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Abstract

When labor incomes approach subsistence levels, the labor supply curve slopes outward, because the fight for survival mandates households to look for longer work hours in response to falling wage rates. We explore conditions under which near-subsistence scenarios may imply wage traps, labor market failures that can be the cause of undernourishment, illiteracy, and child labor. After stating general conditions under which wage traps occur, we look at specific production functions typically employed in quantitative analyses of growth and development. We find that standard Cobb-Douglas production functions do not permit wage traps, whereas CES functions do. Beyond that it turns out that when subsistence requirements increase with work hours, and when work effort rises with the wage rate, up to the efficiency-wage threshold, wage traps become more likely. Measures such as bans on child labor, implementation of minimum wage laws, or the establishment of labor unions may quite effectively improve conditions in wage-trapped labor markets.

Keywords

Subsistence income, labor supply, poverty, child labor, wage trap, market failure, development, growth

JEL Classification

J2, J4, O11

1 Introduction

There is a lengthy discussion on record in the history of economic thought concerning the possibility and implications of a backward-bending labor-supply curve.[1] The typical example of a negatively-sloped labor supply curve occurs at high wage rates and incomes, and is of little interest from the perspective of poor countries with insufficient development dynamics. The other end of the wage spectrum has received much less attention.[2] When wages are very low and labor incomes approach subsistence levels, the need to keep heads above water simply in order to survive renders the slope of the labor supply curve negative as well. In this situation the fight for physical survival dominates all other considerations, such as the consumption/leisure trade-offs embedded in standard utility functions, and forces households to look for longer work hours in response to falling wage rates.

This paper examines the implications of this scenario. In particular, it analyzes the conditions under which near-subsistence scenarios may imply a wage-trap type of market failure that calls for policy interference. If such wage traps only exist in small, low-wage sectors of an otherwise developed economy, chirurgic policy measures such as minimum wage laws may be called for and suffice. If wage traps are characteristic of major parts of a low-income economy, foreign aid of the big-push variety may be called for, as is often suggested in the literature on poverty traps.[3]

2 Outward-Sloping Labor Supply and Wage Traps

The existence of a negatively sloped labor supply curve near subsistence levels is not a serious problem per se. Consider Figure 1, where the bold line shows a complete labor supply curve and helps put the issue at hand in perspective. It has been coined the S-shaped labor supply curve or, more correctly, the *inverted* S-shaped

[1] The traditional explanation of the backward-bending labor supply curve is based on the premise that beyond a certain wage threshold, the income effect dominates the substitution effect. More recent contributions look at other possible explanations. For example, Lin (2003) derives a backward-bending segment of the labor supply curve without an income effect by treating work effort and work hours as distinct variables in an efficiency wage model.

[2] One of the first times the possibility of a negatively-sloped labor supply curve in near-subsistence scenarios was mentioned appears to be Krueger (1962). Later discussions appear in Barzel and McDonald (1973) and Sharif (1991) (see also Sharif, 2003). More recently, Dessing (2002) generalized the idea to an S-shaped labor supply curve, which is actually an inverted S, and used this as a basis for an empirical study.

[3] The most comprehensive survey on poverty traps is Azariadis and Stachurski (2005), which draws on Azariadis (1996, 2004). A recent empirical study on the relevance of two specific kinds of poverty traps, with negative results, is Kraay and Raddatz (2006).

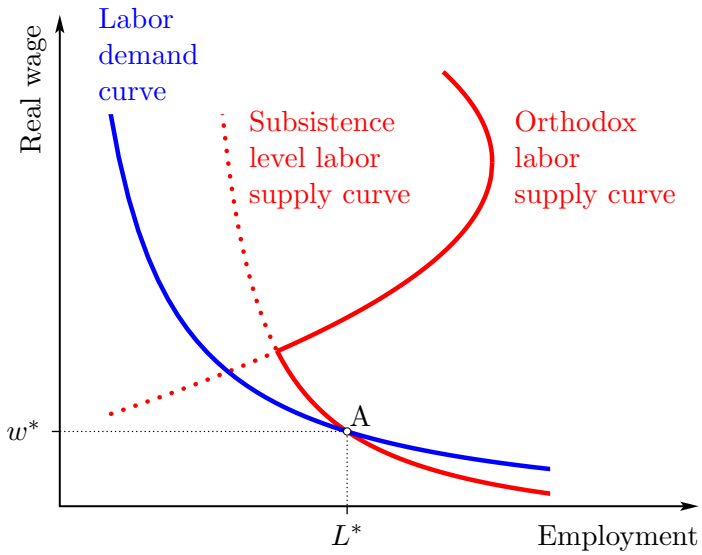

Figure 1: A Stable Labor Market Equilibrium with Outward-Sloping Supply.

labor demand curve. Most fitting, perhaps, is the term 'Z-shaped labor supply curve' suggested by Grimsrud (2003). It includes the familiar backward-bending segment at high wage rates, the normal positively-sloped middle part, and the negatively-sloped segment near the bottom. To distinguish this segment from the backward-bending segment on top, this section is often called the 'outward sloping' (or 'forward falling') part of the labor supply curve.

A simple but straightforward way to rationalize this Z-shape is by proposing that households choose consumption $C \geqslant 0$ and their supply of labor $L \in [0, \overline{L}]$ so as to maximize the utility function

$$U = U(C, \overline{L} - L) \times S,$$

subject to the budget constraint $C = w \cdot L$, where $U(\cdot) > 0$ and where

$$S = \begin{cases} 1 & \text{if } wL \geqslant \text{MIN}, \\ 0 & \text{if } wL < \text{MIN}. \end{cases}$$

The backward bend for high wage levels would result from appropriate properties of the utility function $U(\cdot)$. The outward-sloping segment for low wage levels in turn obtains because utility drops to zero when income falls short of the subsistence level. In order to avoid this, any drop in the wage rate mandates an appropriate increase

in work hours offered to firms.[4]

In the situation depicted in Figure 1, the subsistence-level equilibrium in A is stable, and as technological progress and capital accumulation tilt the labor demand curve upward, two things happen. First, the welfare of workers and their families improves, because while consumption initially remains stuck at the level required for subsistence, work time falls and leisure time increases. This has the added benefit of providing workers with more time to invest in their human capital, which spurs labor productivity growth and accelerates the shift of the labor demand curve. Second, the equilibrium will eventually cross the kink in the labor supply curve and labor income will begin to grow along the positively-sloped segment of the labor supply curve, benefiting from productivity increases.

The case shown in Figure 2 is more dramatic. Here the labor market features multiple equilibria. The one in the middle, marked by point A, occurs at the wage rate w_{T}. Since A is located at the point of intersection between the labor demand curve and the subsistence segment of the labor supply curve, labor income just equals subsistence income. Because the supply curve is flatter than the demand curve, this equilibrium is not stable. From wage rates higher than w_{T}, the labor market converges into a high-income equilibrium C, where labor income comfortably clears subsistence requirements. Once the real wage rate drops below the crucial rate w_{T}, the excess supply of labor drives wages down even further and forces households to expand employment. Initially this may happen through longer work hours for one parent, then for both parents, and finally by drawing on the family's children, in a futile effort to generate the family income needed for sheer survival. At some point, though, the family exhausts all its members' available work time, and employment

[4]The less than elegant kink in the labor supply curve results from our attempt to provide a parsimonious and intuitive formal model of the Z-shaped labor supply curve that makes the subsistence level threshold explicit. For a smoother transition from the positively-sloped to the outward-sloping segment, one might let S be a continuous variable in the interval $[0, 1]$ that measures health, and make it depend on labor income. We do not need to complicate things this way, since this paper's focus is on labor market equilibria effectively positioned *on* the subsistence level supply curve and on the properties of such scenarios.

On a related point, one might imagine the outward slope in the supply curve commencing already at wage levels where sheer survival and health are not as immediately at stake, but where households simply prefer to compensate income losses with additional work hours. Sharif (1991), for instance, proposes an outward-sloping labor supply curve based on a utility function with a varying elasticity of substitution between consumption and leisure, or food and rest time, in his terminology. Again, abstracting from this issue is innocuous to the extent that our ensuing analysis will focus on the outward-sloping part of the supply curve and, more specifically, on wage levels which are so low that labor supply is indeed governed entirely by subsistence needs.

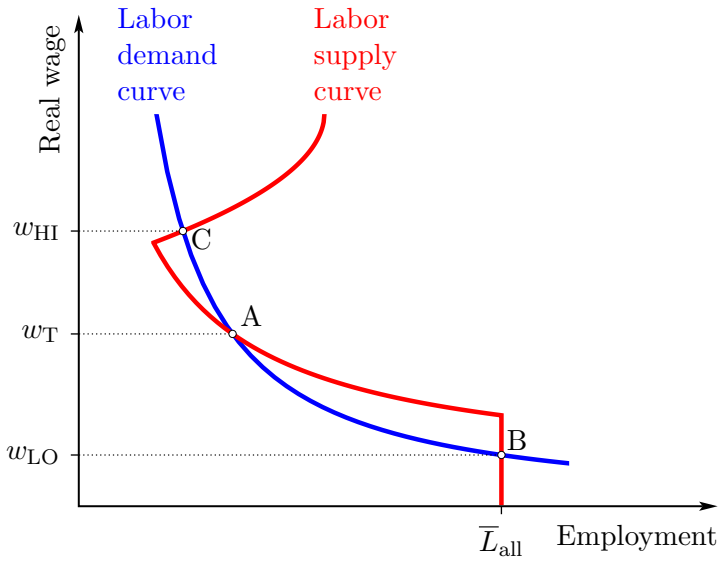

Figure 2: Multiple Equilibria and a Wage-Trapped Labor Market with Outward-Sloping Supply.

cannot increase any further, no matter how low the wage rate becomes. At this point the labor supply curve becomes vertical.[5] It is in this segment, at a point such as B, where the labor demand and supply curves intersect for a new, stable equilibrium towards which the wage-trapped economy is drawn.[6]

This wage-trap equilibrium has some rather nasty characteristics:

(i) Incomes are stuck below subsistence needs, which has consequences for the health and emotional and physical growth of family members.

(ii) Welfare is reduced, of course, since both consumption falls and leisure time evaporates as one slides down the labor demand curve from A to B.

(iii) There is child labor, mandated by families' struggle for survival that dominates all other considerations, causing children to receive but a minimal level of

[5]It has even been suggested (Dessing, 2002, p. 441) that this section is again positively-sloped rather than vertical, since families may be forced to withdraw from the formal labor market to resort to non-market, illegal or outright criminal activities to raise income. These activities range from begging and prostitution to stealing and more serious crime. We ignore this possibility, since it is not of key importance for the issues addressed here.

[6]The vertical segment of the labor supply curve is not really covered by the simple utility function proposed above, since utility is zero at any point below the subsistence curve. Thus, households are indifferent between such points. To remedy this, one might propose a separable utility function of the form $U = U(C, \overline{L} - L) \times S + u(wL - \mathrm{MIN}) \times (1 - S)$ with $u(0) = 0$ and $u' > 0$ which makes sub-subsistence households want to approach the subsistence level.

schooling, if any at all.

The route of escape from this trap would have to be technological progress and the accumulation of physical and human capital, since this would tilt the labor demand curve upward which, in turn, would eventually eliminate the wage trap. Improvement may eventually come when the labor demand curve has moved far enough, but the forces that typically foster this process are either absent or alarmingly weakened in this scenario:

(a) There is virtually no human capital accumulation, both because adults are entirely absorbed by the struggle for survival, and because formal schooling for children is more or less absent.

(b) There is a very high mortality rate among all generations, caused by incomes being stuck below subsistence requirements, which also inhibits human capital accumulation.

(c) The diffusion of technological innovations from the global economy to such labor markets will be possible only in rare cases, as the situation is typically characterized by very low skill levels and a high extent of equally unskilled child labor.

(d) Factors mentioned under (a)–(c) are also detrimental to investment and the growth of the capital stock.

(e) Though improvements in technology and human and physical capital stock may be achieved in spite of the difficulties just mentioned, these will generate only minor effects on the labor demand curve in the region where it counts in the current context. This is because such improvements typically tilt the labor demand curve upward (instead of shifting it), thus hardly affecting the position of wage trap equilibrium A.

It is these unpleasant properties of the wage-trap scenario proposed here that make us ask under what conditions such a trap may occur. With this question in mind, the remainder of the paper is organized as follows. Section 3 states the general conditions under which wage traps occur, cast in terms of the wage elasticities of labor demand and supply. Section 4 then turns to specific production functions of the kind employed in quantitative analyses of growth and development. It is revealed that a standard Cobb-Douglas production function does not permit wage traps, whereas a CES production function does.

In Section 5 the analysis is extended by relaxing some of the assumptions of "pure" scenarios. In particular, we drop the assumption of a parametric subsistence level and permit the level of income required for survival to vary with work hours. We also allow work effort or efficiency to depend on the real wage, as assumed in efficiency wage models, with rather surprising and complex results. Section 6 contains a brief discussion of policy options. Section 7 sums up and suggests questions to be addressed in future research.

3 When Do Wage Traps Occur?

As a backdrop for our analysis, this section formulates generic conditions for the occurrence of wage traps. Letting $L_S(w)$ and $L_D(w)$ denote the labor supply and demand functions, respectively, a market equilibrium w^* obtains for $L_S(w^*) = L_D(w^*)$, that is, for a real wage which equates supply and demand.

Wage traps are encountered when market equilibria are *unstable* in the sense that excess demand is strictly increasing in the wage w. In this case, a wage rate below the market-clearing level w^* leads to an oversupply of labor, which in turn causes wages to fall even further rather than adjusting upward toward the market-clearing rate.[7] Formally, wage traps in the definition employed here will therefore occur if

$$L'_D(w^*) > L'_S(w^*), \tag{1}$$

so that, around the market-clearing wage rate w^*, a drop in the real wage expands labor supply by more than labor demand.

It is convenient to reformulate this stability condition in terms of elasticities. Letting $\varepsilon_S(w) = L'_S(w) \cdot w/L_S(w)$ and $\varepsilon_D(w) = L'_D(w) \cdot w/L_D(w)$ denote the elasticities of labor supply and demand, respectively, condition (1) can be restated as

$$\varepsilon_D(w^*) > \varepsilon_S(w^*). \tag{2}$$

We now turn to the case where the labor market equilibrium is positioned at a point at which labor incomes hover around levels that barely support physical subsistence. In its simplest version, the subsistence-level hypothesis outlined in the

[7] This notion of stability, known as *Walrasian* stability, derives from the idea that the demand side tends to raise its wage bids when excess demand is positive whereas the supply side will lower its requested wage when excess demand is negative (see, e.g., Henderson and Quandt, 1986, Chapter 6–8).

introduction asserts that, for any real wage w, workers will choose labor supply so as to maintain a fixed subsistence-level of income MIN, the minimal income which a worker must obtain to remain in good health. Inverse labor supply around the subsistence level is then given by

$$L_S(w) = \text{MIN}/w.$$

The key property of this subsistence level labor supply function is that $\varepsilon_S = -1$, so that labor supply is perfectly elastic. That is, if the wage drops by 10%, workers will work exactly 10% more in order to retain the subsistence level of income. Consequently, a market equilibrium w^* will be unstable whenever

$$\varepsilon_D(w^*) > -1. \tag{3}$$

Thus, for a wage trap to occur, labor demand must be *inelastic*. A 10% drop in the wage rate must give rise to a hike in employment of *less* than 10%.

4 Wage Traps with Cobb-Douglas or CES Production Functions

Having formulated generic conditions concerning the existence of wage traps in the previous section, we now review the scope for such traps under commonly used production functions. Given any production function $F(L)$ (and holding other factors of production fixed), competitive labor demand is determined by $L_D(w) = F'^{-1}(w)$, so that the elasticity of labor demand becomes

$$\varepsilon_D(L) = \frac{F'(L)}{F''(L) \cdot L}.$$

Cobb-Douglas Production Functions. First, consider the Cobb-Douglas production function, which is perhaps the most commonly used production function in the empirical literature on growth and development issues. For a Cobb-Douglas production function of the form $Y = F(L) = AL^\beta$ ($A > 0$, $0 < \beta < 1$),[8] we have $F''(L) = (\beta - 1)F'(L)/L$, and hence

$$\varepsilon_D = -(1 - \beta)^{-1} < -1.$$

[8]This formulation covers the usual Cobb-Douglas form $Y = \tilde{A}K^\alpha L^\beta$ since capital is held fixed in our considerations.

Thus, under a Cobb-Douglas production function, the demand for labor is always strictly elastic, implying that wage traps as sketched in Figure 2, defined as market failure, cannot occur (i.e., condition (3) will always be violated).

Sub-subsistence equilibria, such as the one which occurs at point B in Figure 2, are nevertheless possible when the production function is of the conventional Cobb-Douglas type. This occurs when technology is so poor and/or the stock of capital is so low that the labor demand curve remains below the supply curve all through the interval $0 \leqslant L \leqslant \overline{L}_{\text{all}}$. A point of intersection still exists because the demand curve is always flatter than the supply curve, and this equilibrium is indeed stable. But since this equilibrium sits outside the available range, to the right of $\overline{L}_{\text{all}}$, it can never be reached, and the labor market finds itself stuck below the subsistence level at B. Contrary to the situation depicted in Figure 2, however, this is not a market failure: it is rather a situation in which no market exists. If such conditions were permanent, the country or region would become deserted, or the industry would disappear. Survival of the region or industry concerned, then, is only possible if subsidies from outside keep it afloat for other motives.[9] If such conditions are created temporarily, say in the wake of a war or a major natural disaster, with infrastructure and capital destroyed on a large scale, reconstruction support from abroad would be needed and suffice in order to return the country to a unique, stable equilibrium with labor incomes above the level of subsistence.

CES Production Functions. Next, consider the family of CES production functions of the form $F(L) = A(\tilde{K} + \beta L^{-\rho})^{-1/\rho}$. For this class of production functions, the elasticity of labor demand is

$$\varepsilon_D = -\frac{\tilde{K} + \beta L^{-\rho}}{(1+\rho)\tilde{K}}. \tag{4}$$

For $\rho < 0$, wage traps can generally be excluded. Labor demand is always elastic since ε_D is bounded from above by $-(1+\rho)^{-1} < -1$. For $\rho > 0$, however, ε_D increases monotonously from $-\infty$ to $-(1+\rho)^{-1} > -1$, so that labor demand is inelastic (and wage traps are possible) for sufficiently high levels of L (low levels of MIN).[10]

[9] Examples include countries that subsidize living in uninviting areas for environmental or strategic purposes (for example high Alpine settlements or the Falklands), or industries with severe comparative disadvantages, such as agriculture, to achieve a minimum level of autarky.

[10] Note for $\rho \to 0$ (as the CES production function approaches a Cobb-Douglas production function), ε_D^{-1} approaches $-\tilde{K}/(\tilde{K}+\beta) > -1$ (and hence becomes independent of L) for $\rho \to 0$.

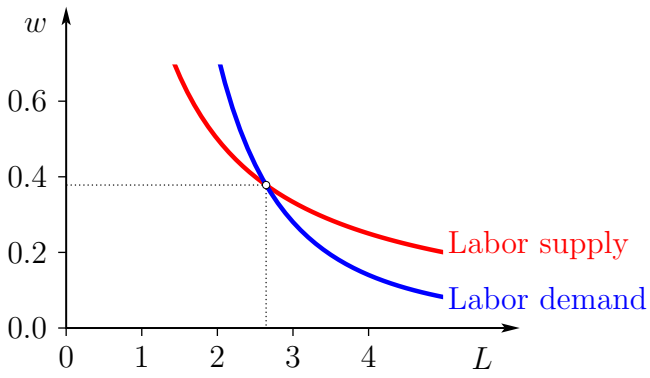

Figure 3: A Wage-Trapped Labor Market with a CES-Production Function.

Recalling that the parameter ρ is related to the (constant) elasticity of substitution σ by $\sigma = (1+\rho)^{-1}$, this implies that wage traps can only occur under a CES production function if the elasticity of factor substitution is less than one.

Figure 3 plots a specific example in which a wage trap occurs under a CES-production function, namely for the following parameter values: $\rho = 1.5$ (implying an elasticity of substitution of $\sigma = 0.4$), $\beta = 0.5$, $\tilde{K} = 2$, $A = 30$, and MIN $= 1$.[11,12]

5 Robustness Checks

Given the prominent role that Cobb-Douglas production functions play in empirical research on income comparisons, growth and development, the above finding that wage traps are not compatible with such functional forms is an important one. In an effort to gauge the robustness of this result we now relax two key assumptions employed in Section 3. We first ask what happens if subsistence requirements are not parametric but depend on physical exertion and, thus, on work hours supplied. Second, we ask what are the consequences of labor productivity or work effort being dependent on the real wage rate? While both modifications may not appear urgent in analyses of industrial countries, studies of labor markets in poor, agrarian economies

[11] Strictly speaking, there is also a *stable* equilibrium at $L \approx 0.21$ that is not shown in the plot. Through the reasoning given in the introduction, in this area of relatively high leisure, consumption and high wages, we should expect labor supply to be governed by concerns other than the subsistence-level issues considered here.

[12] For this parameterization, at L^* (where supply meets demand), the share of labor income is approximately 5%, while the (non-inverse) elasticity of labor demand is approximately 0.6.

may be rendered unrealistic without them.

5.1 Variations on Labor Supply

Suppose the workers' subsistence-level of income MIN depends positively on the number of hours worked, so that $\text{MIN}'(L) > 0$. A plausible explanation for this may simply be that as the number of hours worked increases, the individual's calorie intake required to sustain this additional effort rises. With this modification, the inverse elasticity of labor supply is

$$\varepsilon_S = \left(-1 + \frac{\text{MIN}'(L) \cdot L}{\text{MIN}(L)}\right)^{-1} < -1.$$

Thus, the supply of labor will be strictly elastic and, as a consequence, wage traps may occur even with an *elastic* labor demand as implied by the Cobb-Douglas production function. An example with a constant employment elasticity γ of the subsistence threshold would be $\text{MIN}(L) = \lambda \cdot L^{\lambda}$ $(\lambda, \gamma, L > 0)$. Then $\varepsilon_S^{-1} = -1 + \gamma > -1$, and the labor market features a wage trap even though the production function is Cobb-Douglas whenever $\gamma > \beta$. This functional form must be considered an approximation in the neighborhood of the labor market equilibrium, however, since it implies that the subsistence level drops to zero when households retreat from employment altogether.[13]

5.2 Variations on Labor Demand

Suppose work effort (or efficiency) depends on the real wage rate, an assumption that is at the heart of efficiency wage models. Among many possible explanations for such a relationship the one that focuses on calorie intake and its positive impact on strength and endurance, as is the case in agrarian economies or sectors, appears particularly relevant for the issues at hand. Let the production function be

$$F(L) = A(E \times L)^{\beta}$$

with work effort

$$E = w^{\alpha}.$$

[13] Adding a constant to the suggested equation to obtain $\text{MIN}(L) = \lambda_0 + \lambda_1 \cdot L^{\gamma}$ would make the employment elasticity of the subsistence level increase with L. Then this elasticity and the wage elasticity of labor supply would have to be evaluated at the point of intersection with the labor demand curve.

With this modification, the demand for labor is given by

$$L = \left(\beta A w^{\alpha\beta-1}\right)^{\frac{1}{1-\beta}}$$

and the real-wage elasticity of labor demand is

$$\varepsilon_{\mathrm{D}} = -\frac{1-\alpha\beta}{1-\beta},$$

which coincides with what we derived for the orthodox Cobb-Douglas production function in Section 4 when $\alpha = 0$. This elasticity decreases (i.e., the demand for labor schedule in a wage-employment diagram becomes steeper) when α increases. However, a wage-dependent work effort, i.e., a positive value for α, is not generally enough to generate a wage trap. Only when the elasticity of labor demand falls below -1, the inverse wage elasticity of labor *supply* at the subsistence limit, do wage traps spring up. The condition for this to happen is obviously $\alpha > 1$. As the real wage elasticity of work effort increases still further, the labor demand curve continues to turn steeper, and eventually becomes vertical when $\alpha = 1/\beta$. At this point, the wage elasticity of income equals 1. Then any change in the real wage generates an identical change in the marginal product of labor. Thus, firms always demand the same amount of labor, no matter what the real wage rate is.

Now as α increases even beyond this threshold, the occurrence of a wage trap does not become more likely, as one might presume. This is because we are now entering efficiency-wage territory. By now the "labor demand curve" has turned positive and firms expect to increase profits by raising the wage rate, due to the fact that when the wage rate goes up the marginal productivity of labor goes up even faster. So there is no downward spiral of the wage rate below the equilibrium point, even though the supply of labor exceeds the demand for labor at any given wage rate. Despite this excess supply, firms pay an efficiency wage that exceeds the wage demands of workers.

Figure 4 may help to motivate these results. The dashed line is the labor demand curve that derives from the conventional Cobb-Douglas production function. This curve obtains when $\alpha = 0$ and it is flatter than the subsistence-level labor demand curve. Thus the labor market equilibrium is stable. As α increases, the labor demand curve turns steeper than the labor supply curve and the labor market is unstable, and wage trapped. When α crosses the second threshold $\alpha = 1/\beta$, the labor demand curve turns out of the shaded region, and its slope becomes positive.

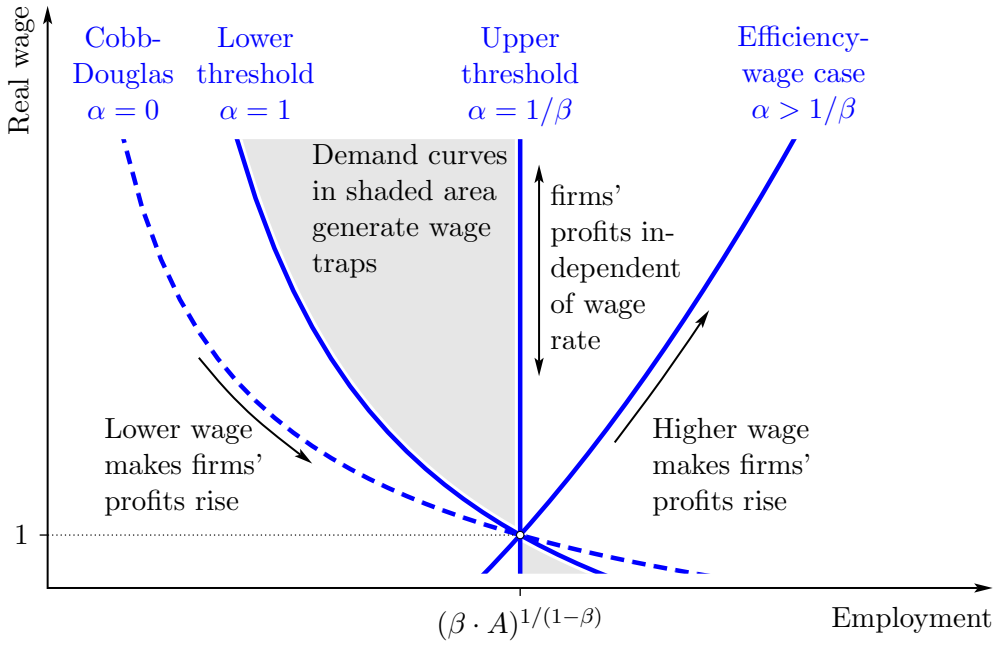

Figure 4: The Wage Elasticity of Work Effort and the Slope of the Labor Demand Curve.

Now profits increase as we slide up the labor demand curve, and firms voluntarily pay wages that exceed the subsistence level.

So the result of this section is quite complex: wage-dependent work effort may indeed be the cause of wage traps even though the production function is the Cobb-Douglas and the subsistence level is parametric. But for a wage trap to occur and be operational, the wage elasticity of work effort must be in the zone $1 < \alpha < 1/\beta$. Outside this zone the equilibrium either remains stable, or firms pay efficiency wages despite an apparent excess supply of labor.

In judging the empirical relevance of this condition, we note that it is less demanding than the condition required by efficiency-wage models, which is $\alpha > 1/\beta$. For a wage trap to occur, we need a weaker response of work effort to changes in the real wage rate than efficiency-wage models do.

As a further refinement, again with an eye on conditions characteristic of employment in agriculture, let work effort not only rise with the real wage, but also decline with work hours as workers tire. Then

$$E = \frac{w^{\alpha}}{L^{\delta}},$$

and the wage elasticity of labor demand changes to

$$\varepsilon_D = -\frac{1-\alpha\beta}{1-(1-\delta)\beta}.$$

This leaves the upper limit for α to generate wage traps unaffected, but lowers the lower limit. Wage traps now occur when the real-wage elasticity of work effort is in the wider range of $1-\delta < \alpha < 1/\beta$.

6 Policy Measures

Section 2 provided a glimpse at the rather unpleasant properties of wage-trap equilibria in the labor market, and the negative effect this has on development prospects. The natural question to ask now is what can be done once such a trap is diagnosed. This section looks at a few structural measures from the toolbox of labor market and development policies. It indicates that if the culprit behind a poverty trap is a wage-trapped labor market, measures traditionally suggested in the literature on poverty traps in models of economic growth should not be overlooked, but should be supplemented by labor market instruments for quicker results or temporary relief. Regarding these labor market instruments, we also see that in the presence of wage traps, conventional wisdom on labor market policy is often turned on its head.

Foreign aid. Standard measures of development aid in terms of grants or long-term loans at favorable interest rates, earmarked for investment in infrastructure, technology, education or private investment subsidies, would mainly target the labor demand curve. Effects from such measures may take a long time to materialize. Also, help needs to be substantial in order to push the economy out of the wage-trap region, similar to big-push proposals advanced in the context of conventional poverty traps such as those that derive from inadequate savings rates at low income levels. And, as already mentioned in Section 2, effects may be rather small in the very region where the low labor-income equilibrium is positioned, since the productivity of child labor may not respond very strongly to capital accumulation and the influx of established technology from the global economy. Other help, in kind or in money, that covers at least part of the subsistence gap in labor income, may improve the situation for families and their children during the time needed to move out of the wage trap, and in fact, may speed things up by making aid conditional on children returning to schools.

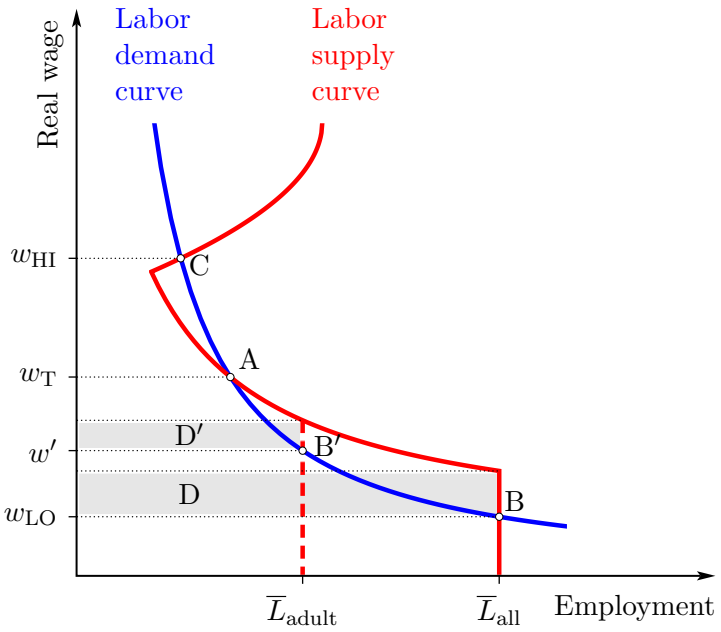

Figure 5: Policy Measures in a Wage-Trapped Labor Market: A Ban on Child Labor.

A ban on child labor. Consider Figure 5. Suppose that all available family labor, including child labor, is exhausted at $\overline{L}_{\text{all}}$. Then the sub-subsistence equilibrium is at point B and the family's labor income falls short of subsistence needs by an amount measured by the shaded area D. Now let available adult labor be $\overline{L}_{\text{adult}}$. Then the effect of an outright ban on child labor, say through domestic legislation, is to move the sub-subsistence equilibrium to point B′. In addition to the primarily targeted elimination of child labor and improved schooling, this has the added benefit of moving family incomes closer to subsistence requirements. The subsistence deficit in labor incomes has shrunk from the shaded area D to area D′.[14]

Minimum wages. Simply instituting the minimum wage rate w' can generate the same aggregate outcome that results from a ban on child labor. Underneath aggregate numbers, however, it is uncertain that it is exclusively or even predominantly children who drop out of employment when labor demand falls. On the other hand,

[14] A sufficient condition for D′ < D is that, for any $L > \overline{L}_{\text{adult}}$, the labor demand curve is steeper than the supply curve. This is always met with the constant-elasticity specifications used in most parts of this paper. Necessary conditions are much weaker, of course. Nevertheless, functional forms that do not support this result may exist.

minimum wages could even lift the labor market out of the wage trap entirely and restrict it to a range where market forces work properly. Setting the minimum wage rate only slightly above the threshold w_{T} would make firms bid up wage rates until they reach w_{HI}. At this wage rate, child labor would become extinct,[15] there would be no unemployment and, perhaps most importantly, labor income would sit comfortably above the level of subsistence.

Trade unions. Labor unions with sufficient monopoly power can set wage rates at any desired level, while leaving it up to firms to decide how much labor they want to employ at that price. Typically, such a trade union would demand a wage rate above w_{HI}, just as any monopolist would set prices higher than the level obtained under perfect competition. This would prevent the labor market from falling into the wage trap: it effectively removes incentives for child labor and raises labor income far above the subsistence level. The downside of this institutional change would probably be a certain amount of involuntary unemployment.

Fair trade agreements. When properly set up, monitored and enforced, fair trade agreements can achieve the same results as national legislation banning child labor, or setting minimum wages, and can also help establish trade unions or give them more leverage.

7 Summary and Outlook

When work incomes hover around subsistence levels, further cuts in wage rates may force families to increase their supply of labor. If, in addition, the elasticity of this labor supply with respect to the real wage rate exceeds the wage elasticity of labor demand, equilibria on this outward-sloping segment of the labor supply curve are unstable and labor incomes may end up trapped at or below subsistence levels. Additional unpleasant properties of such degenerated equilibria include adult illiteracy, child labor and a far-ranging detachment from global development trends.

Fortunately, when turning to specific functional forms with proven empirical credentials, generic conditions for wage traps are not met when the production function is Cobb-Douglas and income levels required for survival are exogenous.

[15] Here, we assume that parents make their children drop out of school and work only when pressured by sub-subsistence incomes.

However, the more general CES production function does permit wage traps under quite plausible parameter scenarios.

Beyond our reference setting, features that render wage traps more likely are endogenous subsistence levels that increase with work time, and work effort (or labor productivity) that is positively related to wage rates, as proposed in efficiency wage theory. Both of these features are often encountered in poor countries with dominant agricultural sectors, where the physical aspects of work prevail. Interestingly though, the influence of the wage elasticity of work effort on the occurrence of wage traps is not monotonic. The effect is positive only up to a certain threshold. Once we go beyond this point to enter efficiency-wage territory, the wage trap disappears because profit-maximizing firms pay higher wage rates voluntarily.

Wage-trapped economies may benefit from policy measures that tend to be snubbed by from conventional labor market analysis. A ban on child labor has the added benefit of reducing the subsistence gap in family incomes. Minimum wage laws have the same effect when implemented modestly, and can even raise the labor market out of the wage trap entirely when the minimum is set high enough. The definitive remedy for wage traps are trade unions with a sufficient degree of market power. But this comes at a price, since it has the side effect of some involuntary unemployment. Consumers in the rich part of the world can play an important role in this process by favoring products certified by fair trade agreements which enforce standards that include all or some of the above policies.

This paper has taken a more or less isolated look at the labor market and has omitted empirical issues altogether. Future work will have to remedy this. This can be done first by putting wage traps in macroeconomic context in order to properly address issues of growth and development with a special focus on poverty traps, and then by looking at available policy choices and their national and global repercussions.[16] Secondly, this can be accomplished by exploring the empirical relevance of wage trap scenarios. Quite a number of empirical findings and statistics exist that are well in line with the properties of a wage-trapped labor market, and point to the relevance and potential benefits of studying such scenarios. Examples are the many studies that detect a substantial increase in employment when already low wage rates drop further;[17] or estimates that about one billion people worldwide and al-

[16]This would fit into a research agenda initiated by Agénor (2005), who advocates a shift away from an "excessive focus on micro and measurement issues" towards a "macroeconomics of poverty reduction" (p. 349).

[17]Representative examples of older and more recent empirical studies that detect positive em-

most half the population in regions such as the Indian subcontinent or sub-Saharan Africa must live on less than 1 Dollar a day (World Bank, 2007, p. 65). As a compelling sign that such incomes fall way short of subsistence requirements, a similar percentage of children are underweight in many of these countries (World Bank, 2007, p. 67). In addition, child labor abounds and a high percentage of children do not receive a formal primary education.[18] While these are but isolated pieces of evidence, they feed into a more complete assessment that needs to be developed.

ployment responses to falling wage rates in low income sectors or countries include Miracle (1976) for African regions, Rosenzweig (1980) for India, Hernández-Licona (2000) for Mexico, and Dessing (2002) for the Philippines.

[18]In sub-Saharan Africa, an estimated 69 million or 35 percent of all children aged 5–14 work, and 41 million of these children are out of school (Unicef, 2007, pp. 12 and 44).

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