^C(w_m, w_a) = \begin{cases} 0 & \text{if } \frac{1}{2}(w_m + w_a) > s \text{ or } k_m^C = 0 \\ \min \left\{ \frac{s - \frac{1}{2}(w_m + w_a)}{\gamma w_m - pD}, m \right\} & \text{if } \frac{1}{2}(w_m + w_a) \leq s \text{ and } k_m^C = 1 \end{cases}$$

$$(14) \quad S_a^C(w_m, w_a) = \begin{cases} 0 & \text{if } \frac{1}{2}(w_m + w_a) > s \text{ or } k_m^C = 1 \\ \min \left\{ \frac{s - \frac{1}{2}(w_m + w_a)}{\gamma w_a}, m \right\} & \text{if } \frac{1}{2}(w_m + w_a) \leq s \text{ and } k_m^C = 0 \end{cases}$$

with $k_m^C = 1$ if the child has access to the manufacturing sector, and $k_m^C = 0$ if she has access to the agricultural sector. Finally, for reasons that will be apparent later, we make the technical assumption that a unit change in the equilibrium wage of one sector leads to a change smaller than a unit in the other.

Restricting ourselves to the cases of interest, the pre-ban equilibrium can be seen in with the solid lines in Figure 10. As it has been drawn in this case, the equilibrium wage in manufacturing is higher than that in agriculture, but none of the children or adults in agriculture have access to the manufacturing sector. The total effective supply of child labor is $(L_a^* + L_m^*) - (L_a^1 + L_m^1)$.

The dashed labor supply curves illustrate the post-ban equilibrium. The effect on the manufacturing sector should be intuitive; it looks much like the one sector case. The lower wage in manufacturing implies that the children in the agricultural sector are receiving less income from their parents, inducing them to supply more labor in that sector. This in turn lowers the the wage in agriculture, causing children in manufacturing to work more, etc. until the markets equilibrate. Effective child labor increases by $(L_m^{*'} + L_a^{*'}) - (L_m^* + L_a^*)$. Wages for children and adults fall proportionally in the agricultural sector, but child wages fall more significantly in manufacturing, because $\frac{\gamma w_m^{*'} - pD}{\gamma w_m^*} < \frac{w_m^{*'}}{w_m^*}$.

3.3. Partial Mobility

Finally, the partial mobility case assumes that some agents have access to both sectors, while other have access only to agriculture. Adults supply labor inelastically in the sector having the highest wage, conditional on having access to that sector. Thus, adult labor is given by

$$(15) \quad S_m^A(w_m, w_a) = \begin{cases} 1 & \text{if } w_m > w_a \text{ and } k_m^A = 1 \\ q^A & \text{if } w_m = w_a \text{ and } k_m^A = 1 \\ 0 & \text{if } w_m < w_a \text{ or } k_m^A = 0 \end{cases}$$

$$(16) \quad S_a^A(w_m, w_a) = \begin{cases} 1 & \text{if } w_a > w_m \text{ or } k_m^A = 0 \\ 1 - q^A & \text{if } w_a = w_m \text{ and } k_m^A = 1 \\ 0 & \text{if } w_a < w_m \text{ and } k_m^A = 1 \end{cases}$$

where $k_m^A = 1$ implies the adult has access to both sectors, $k_m^A = 0$ implies the adult has access only to the agricultural sector, and q^A is determined in equilibrium if wages are equal in the two sectors.

Child labor is supplied very similarly to the other cases, except that now a family's children may or may not have access to the manufacturing sector. Children supply labor to the sector with the highest wage, conditional on having access to that sector, until they reach subsistence or cannot

supply any more labor. Thus, child labor supply is

$$(17) \quad S_m^C(w_m, w_a) = \begin{cases} 0 & \text{if } \frac{1}{2}(w_m + w_a) > s, \gamma w_a > \gamma w_m - pD \text{ or } k_m^C = 0 \\ \min \left\{ q^C \cdot \frac{s - \frac{1}{2}(w_m + w_a)}{\gamma w_m - pD}, q^C m \right\} & \text{if } \frac{1}{2}(w_m + w_a) < s, \\ & \gamma w_m - pD = \gamma w_a, \text{ and } k_m^C = 1 \\ \min \left\{ \frac{s - \frac{1}{2}(w_m + w_a)}{\gamma w_m - pD}, m \right\} & \text{if } \frac{1}{2}(w_m + w_a) < s, \\ & \gamma w_m - pD > \gamma w_a, \text{ and } k_m^C = 1 \end{cases}$$

(18)

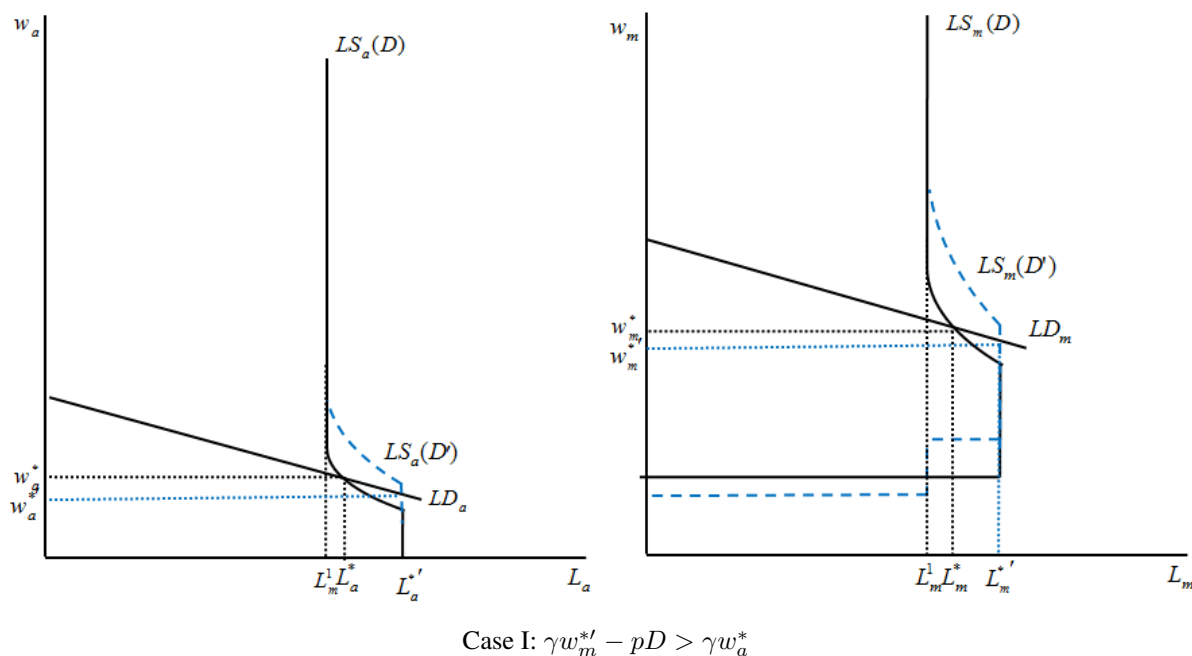
$$S_a^C(w_m, w_a) = \begin{cases} 0 & \text{if } \frac{1}{2}(w_m + w_a) > s, \gamma w_m - pD > \gamma w_a \text{ and } k_m^C = 1 \\ \min \left\{ (1 - q^C) \cdot \frac{s - \frac{1}{2}(w_m + w_a)}{\gamma w_a}, (1 - q^C)m \right\} & \text{if } \frac{1}{2}(w_m + w_a) < s, \\ & \gamma w_a = \gamma w_m - pD, \text{ and } k_m^C = 1 \\ \min \left\{ \frac{s - \frac{1}{2}(w_m + w_a)}{\gamma w_a}, m \right\} & \text{if } \frac{1}{2}(w_m + w_a) < s, \\ & \text{and } \gamma w_a > \gamma w_m - pD \text{ or } k_m^C = 0 \end{cases}$$

where $k_m^C = 1$ implies the child has access to both sectors, $k_m^C = 0$ implies the child has access only to the agricultural sector, and q^C is determined in equilibrium if wages are equal in the two sectors.

The solid lines in Figure 11 show the equilibrium in the partial mobility case before the ban has been imposed. The agricultural sector looks very similar to the single sector case. The manufacturing sector has a higher wage since those in the agricultural sector can't shift. The flat portion of the labor supply curve in manufacturing comes from the fact that if wages in manufacturing fall below those in agriculture, all manufacturing workers shift to the agricultural sector. The total effective child labor is once again $(L_a^* + L_m^*) - (L_a^1 + L_m^1)$.

The post ban equilibrium can be split up into three different cases, effectively differentiated by the relationship between the initial effect of the ban on child wages in both sectors. The

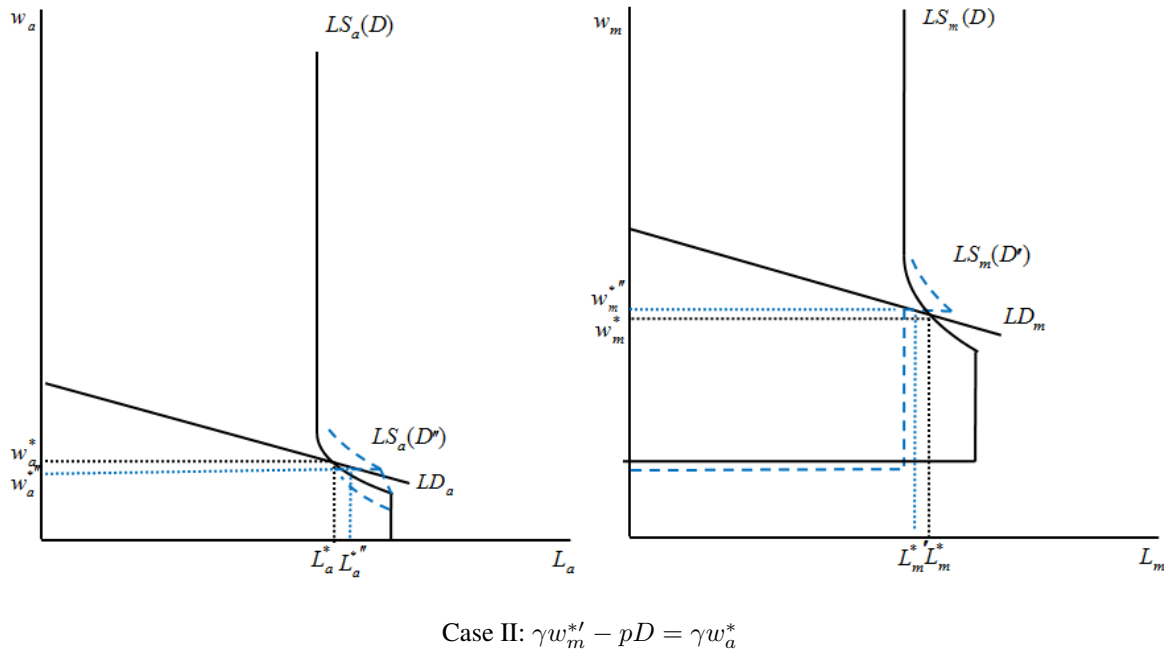
FIGURE 11. Effect of a ban on child labor in a two sector model assuming partial labor mobility.



first case, in which child wages are still higher in manufacturing (i.e. $\gamma w_m^{*'} - pD' > \gamma w_a^*$) can be seen with the dashed portion of Figure 11. Since child wages are still higher in manufacturing, adult wages must also still be higher in manufacturing, none of the children or adults who have access to the manufacturing sector will switch to the agricultural sector. The increase in the fine lowers the wage for children in manufacturing, increasing labor supply in that sector and lowering the equilibrium wage. Similar to the no mobility case, this lower wage in manufacturing increases the labor supply of children in agriculture, because they need to work more to make up for their parents' lower income. This again leads to an iterated increase in labor supply in both markets until the markets equilibrate in an equilibrium with increased effective labor supplied and lower equilibrium wages in both sectors. Since adult labor supply has not changed, this implies that effective child labor has increased in both sectors. Finally, we can see that wages have fallen for children more in the manufacturing sector than they have in the agricultural sector, because $\frac{\gamma w_m^{*'} - pD}{\gamma w_m^*} < \frac{w_m^*}{w_m^*}$.

Figure 12 shows the pre and post ban equilibria in the case in which the ban initially equates child wages in the two sectors ($\gamma w_m'' = \gamma w_a''$). In this case, children are now indifferent between working in agriculture and working in manufacturing. However for families with children who initially worked in manufacturing, wages are now lower so more children must work to

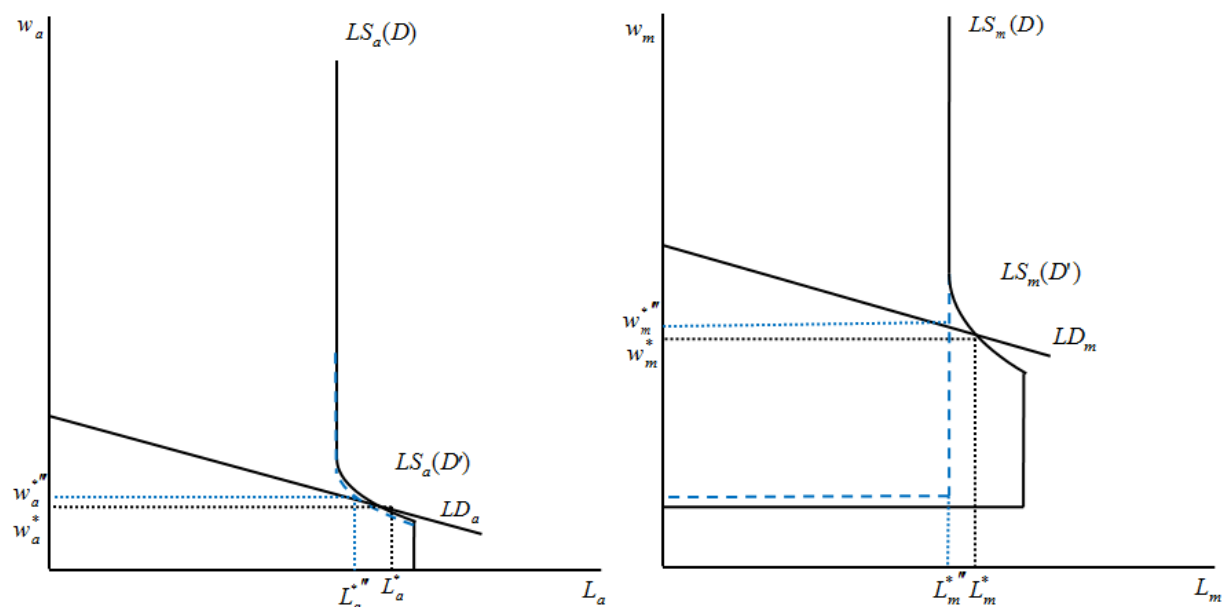
FIGURE 12. Effect of a ban on child labor in a two sector model assuming partial labor mobility.



achieve subsistence consumption. Total labor supply shifts out, lowering wages in both sectors. The end result is more child labor and lower wages though child wage has fallen by a larger proportion relative to adult wages in manufacturing (not in agriculture where adult and child labor fall by the same proportion).

Figure 13 shows one potential illustration of the final case, in which the equilibrium child wage in agriculture is higher than the equilibrium child wage in manufacturing ($\gamma w_a''' - pD < \gamma w_m'''$). Intuitively, one could think of this as the case in which the government set p and D high enough to push children out of the manufacturing market. The effect on labor supply in the manufacturing sector is simple; only adults work in the sector for any wage, and if the wage falls below the wage in agriculture, all of the adults will leave. Labor supply in the agricultural sector looks as if it would if all children *only* have access to the agricultural sector. Wages unambiguously rise in manufacturing. If this wages increase is large enough to reduce overall child employment, this leads to a reduction in agricultural labor supply and wages rise in that sector as well. However, if the manufacturing wage increase is not enough to reduce the number of working children, the labor supply curve will shift out in agriculture, lowering wages in that sector. The combination of

FIGURE 13. Effect of a ban on child labor in a two sector model assuming partial labor mobility.



Case III: $\gamma w_m^{*I} - pD < \gamma w_a^*$

the two effects - higher manufacturing wages but lower agricultural wages - leads to an ambiguous overall effect of the ban on levels of child labor.

4. RELATIVE WAGE RESPONSE TO FINES

Child wage in the manufacturing sector (w_m^C) are set according to

$$(19) \quad w_m^C = \gamma w_m^A - pD$$

Child wages fall in response to a ban, i.e. $\frac{dw_m^C}{dD} \cdot \frac{1}{w_m^C} < 0$. The proportional change in child wage due to a change in fines $\left(\frac{dw_m^C}{dD} \cdot \frac{1}{w_m^C}\right)$ is more negative than the change in adult wage $\left(\frac{dw_m^A}{dD} \cdot \frac{1}{w_m^A}\right)$ as long as

$$(20) \quad \frac{dw_m^C}{dD} \cdot \frac{1}{w_m^C} < \frac{dw_m^A}{dD} \cdot \frac{1}{w_m^A}$$

because $\frac{dw_m^C}{dD} \cdot \frac{1}{w_m^C}$ and $\frac{dw_m^A}{dD} \cdot \frac{1}{w_m^A}$ are both negative.

Totally differentiating (1) with respect to the size of the fine, D , the response of child wages to the ban is given by:

$$\frac{dw_m^C}{dD} = \gamma \frac{dw_m^A}{dD} - p$$

Dividing both sides by (w_m^C) to get the percent change in child wages, we get

$$\frac{dw_m^C}{dD} \cdot \frac{1}{w_m^C} = \gamma \frac{dw_m^A}{dD} \cdot \frac{1}{w_m^C} - p \cdot \frac{1}{w_m^C}$$

Substituting in (19),

$$\begin{aligned} \frac{dw_m^C}{dD} \cdot \frac{1}{w_m^C} &= \gamma \frac{dw_m^A}{dD} \cdot \frac{1}{\gamma w_m^A - pD} - p \cdot \frac{1}{w_m^C} \\ &= \gamma \frac{dw_m^A}{dD} \cdot \frac{1}{\gamma w_m^A \left(1 - \frac{pD}{\gamma w_m^A}\right)} - p \cdot \frac{1}{w_m^C} \\ &= \frac{dw_m^A}{dD} \cdot \frac{1}{w_m^A} \frac{1}{1 - \frac{pD}{\gamma w_m^A}} - p \cdot \frac{1}{w_m^C} \end{aligned}$$

Combining the above with (20), child wages are more responsive to the increase in fines than adult wages when

$$\frac{dw_m^A}{dD} \cdot \frac{1}{w_m^A} \frac{1}{1 - \frac{pD}{\gamma w_m^A}} - p \cdot \frac{1}{w_m^C} < \frac{dw_m^A}{dD} \cdot \frac{1}{w_m^A}$$

Rearranging we get

$$-p \cdot \frac{1}{w_m^C} < \frac{dw_m^A}{dD} \cdot \frac{1}{w_m^A} \left(1 - \frac{1}{1 - \frac{pD}{\gamma w_m^A}}\right)$$

Since $\frac{dw_m^A}{dD} \cdot \frac{1}{w_m^A} < 0$ and $-p \cdot \frac{1}{w_m^C} < 0$, if the third term is also negative, the above condition will hold. Restricting attention to the third term, it will be negative if

$$1 - \frac{1}{1 - \frac{pD}{\gamma w_m^A}} < 0$$

Rearranging,

$$1 < \frac{1}{1 - \frac{pD}{\gamma w_m^A}}$$

$$1 - \frac{pD}{\gamma w_m^A} < 1$$

$$-\frac{pD}{\gamma w_m^A} < 0$$

which always holds since p , D , γ and w_m^A are all positive by assumption.

In the agricultural sector (where there is no ban) child wages (w_a^C) are set according to

$$(21) \quad w_a^C = \gamma w_a^A$$

and so a decrease in fines leads to the same proportional decrease in adult and child wages. This is seen most clearly by first taking logs of (21).

$$\log(w_a^C) = \log(\gamma w_a^A) = \log(\gamma) + \log(w_a^A)$$

Totally differentiating with respect to D ,

$$\frac{d \log(w_a^C)}{dD} = \frac{d \log(w_a^A)}{dD}$$

Thus even though the drop in child wages is smaller than that in adult wages ($dw_a^C/dD < dw_a^A/dD$), the proportional decrease in wages is equal for adults and children.

5. ADDITIONAL EMPIRICAL RESULTS AND ROBUSTNESS CHECKS

5.1. Family-level specifications

The original model of Basu (2005) and the model in Section 3 are constructed at the level of the household. Although we define treatment at the household level in the empirical specification, we conduct the primary analysis at the child level to pick up important heterogeneity in the effect of the ban by child age and gender. That said, we also perform family-level regressions

to more closely match the theoretical model. Our regressions are of the form

$$(22) \quad Prop_{jt} = \alpha_1 Treatment_j + \alpha_2 * Post1986_t \\ + \alpha_3 (Treatment_j \times Post1986_t) + \alpha_X X_{jt} + \delta_t + u_{jt}$$

where $Prop_{jt}$ is the proportion of working children in a given age range for family j in year t . $Treatment_j$ is a dummy variable for whether the family has at least one child who is both underage in the eyes of the law and working age, which we define to be a child of age 10-13 when we consider the proportion of working children ages 6-9 or 14-17. When we look at the effects of the ban on the proportion of children working in the 10-13 age range, we define $Treatment_j$ as 1 if a family has at least *two* children who are age 10-13. This is because for this age range, each family automatically has at least 1 child 10-13 (otherwise the outcome variable, proportion of working children, is undefined). In order for children ages 10-13 to be eligible to be affected by the ban, they must have another sibling who is also in this age range, i.e. there must be two children in that age range.

Online Appendix Table 4 reports the results for specification (22) for both the broad and the narrow definitions of treatment. Both sets of results are consistent with the child-level results. This is largely because the chosen age ranges are fairly narrow; since there are few families with multiple children in each of the 6-9, 10-13 and 14-17 age ranges, the variation in the proportion of working children at the family level is very similar to the variation in child-level employment for each family.

5.2. Narrow-definition Sibling-based Effects

In reality, since only 14% of children ages 10-13 are working before the ban, the effect of the ban on truly “treated” families (those with working children ages 10-13) could be much larger. By altering our definition of “Treatment” to include only those children who have siblings under 14 *working in manufacturing* (the sector affected by the Act of 1986), we can identify a more focused “Intent-to-Treat” effect. This “narrow” definition isolates families who we believe are the most likely to be affected by the ban, although we cannot distinguish between families who had

children working in manufacturing before the ban from those whose children began working as a consequence of the ban. With this narrower definition of treatment we find (as expected) larger point estimates for both child employment and household welfare measures (Online Appendix Tables 2 and 3).

5.3. Sampling Weights

Our baseline specification does not include sample weights, despite the fact that the surveys are collected using stratification.¹⁰ We do not weight our regressions for two reasons. First, the documentation for the earlier rounds (1983 and 1987) does not include a description of the sampling frame. Second, we believe that the true effect of the ban is heterogeneous on many levels, including ones that are likely to be used for sampling (urban location, economic status of the household) as well as child-specific ones as well (gender and age). For this reason, we follow Solon et al. (2013) and directly model the heterogeneity rather than include sample weights, as including sample weights could lead to inconsistent estimates. Nonetheless, we do re-run our baseline specification with sampling weights as a robustness check and find that doing so leaves the estimated effects virtually unchanged, though it does reduce precision for some of the results. These results are reported in Online Appendix Table 8.

5.4. More flexible demographic controls

Online Appendix Table 9 runs our baseline specifications and adds in additional and more flexible controls for demographic characteristics, namely family size fixed effects, number of children under 17 fixed effects, number of females fixed effects, and number of males fixed effects.

5.5. Additional Falsification Exercises

In the paper, we consider both the 1987 and 1993 rounds as post-ban periods and 1983 as a pre-ban period. By limiting our sample to only the post-ban periods we can see whether the data show any differing trends for children under 14 versus over 14 after the ban is in place. Although there were amendments made to the Child Labor Act in the period between 1987 and 1993, the

¹⁰All of our descriptive sample statistics such as pre-ban means of dependent variables and summary statistics are all calculated using weights.

majority of the significant legislation for child labor was passed in the 1986 Act. Therefore we expect there to be no substantial breaks in trends for those over and under 14 between the 1987 and 1993 rounds. Online Appendix Table 6 displays the results of estimating our basic specification using only post-ban data. We observe no statistically significant differences in under-14 versus over-14 wages or employment between 1987 and 1993, in either the overall effects or the sibling-based effects.

5.6. Narrow bandwidths

In Table 10 we show that overall employment results are robust to narrow bandwidths.

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6. ONLINE APPENDIX FIGURES AND TABLES

FIGURE 14. Age distribution pre- and post-ban.

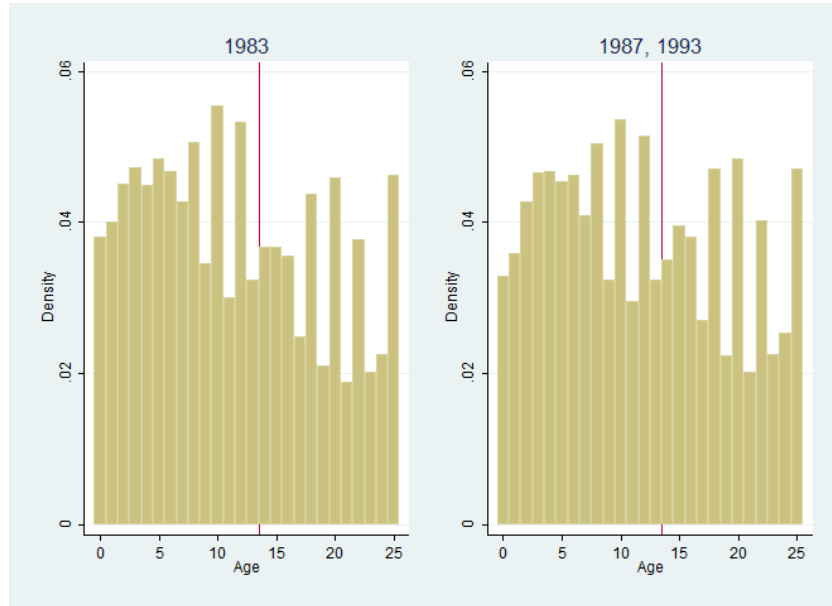


FIGURE 15. Age distribution pre- and post-ban for children working in manufacturing.

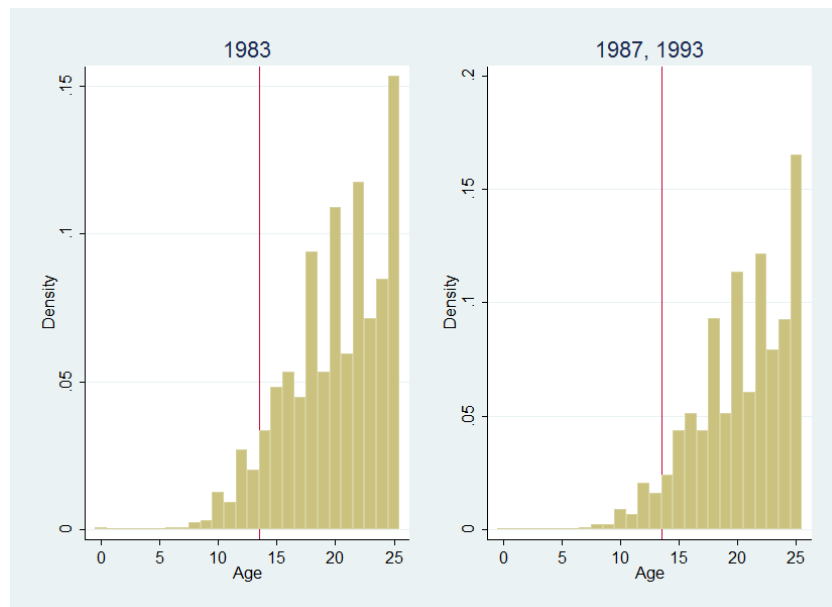


TABLE 1. Correlations between welfare measures

	Ln(pc exp.) (1)	Ln(pc food exp.) (2)	Ln(calories) (3)	Stape share (4)	Asset Index (5)
Ln(pc expenditure)	1.00				
Ln(pc food exp.)	0.92	1.00			
Ln(calories)	0.44	0.54	1.00		
Staple share	-0.57	-0.47	0.15	1.00	
Asset Index	0.50	0.41	0.02	-0.53	1.00

TABLE 2. Sibling-based Effects of the Ban on Child Employment: Narrow Definition

Dependent Variable: Employed (1=Yes, 0=No)			
	Ages 6-9 (1)	Ages 10-13 (2)	Ages 14-17 (3)
Treatment*Post1986	0.017** (0.009)	0.046** (0.023)	0.044** (0.019)
Pre-Ban Mean of Dep. Var.	0.022	0.147	0.327
Observations	22,164	26,977	29,290
R-squared	0.050	0.132	0.208

*** p<0.01, ** p<0.05, * p<0.1 All regressions include a dummy for Post-1986, a dummy for “Treatment” as well as controls for gender, family size, age of household head, age fixed effects, gender of household head, urban status, survey year fixed effects, state-region fixed effects, hh type fixed effects, religion fixed effects, household head’s education level fixed effects, household head’s industry fixed effects. Sample consists of all children with at least one sibling under 25 years old working in manufacturing who are related to the household head, excluding any who are the household head or the spouse of the household head. “Treatment” is a dummy variable that takes the value of 1 if the child has a sibling who is under age 14 and working in manufacturing. Standard errors are clustered by household.

TABLE 3. Welfare Effects: Intent-to-treat effects (Narrow Definition)

Dep. Var.	Treatment=At least one child aged 10-13 working in manufacturing				
	Log exp. pc (1)	Log food exp. pc (2)	Log cal. pc (3)	(1-staple share) (4)	Asset index (5)
Treatment*Post1986	-0.040** (0.017)	-0.027* (0.015)	-0.018 (0.014)	-0.000 (0.004)	-0.105 (0.066)
Pre-ban Mean of Dep. Var.	4.797	5.114	7.599	0.329	-0.324
Pre-ban S.D. of Dep. Var.	0.574	0.518	0.488	0.181	2.247
Observations	55,410	55,203	55,554	55,555	55,919
R-squared	0.511	0.450	0.183	0.524	0.536

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors in parentheses. All regressions include a dummy for Post-1986, a dummy for "Treatment" as well as household size fixed effects, number of children 0-5 fixed effects, number of children 6-17 fixed effects, number of adult female fixed effects, number of female children fixed effects, age of HH head, gender of HH head, urban status, survey year fixed effects, state-region fixed effects, religion fixed effects, HH head's education level fixed effects, HH head's industry fixed effects. Sample includes all households with at least one member under the age of 25 working in manufacturing.

TABLE 4. Family-level regressions

	Treatment = At least 1 sibling ages 10-13			Treatment = At least 1 child under 14 working in manufacturing		
	Ages 6-9 (1)	Ages 10-13 (2)	Ages 14-17 (3)	Ages 6-9 (4)	Ages 10-13 (5)	Ages 14-17 (6)
Treatment*Post1986	0.004*** (0.001)	0.008*** (0.003)	-0.010** (0.005)	0.029** (0.012)	0.013 (0.009)	0.047** (0.021)
Pre-Ban Mean	0.020	0.150	0.351	0.031	0.240	0.482
Observations	140,725	139,301	117,700	16,903	21,953	27,513
R-squared	0.021	0.098	0.149	0.125	0.730	0.172

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ All regressions include a dummy for Post-1986, a dummy for "Treatment" as well as age group fixed effects, survey year fixed effects, state-region fixed effects, hh type fixed effects, religion fixed effects, household head's education level fixed effects, household head's industry fixed effects. All regressions include a dummy for Post-1986, a dummy for "Treatment" as well as age controls for gender, family size, age of HH head, age fixed effects, gender of HH head, urban status, survey year fixed effects, state-region fixed effects, hh type fixed effects, religion fixed effects, HH head's education level fixed effects, HH head's industry fixed effects. Columns (1)-(3): Sample consists of all households with at least 1 child in the given age range. Treatment = 1 if household has at least 1 child ages 10-13 (for column 1 and 3) or at least 2 children ages 10-13 (column 2). Columns (4)-(6): Sample consists of all households with at least 1 child in the given age range and who have at least 1 child working in manufacturing the 0-25 age range. Robust standard errors reported.

TABLE 5. Effect of Child Labor Ban on Employment of Other Age Groups

	Men & Women		
	Ages 18-25	Ages 26-55	Ages 55+
Treatment*Post1986	-0.003 (0.004)	-0.001 (0.002)	-0.001 (0.005)
Pre-Ban Mean of Dep. Var.	0.530	0.650	0.380
Observations	216,922	611,785	141,331
R-squared	0.307	0.448	0.356
	Men		
	Ages 18-25	Ages 26-55	Ages 55+
Treatment*Post1986	-0.006 (0.006)	-0.001 (0.002)	0.002 (0.007)
Pre-Ban Mean of Dep. Var.	0.746	0.933	0.607
Observations	121,939	311,861	72,293
R-squared	0.193	0.021	0.239
	Women		
	Ages 18-25	Ages 26-55	Ages 55+
Treatment*Post1986	0.000 (0.006)	-0.003 (0.003)	0.006 (0.005)
Pre-Ban Mean of Dep. Var.	0.248	0.360	0.153
Observations	94,983	299,924	69,038
R-squared	0.173	0.188	0.147

*** p<0.01, ** p<0.05, * p<0.1 All regressions include a dummy for Post-1986, a dummy for “Treatment” as well as controls for gender, family size, age of household head, age fixed effects, gender of household head, urban status, survey year fixed effects, state-region fixed effects, hh type fixed effects, religion fixed effects, household head’s education level fixed effects, household head’s industry fixed effects. Sample of children consists of all who are related to the household head, excluding any who are the household head or the spouse of the household head. “Treatment” is a dummy variable that takes the value of 1 if the child has a sibling who is between the ages of 10 and 13 (inclusive) and takes on a value of 0 if sibling is between ages of 14-25 (inclusive) or below the age of 9. Standard errors are clustered by household.

TABLE 6. Post-trends in wages and employment (1987, 1993 data only)

	Overall Effects		Sibling-based Effects
	Ages 6-20 (1)	Ages 10-17 (2)	Ages 10-13 (3)
Under14*Post1987	0.024 (0.029)	-0.007 (0.005)	0.000 (0.003)
Observations	16,918	218,044	118,244
R-squared	0.242	0.164	0.087

*** p<0.01, ** p<0.05, * p<0.1 See notes for Online Appendix Table 5 for additional controls. In columns 1 and 2, “Treatment”= “Under 14” and standard errors are clustered by age-year.

TABLE 7. Effect of Ban on Child Employment in States with Low Operation Blackboard Intensity

	States that rank in the bottom half of states according to Operation Blackboard intensity			
	Overall Effects		Sibling-based Effects	
	Ages 10-17 (1)	Ages 6-9 (2)	Ages 10-13 (3)	Ages 14-17 (4)
Treatment*Post1986	0.014*** (0.005)	0.001 (0.001)	0.010** (0.004)	-0.010 (0.007)
Pre-Ban Mean of Dep. Var.	0.195	0.011	0.111	0.302
Observations	150,837	81,775	81,233	67,662
R-squared	0.166	0.011	0.072	0.180

*** p<0.01, ** p<0.05, * p<0.1 See notes for Online Appendix Table 5. In column 1, "Treatment"="Under 14" and standard errors are clustered by age-year. Intensity of Operation Blackboard figures taken from Chin (2005).

TABLE 8. Adding sample weights

	Overall Effects		Sibling-based Effects	
	Ages 10-17 (1)	Ages 6-9 (2)	Ages 10-13 (3)	Ages 14-17 (4)
	Treatment*Post1986	0.017*** (0.005)	0.003** (0.002)	0.009** (0.004)
Pre-Ban Mean of Dependent Variable	0.225	0.020	0.142	0.336
Observations	332,282	187,125	182,004	145,560
R-squared	0.172	0.030	0.106	0.182

*** p<0.01, ** p<0.05, * p<0.1 See notes for Online Appendix Table 5.

TABLE 9. Including more (and more flexible) controls for demographics

	Overall Effects		Sibling-based Effects	
	Ages 10-17 (1)	Ages 6-9 (2)	Ages 10-13 (3)	Ages 14-17 (4)
	Treatment*Post1986	0.015*** (0.005)	0.003*** (0.001)	0.008*** (0.003)
Pre-Ban Mean of Dep. Var.	0.225	0.020	0.142	0.336
Observations	332,282	187,126	182,005	145,562
R-squared	0.177	0.026	0.101	0.186

*** p<0.01, ** p<0.05, * p<0.1 See notes for Online Appendix Table 5. Additionally, all regressions include controls for gender, family size fixed effects, number of children under 17 fixed effects, number of females fixed effects, and number of males fixed effects.

TABLE 10. Overall Effects using Narrower Age Ranges

	Dependent Variable: Employed				
	Age Ranges				
	6-20 (1)	10-17 (2)	11-16 (3)	12-15 (4)	13-14 (5)
Under14*Post1986	0.019** (0.008)	0.017*** (0.005)	0.016*** (0.004)	0.014*** (0.002)	0.013*** (0.001)
Mean of Dep. Var. (for under 14)	0.079	0.141	0.165	0.183	0.197
Observations	644,893	332,282	244,681	171,950	73,765
R-squared	0.256	0.172	0.165	0.149	0.127

*** p<0.01, ** p<0.05, * p<0.1