Food for education versus school quality: a comparison of policy options to reduce child labour

Saqib Jafarey *Department of Economics, City University, London*
Sajal Lahiri *Department of Economics, Southern Illinois University*

Abstract. In a model in which credit markets play a crucial role, we examine two policy options for reducing child labour, 'food for education' and 'investment in education quality,' With an imperfectly elastic supply of credit, an increase in food subsidy is more effective in reducing child labour than an 'income-equivalent' increase in expenditures in education quality. The effectiveness of the latter policy improves, and the optimal share of resources devoted to this policy increases, at the expense of food subsidies, as the supply of credit becomes more elastic. JEL classification: H52, O10

De «l'aide alimentaire pour encourager l'éducation» et des fonds pour accroître la qualité de l'éducation: une comparaison de diverses politiques pour réduire le travail des enfants. Partant d'un modèle qui donne un rôle crucial aux marchés du crédit, on examine deux types de politiques pour réduire le travail des enfants: l'aide alimentaire pour encourager l'éducation et des investissements dans la qualité de l'éducation. Dans un monde où l'offre de crédit est imparfaitement élastique, un accroissement des subventions pour la nourriture est plus effectif pour réduire le travail des enfants qu'un accroissement équipollent dans les dépenses pour accroître la qualité de l'éducation. L'efficacité de la seconde stratégie s'améliore, et la portion optimale de ressources à allouer dans cette direction s'accroît, au détriment de la stratégie de subventions pour la nourriture, à proportion que l'offre de crédit devient plus élastique.

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1. Introduction

It is almost universally accepted that children under the age of fifteen should go to school and enjoy their childhood rather than work. Unfortunately, however, tens of millions of today's children work full time, mainly in the developing world.[1] The international community is therefore very keen to find ways to eliminate child labour within the next 10 to 15 years. The question is how best to achieve this objective. Many policies have been suggested, with some being actively tested. It is very likely that a number of policies will have to be tried in conjunction with each other. In this paper, we consider two policy measures that are now being tried by the World Bank on a pilot basis, namely, the 'food-for-education' program and the 'investment in education' program. Under the first, poor families are given food if their children enrol in a school. Under the second, investments are being made to increase the quantity of schools and improve the quality of the education that poor children receive.

The two policy options that this paper examines have very topical and practical policy relevance. A significant proportion of foreign aid by most governmental and international agencies these days is directed to investments in education quality. Recently, strong arguments for more investment in education quality have been made by, among others, the Probe Team (1999) and Drèze and Gandhi-Kingdon (2001). As for the food-for-education policy, it is already being piloted in many parts of the world. In Bangladesh, targeted families receive 15–20 kilograms of wheat per month if their children attend school (see, for example, Ravallion and Woodon 2000 for an analysis of the food-for-education program in Bangladesh). In 1996 over a million families were in the program. The Bolsa Escola program in Brazil targets families with an unemployed adult and pays a monthly stipend to such families if they send all their children to school. Similarly, the Program for Education, Health and Nutrition (PROGRESA) in Mexico, among other aspects, attempts to divert child labour to schools by paying their families stipends as long as the attendance rate is over 85%. About 2.5 million families have benefited from this program.

In order to assess the impact of the two policy options on child labour, it is important to systematically understand the factors causing the problem. In this regard, there has been a recent surge of interest, at both the empirical and theoretical levels, in explaining the existence of child labour.[2] A number of

1 See Ashagrie (1993), Grootaert and Kanbur (1995), ILO (1996) and Basu (1999) for a sense of the magnitude and nature of the problem. Recently, the ILO has published new global estimates of child labour (see ILO (2002)). According to these estimates, in the year 2000, 211 million children in the age group 5–14 were economically active and 186.3 million among all the children in the world were considered 'child labourers' according to the ILO definition of child labour.

2 The theoretical studies are discussed later on in this section. Empirical studies include Bhalotra (2003), Bhalotra and Heady (2001, 2004), Cockburn (2000), Ilahi (1999), Ravallion and Woodon (2000), and Ray (2000, 2002).

culprits have been identified, with abject poverty being one of the main ones (see, for example, Bhalotra 2003 and Ray 2000 for empirical evidence). Poverty affects the incidence of child labour via a number of channels. First, for the extremely poor, a child's contribution to family income can be an essential means for the survival of the entire family. Second, poverty makes the marginal utility of income very high and induces substitution away from non-labour activities such as leisure and education.[3] Third, because poverty is associated with a lack of collateral, poor households cannot borrow from the organized sector at reasonable interest rates. The lack of credit facilities makes it more costly for poor families to forgo present income by sending their children to school (see Ranjan 2001 and Jafarey and Lahiri 2002).[4] Thus, poverty and lack of credit possibilities increase the incidence of child labour and reduce the demand for education.

Empirical studies have also stressed deficiencies on the supply side of the educational system. It has been found that the quality of primary education is extremely poor in many parts of the world where the incidence of child labour is high (see The Probe Team 1999 and Ray 2002).[5] This supply-side problem not only makes the educational experience rather dull and uninteresting, but also leads to low returns from education (see Cohen and House 1994 and Saha and Sarkar 1999). This makes poor families less willing to invest in the education of their children.

In light of the above stylized facts, we examine the effectiveness of the two policy prescriptions, namely, food for education and investment in school quality, in a two-period aggregative model in which the availability of credit plays a central role. There are two groups of families: rich and poor.[6] Poor families face a decision on how many of their children should go to school and how many should work. Rich families are assumed to be rich enough that their decision is trivially to send all their children to school. The rich act only as potential suppliers of credit to the poor.

Children who go to school in period 1 earn a higher wage in period 2 than those who do not. Their families also receive a food-for-education subsidy in

3 In Basu and Van (1998), low adult wages have a negative impact on children's leisure. In Jafarey and Lahiri (2002), low parental incomes lead to substitution away from child education.

4 Indeed, in countries like Pakistan, the relationship between child labour and poor credit opportunities is sometimes reflected in implicit contracts between employers and the children's families in which employers pay the first few months of the child's wages up front to the parents, in exchange for the promise of using the child's labour over an extended period of time (see PILER 1998).

5 In general, the role of elementary education in economic development has been emphasized by many; see, for example, Drèze and Sen (1995). There are many reasons why investment in education and other forms of public capital is low in many developing countries. One important reason for this could be the political economy of taxation and its implications for the funding of public capital (see Alesina and Rodrik 1994).

6 Since we do not consider a fully dynamic model, the consequences of a reduction in poverty in period 2 as a result of child education in period 1 are not considered here. For such intergenerational effects see, for example, Dessy (2000) and Galor and Zeira (1993).

period 1. The wage premium for education depends on the quality of education, which is in turn dependent on the amount of public resources invested in education. An international institution (such as the World Bank) is concerned with reducing child labour and has resources that can be allocated between investment in school quality and a food-for-education program.

We first study the impact of a marginal increase in expenditures exclusively on one instrument, seeing how this impact is affected by the availability, as captured by the supply elasticity, of credit to the poor. We find that a small increase in a food-for-education subsidy unambiguously reduces the incidence of child labour for any given supply elasticity of credit.

When poor households face a sufficiently elastic supply of credit, investment in school quality also reduces child labour, but for a sufficiently low elasticity, it becomes theoretically possible that a perverse effect results from this instrument on the incidence of child labour. The efficacy of this instrument increases monotonically with the supply elasticity of credit.

These results can be explained as follows. Both instruments can be interpreted as having the following effects: a positive income effect that raises the demand for schooling, a 'direct' substitution effect that raises the marginal benefit of schooling, and an 'indirect' effect that works through the household's demand for credit. The direct effect of a food-for-education subsidy is to increase household income per additional school-going child. Since this additional income arises when children are still young, the indirect effect is to reduce the household's demand for loans. Under any conventional scenario concerning the supply elasticity of credit, this tends to reduce its marginal rate of intertemporal substitution between present and future consumption (which in turn implies a reduction in its subjective rate of time discount). This in turn makes future income more valuable at the margin and induces households to seek out the higher rewards associated with educating their children. Thus, both the direct and the indirect effects encourage schooling.

The direct effect of better schools is to increase the marginal return to schooling through an increase in the pecuniary reward to education. But the higher rewards arise only in the future. Through the desire to smooth consumption, this increases the demand for credit by the household and puts upward pressure on its subjective rate of time discount, which in turn tends to make schooling less attractive. If the supply of credit is sufficiently elastic, the additional demand for credit can be met with a sufficiently small (or no, in the case of perfectly elastic credit) increase in the discount rate. If the supply of credit is sufficiently inelastic, however, the increased demand for credit (at given rates of school enrolment) can lead to a large increase in the household's discount rate. This can lower the value placed on future income to the extent that the household actually sends fewer children to school in an attempt to increase its current income. While this scenario is extreme and quite possibly unrealistic, it remains a useful theoretical benchmark that underpins our comparisons between the two instruments.

In making these comparisons, we find that for the hypothetical benchmark of perfectly elastic credit, expenditures on the two instruments that raise the present value of a household's lifetime income by the same amount (which we define as income-equivalent expenditures) lead to identical reductions in child labour. However, under the more realistic scenario of imperfectly elastic credit, a food-for-education subsidy reduces child labour by more than an income-equivalent investment in school quality, the difference arising from the differential qualitative impacts of the two instruments on household discount rates.

Given these results and also because it is a matter of some debate within organizations like the World Bank as to how to weigh each alternative, we also examine the optimal allocation of a *fixed* amount of resources between the two instruments. In keeping with the results on each instrument funded separately, we find that the optimal share of resources devoted to investment in education quality increases at the expense of food-for-education as the supply of credit becomes more elastic.

This paper forms part of a growing literature in which academic economists have attempted to understand the proximate causes of child labour in order to better analyse policies to combat it. Aside from poverty and poor school quality, which were already discussed above, the literature goes deeper into the problem by examining various factors that might, for example, underlie poverty itself. Basu and Van (1998) and Basu (2001) identify perverse labour market outcomes as causing both adult poverty and child labour. Dessy (2001) analyses a vicious cycle that leads to the perpetuation of child labour and parental poverty through successive generations. Other papers that share an emphasis on limitations in the supply of credit with the present one include Ranjan (2001) and Jafarey and Lahiri (2002). Baland and Robinson (2000), by contrast, focus on the demand for credit and argue that the inability of parents to control their offspring's income in later years can bias outcomes towards child labour even when credit is perfectly available. In none of the other papers has the policy choices analysed herein been studied. Note that both of these are policies whose relative merits are being actively debated within the international community as it attempts to reduce child labour.[7]

The model is spelt out in section 2. In section 3 we examine the comparative static effects of an earmarked increase in resources spent on each of the two initiatives. In section 4 we analyse the issue of optimal allocation of resources between the two policy initiatives and how this optimal allocation interacts with the nature of the credit market. Some concluding remarks are made in section 5.

7 Other policies have been examined in the papers cited above. For example, Ranjan (2001) and Jafarey and Lahiri (2002) consider the effectiveness of trade sanctions. Basu and Van (1998), Basu (2001) and Dessy (2000) examine compulsive measures such as an outright ban on child labour. The case of adult minimum wage is taken up by Basu (2000).

2. The basic framework of analysis

We consider an economy with a two-period horizon, indexed by $t = 1,2$ respectively. The economy produces a single good per period. Goods are labelled 1 and 2, respectively, depending on the period of production. The production technology is linear in effective units of labour and normalized such that one effective unit of labour produces one unit of output per period.

The economy is made up of a collection of households, each headed by a single parent. Households are classified as rich or poor, depending on the skill level of the parent, which may be either high or low and remains constant over the two periods. The high level of skill is normalized to unity, while the low skill level is denoted by ϕ^u, $0 \leq \phi^u \leq 1$. We shall initially describe the problem facing poor households and then address the issue of rich households.

Each poor household has N children. Children are endowed at birth with a low skill level, ϕ^u. But unlike their parents, children can increase their skill level by undertaking full-time schooling in the first period. The schooling available to poor children is imperfect in that it raises their skill level only to ϕ ($\phi^u \leq \phi \leq 1$); in turn, ϕ depends on social investment in public schooling, z, according to a concave and increasing function $\phi = \phi(z)$.[8]

For each poor child not educated, its family receives a wage income of ϕ^u units of output per period.[9] For each child who undertakes schooling, the family forgoes the child's wage in the first period but receives a higher wage, ϕ in the second period. A poor family also receives a means-tested 'food-for-education' subsidy of σ units for each child who attends school.

Each parent's preferences are represented by a utility function over the two consumption goods and a measure of the educational level of children:

$$v = w(c_1,c_2) + g(Ne), \tag{1}$$

8 Taken literally, z represents aggregate, rather than per pupil, investment. For this paper, it would make no difference if it were defined alternatively in per pupil terms, so long as the per pupil analogue is either exogenous or, when it is chosen optimally, individual households do not internalize the effects of their own schooling decisions on the optimal level of z. Furthermore, we assume that investment in school quality affects the education of only the children from poor households. Implicitly, we assume that poor children and rich children go to different schools, and the investments we consider refer only to those in schools where the poor children go.

9 We do not model leisure explicitly. A child who does not go to school may not necessarily work but may spend the time on leisure activities. The empirical evidence seems to be inconclusive on this regard. Ravallion and Woodon (2000) find the food-for-education program in Bangladesh had a significant impact on school enrolment but no significant effect on child labour. Drèze and Gandhi-Kingdon (2001), on the other hand, find that in India there is a significant negative correlation between child labour and school enrolment. In any case, if we assume that the family takes the opportunity cost of leisure as the wages for the uneducated, we could combine child labour and leisure into one variable. However, for expositional convenience, we ignore the presence of leisure in our discussion.

where v is utility, c_i is consumption of good i ($i = 1,2$), and e is the proportion of children who receive schooling at $t = 1$.[10] The functions w and g are increasing and concave in their respective arguments, and $g(\cdot)$ can be interpreted as capturing the subjective preference that parents have for schooling over child labour.[11] There is considerable anecdotal evidence suggesting not only that most parents derive some form of disutility from subjecting their children to labour, but also that they get positive utility from educating them instead, even when the pecuniary returns to education by themselves might not warrant this choice.[12] A similar subjective preference is implicit in Basu and Van (1998), except that in their formulation, education is not an explicit alternative, so the preference is interpreted literally as over child leisure. Further, they assume this preference to be discontinuous and to be exercised only when household income is high enough, while we are assuming continuous preferences that in turn imply that child labour is a continuous function of household income.

Consumption is assumed to be non-rivalrous within households, allowing us to abstract from intra-household distributional issues. This completes the description of poor households. We now proceed to the basic decision-making problem facing them.

The household's budget constraint in each period can be expressed as

$$Pc_1 \leq \phi^u + N(1-e)\phi^u + Ne\sigma + b$$
$$Pc_2 - rb \leq \phi^u + Ne\phi + N(1-e)\phi^u,$$

where P is the static price of the consumption good in each period; b stands for desired borrowing at $t = 1$, and r is the market interest factor (one plus the interest rate). The first three terms on the right-hand side of the period-one budget constraint are, respectively, the first-period income of the parent, that of child workers, and the food subsidy received for school-going children. The terms on the right-hand side of the period-two budget constraint are, respectively, the parent's income and the second-period incomes of educated and uneducated children. Eliminating b and adding, the two constraints can be consolidated:

$$Pc_1 + \frac{Pc_2}{r} \leq \phi^u + N(1-e)\phi^u + Ne\sigma + \frac{\phi^u}{r} + Ne\frac{\phi}{r} + N(1-e)\frac{\phi^u}{r}. \tag{2}$$

10 If we take the interpretation given in fn. 9, the variable $1-e$ is then the proportion of children that either work as child labour or enjoy leisure.

11 An alternative formulation would be to assume that utility is separable across children; that is, $Ng(e)$. Under this alternative, the *marginal* utility of an additional educated child diminishes in e (for given N) but is constant with respect to N (for given e), while the present case implies diminishing marginal utility in both e and N. The latter sounds more plausible, although it should be stressed that our main results are not affected by this choice.

12 A recent survey conducted in villages of six northern provinces of India found that economic motives are not the only reasons why poor families want their children to go to school (see The Probe Team 1999, chs 2 and 3).

The household's problem consists of choosing c_i, $i=1, 2$, and e in order to maximize (1) subject to (2), and to the constraint, $e \in [0,1]$. Subsequent analysis is made easier and more compact if we express the optimization problem in terms of the dual approach. The dual problem is one of minimizing the present value of total expenditure on consumption:

$$\min_{c_1,c_2} E = Pc_1 + \frac{Pc_2}{r},$$
$$\text{subject to : } w(c_1,c_2) + g(Ne) \geq v.$$

The solution of this problem is represented by an expenditure function, denoted by $E(P, P/r, v - Ng(e))$, which has well-known properties.[13] In particular, E is increasing in all three arguments and has a negative second derivative with respect to the first two arguments and a non-negative second derivative with respect to the third.[14]

The intertemporal budget constraint (2) can be rewritten in terms of the expenditure function as[15]

$$\phi^u + N(1-e)\phi^u + Ne\sigma + \frac{\phi^u}{r} + Ne\frac{\phi}{r} + N(1-e)\frac{\phi^u}{r} = E\left(P, \frac{P}{r}, v - g(Ne)\right). \quad (3)$$

We assume that the two goods are normal and intertemporal substitutes and that the marginal utility of income is positive and diminishing; that is,

$$E_{i3} > 0,\ i = 1,2;\ E_3 > 0, \quad \text{and} \quad E_{33} > 0.$$

The optimal choice of education is found by maximizing v with respect to e, subject to the budget constraint (3) and $e \in [0,1]$. Assuming a positive choice of e, the first-order condition can be written as

13 Implicit in this solution is the choice of b, which is in turn characterized by the well-known Euler equation; in this case, $w_1(c_1, c_2)/w_2(c_1, c_2) = r$. Note that the household's subjective rate of time discount is implicit in the left-hand side of the Euler condition, which represents the marginal rate of intertemporal substitution (MRIS) an increase that also implies an increase in the subjective discount rate. Further, since the household sets the MRIS equal to the market interest factor in a neoclassical credit market, increases in the latter will accompany increases in the household's rate of time discount. Thus, in our exposition, increases in the equilibrium value of r will implicitly reflect greater impatience by the household. However, see fn. 20, concerning extensions to non-neoclassical scenarios.

14 The partial derivative of an expenditure function with respect to the price of a good gives the Hicksian compensated demand function for that good. Moreover, the the matrix of second-order partial derivatives of the prices, which represent the own- and cross-price effects, is negative semi-definite. For this and other properties of expenditure function see, for example, Dixit and Norman (1980).

15 From now on we assume that the budget constraint is binding. Furthermore, implicitly, we assume that investment in education quality does not create any income for the poor families in period 1.

$$E_3 g'(Ne) + \sigma + \frac{(\phi - \phi^u)}{r} \geq \phi^u, \tag{4}$$

with strict inequality if $e = 1$.[16] The marginal benefit of an extra child in education is represented by the left-hand side of (4): an increase in e leads to a marginal pecuniary gain of σ units of first-period income and $(\phi - \phi^u)$ units of second-period income, plus a marginal utility increase of g', which has a pecuniary value of $E_3 g'$ (E_3 represents the inverse of the marginal utility of income). The term on the right-hand side represents the marginal cost, that is, the loss of ϕ^u units of first-period income.

An interior choice of e results if E_3 is low, which in turn implies a low level of family income. An interior choice of e also reflects negative discounted pecuniary returns (net of opportunity cost) to education for the representative household. This in turn reflects a low level of value added by schooling, $(\phi - \phi^u)$. In this situation, the subjective parental preference for education plays a crucial role in determining a positive value for e. Such a situation is consistent with evidence both on the quality of primary schooling available to poor households in developing countries and on the subjective parental attitudes towards education among such households (see The Probe Team 1999).

In the absence of a subjective parental preference for education, an interior solution for e can be found so long as r is endogenous. This is true in all but the limiting credit market scenario, $S' = \infty$, in which case r is exogenous. Apart from its empirical appeal, the assumption of a parental preference for education plays the analytical role of allowing e to be interior in this extreme case as well.[17]

It is to be noted that there are both demand-side and supply-side factors in equation (4). For example, while the low value added by schooling is a problem on the supply side, a high marginal utility of income is a demand-side problem. In this context, the policy instruments σ and z address, respectively, the demand and the supply side of the problem.

Turning now to rich households, we note that their main role is to provide a general equilibrium underpinning for the flow of credit in our model. We shall therefore not get into the analogous problems facing them, assuming from the outset that their circumstances are such that they always choose to send all

16 When the solution for e is in the interior, that is, $e \in (0,1)$, equation (4) (with equality) is obtained by totally differentiating (3), taking r as given (i.e., price-taking behaviour) and setting $dv/de = 0$.

17 Rosenzweig (1990) also considers a case where parents derive utility from children's education, but he also assumes that time spent in education yields diminishing marginal returns in terms of the educational wage premium. This allows him to generate an interior solution even if the assumption of parental preference for education is dropped and the household can freely transfer resources between adults and children (as under a perfect credit market). Therefore, while there are two ways to have an interior solution for e in the case of perfectly elastic supply of credit, neither of these is necessary when the supply of credit is imperfectly elastic. For analytical purposes, therefore, our assumption of a subjective preference for education does not influence the spirit of our results, which are based mostly on imperfectly elastic credit supply (see fns 30 and 32).

their children to school. Elsewhere, in Jafarey and Lahiri (2002), we have identified various factors that may lead to differential educational outcomes between rich and poor households. We have also identified factors that cause rich households to act as lenders and poor households as borrowers in general equilibrium.[18] Rather than repeat those exercises here, we shall summarize its most pertinent conclusion, namely, that the supply of credit can be described by a function, $S(r)$, with $S'(r) \geq 0$ over at least an initial range of values of r, which describes the savings behaviour of rich households.

It should be acknowledged that even neoclassical assumptions cannot prevent the supply of credit from possibly bending backwards. As is well known, this can happen if the income effect from higher interest rates exceeds the substitution effect of cheaper future consumption. A second scenario under which a non-monotonic supply of credit can arise is if the credit market is not neoclassical in nature but is marked by informational asymmetries, as in Stiglitz and Weiss (1981). Both cases have well-known complications that are important from a theoretical point of view (multiplicity and possible instability of credit market equilibria) but add little to the policy analysis that we wish to carry out (the qualitative effects of policy experiments on stable equilibria). Hence, we do not dwell on them, and assume that *at the equilibrium* the supply function is upward sloping.[19]

A second possibility which arises under the Stiglitz and Weiss (1981) scenario is that the supply of credit becomes discontinuous in the interest rate. In particular, the supply of credit can drop to zero if the interest rate exceeds a critical maximum value. If there is an excess demand for credit at this interest rate, the subjective discount rate of borrowers will exceed the market interest rate.[20] An increase in the demand for loans then leads to an increase in the borrower's implicit discount rate, with no change in the market interest rate or the supply of loans. The qualitative impact of any policy on the choice of e will in this case be similar to one of the extreme case of our present formulation, $S'(r) = 0$.

In our analysis, the supply curve is continuous and its elasticity varies between zero and infinity, depending on the preferences of rich households, their income streams, and their numbers relative to poor households. One limiting case, $S' = 0$ has been interpreted in the preceding paragraph. There is credit rationing in equilibrium so the supply of credit becomes effectively

18 The main purpose of Jafarey and Lahiri (2002) is to examine the effect of trade sanctions; to this end, a two-good model of international trade is considered.

19 Indeed, our analysis could accommodate a departure from upward-sloping supply of credit so long as the supply curve was steeper downwards (when drawn with r on the vertical axis) than the demand curve. All the comparative static results presented below would go through. Note that this restriction is precisely the stability condition which allows comparative static exercises to be carried out in the first place (see also fn. 24).

20 In this case, the variable we define as r in our analysis would have to be interpreted directly as the household's subjective MRIS.

impervious to (small) perturbations which shift the demand curve. The case of $S' = \infty$ represents a deviation of another kind. This case arises if, in addition to credit from rich households, the poor households also have free access to a perfect international capital market and the economy is a small one. In this case, the market interest rate is exogenous and impervious to changes in the domestic demand for credit.

In each of the cases involving credit supply, a poor household faces an interest factor, r, resulting from credit market equilibrium. For a given r, the values of e and v are determined by equations (3) and (4). Its borrowing, b, can now be described by reference to the expenditure function:

$$b = E_1 - [\phi^u(1 + N(1 - e)) + Ne\sigma]. \tag{5}$$

The equilibrium value of r is determined by the credit market clearing condition:

$$Mb = S(r), \tag{6}$$

where M denotes the total number of poor households and b is given by equation (5). Equations (3), (4), and (6) jointly determine v, e, and r as functions of σ and z.

Finally, the international institution's budget constraint links expenditures on the two policy instruments. For simplicity, we assume that expenditures on both instruments are financed out of a lump-sum injection of foreign aid, F:[21]

$$F = MNe\sigma + z. \tag{7}$$

This completes the description of the model.

3. Comparative statics

In this section, we shall analyse the comparative static effect of increases in one of the policy variables, σ or z, on the educational choice of poor households. We assume that such increases are funded at the margin by receipts of extra foreign aid that has been tied by donors to the specific instrument in question. This means that the international institution's budget constraint, equation (7), can be ignored. The question of the optimal allocation of resources is not at stake here. We shall turn to these issues in the next section.

21 We have also studied the case where these instruments are financed domestically through a lump-sum tax on rich households. Most of the insights of the paper are robust to this alternative form of financing, and since the case of foreign financing is easier to outline, we concentrate on it. A brief discussion of the results from the case of tax financing is provided in the following section. It should be noted that we ignore the political economic issues of redistribution between rich and poor in this case. The case where education financing is done via distortionary taxation is also not considered here.

We start by gathering the system of equations, (3), (4), and (5) plugged into (6), which jointly determine e, v, and r. Note that in (3) we have normalized the price of first-period consumption, P, to be equal to unity.

$$E\left(1, \frac{1}{r}, v - g(Ne)\right) = \phi^u + N(1-e)\phi^u + Ne\sigma + \frac{\phi^u}{r} + Ne\frac{\phi}{r} + N(1-e)\frac{\phi^u}{r},$$

$$\phi^u = E_3 g'(Ne) + \sigma + \frac{(\phi - \phi^u)}{r},$$

$$S(r) = M\{E_1 - [\phi^u(1 + N(1-e)) + Ne\sigma]\}.$$

Totally differentiating the first two of these equations with respect to v, e, r, σ, and z, we get

$$-A\ de = -d\sigma - \frac{\phi'}{r}dz + C\ dr - E_{33}g'\ dv, \tag{8}$$

$$E_3\ dv = Ne\ d\sigma + \frac{Ne\phi'}{r}\ dz - \frac{b}{r}\ dr, \tag{9}$$

where $A = N[E_{33}(g')^2 - E_3 g''] > 0$ and $r^2 C = E_{23}g' + (\phi - \phi^u) > 0$.

The first two terms on the right-hand side of (8) give the direct (positive) effects of the policy options on e. The third term states that an increase in the interest factor reduces e by lowering the present value of returns from education. The fourth term gives us the income effect: an increase in real income reduces the marginal utility of income and therefore lowers the opportunity cost of education. The first two terms on the right-hand side of (9) are direct (positive) effects of the policy options on real income. The third term gives the intertemporal terms-of-trade effect: an increase in the interest factor decreases the welfare of a borrower.

Substituting dv from (9) into (8), we obtain

$$-A\ de = -B\ d\sigma - \frac{\phi' B}{r}\ dz + G\ dr, \tag{10}$$

where

$$B = 1 + \frac{E_{33}g'Ne}{E_3} > 0$$

$$G = C + \frac{E_{33}g'b}{rE_3} > 0.$$

The term B captures the direct and indirect effects of increases in σ and z, respectively on e, at given values of r.[22] An increase in the food subsidy raises

22 We explain below the effects of an increase in σ alone. At given values of r, the effects of an increase in z are proportional to those of an increase in σ by the factor ϕ'/r.

family income by an amount equal to $d\sigma$ per school-going child. This increases the marginal incentive to educate children by a factor of unity, as captured by the first term in B. The second term captures the indirect effect, which works through the parent's innate preference for educating children. An increase in σ raises household income, which in turn makes parents demand more education for their children. If the subsidy was not linked to schooling but handed out as an unconditional transfer to poor households, the direct effect would be missing and only the indirect income effect would remain.[23] Further, if education was not valued for subjective reasons, the second effect would be missing as well. For given values of r, an unconditional income transfer would then have no effect on the choice of education, a point also made in Rosenzweig (1990).

Changes in r itself can be accounted for by totally differentiating the last equation in the system.

$$-\frac{E_{12}}{r^2}\ dr + E_{13}\ dv + [(\phi^u - \sigma) - E_{13}g']N\ de - Ne\ d\sigma = \frac{S'}{M}\ dr. \tag{11}$$

Eliminating dv using equation (9), and noting that, from equation (4), $\phi^u - \sigma = E_3 g' + (\phi - \phi^u)/r$, equation (11) reduces to

$$\Omega\ dr = N\Theta\ de - NeK\ d\sigma + \frac{(1-K)Ne\phi'}{r}\ dz, \tag{12}$$

where

$$K = 1 - \frac{E_{13}}{E_3}, \quad 0 \leq K \leq 1$$

$$\Omega = \frac{E_{12}}{r^2} + \frac{bE_{13}}{E_3} + \frac{S'}{M} > 0$$

$$\Theta = \frac{\phi - \phi^u}{r} + E_3 g' K > 0.$$

An increase in e reduces family income in period 1 and increases that in period 2. This would raise the demand for loans and therefore the equilibrium interest factor. An increase in σ, for a given value of e, increases income in period one, lowering the demand for loans and therefore the equilibrium value of r. An increase in z on the other hand increases income in period 2, raising the demand for loans in period 1, and this raises the equilibrium value of r.

Simultaneously solving (10) and (12), we get:[24]

23 See fn. 26 for a further discussion of this point.

24 It is to be noted that the coefficient of r in equation (13) gives the slope of the excess supply of loans function. This needs to be positive for the loan market to satisfy Walrasian stability. Note that non-negative S' is a sufficient but not necessary condition for this stability condition to be satisfied.

$$\left[\Omega + \frac{N\Theta G}{A}\right] dr = N\left[\frac{\Theta B}{A} - eK\right] d\sigma + \frac{N\phi'}{r}\left[(1-K)e + \frac{\Theta B}{A}\right] dz \tag{13}$$

$$-\left[A + \frac{NG\Theta}{\Omega}\right]\ de = -\sum\ d\sigma - \frac{\phi'}{r}\left[\sum - \frac{GNe}{\Omega}\right] dz, \tag{14}$$

where

$$\sum = B + \frac{GNeK}{\Omega} > 0.$$

Hence,

$$\frac{de}{d\sigma} = \frac{\sum}{A + \frac{NG\Theta}{\Omega}} > 0,$$

$$\frac{de}{dz} = \frac{\phi'}{r}\frac{B - \frac{GNe(1-K)}{\Omega}}{A + \frac{NG\Theta}{\Omega}}.$$

An increase in σ unambiguously increases e regardless of the elasticity of the supply of credit, represented here by the magnitude of S', which for comparative static purposes can be treated as a parameter.[25] An increase in z, however, does not have an unambiguous effect on e for all values of S'. In the limit as $S' \to \infty$, an increase in z does indeed raise e (since Ω is infinitely large in that case, and therefore the terms involving Ω disappear). But, in the general case, the second terms in both the numerator and the denominator decrease (in magnitude) in S'. Hence, as the supply of credit becomes more inelastic, de/dz unambiguously decreases and the possibility of a perverse effect rises.

Intuitively, a food-for-education subsidy, at given values of e, helps to reduce the demand for borrowing by providing income in the first period.[26] It is therefore not surprising that it leads to higher education regardless of whether credit opportunities are perfect or not. On the other hand, expenditure on school quality increases income only once children complete their education. This *increases* the demand for borrowing at given values of e, as households smooth consumption in anticipation of higher future income. So long as the supply of credit is perfectly elastic, the increased demand for borrowing generates no feedback effects on the demand for education. But with an upward-sloping or vertical supply of credit, changes in r

25 Allowing S' to change in the expression for de/dz amounts to rotating the supply of credit around an initial equilibrium and keeping track of changes in e for a given change in z as this happens.

26 The same effect on the demand for borrowing can be achieved by an equivalent unconditional lump-sum income transfer or an unconditional loan in period 1. But, as noted in the paragraph after equation (10), these two instruments would lack the direct incentive of making school enrolment more attractive, which arises under a conditional transfer. It would therefore be more effective to condition the transfer or loan on school enrolment than to hand it out unconditionally.

generate offsetting effects on e (note the negative relationship between e and r implied by the third term in equation (10)). Indeed, with sufficiently inelastic credit, the increased demand for borrowing can actually lead to fewer children being sent to school, as the household internally 'borrows' against the higher income of those who do.[27] In the appendix, we report a numerical example that establishes that this is at least theoretically possible.

Consider independent increases in σ and z such that $d\sigma = (\phi'/r)\, dz$. Such increases in each instrument – which we shall call 'income-equivalent' increases – will generate an increase in household income of the same present value (at given values of e). Given such increases from an identical initial equilibrium, it is clear that the effect on e will be exactly the same for both instruments in the the limiting case of an infinitely elastic supply of funds (compare $de/d\sigma \mid_r$ with $de/dz \mid_r$). However, in the presence of an inelastic supply of credit, an improvement in school quality will be less effective than an increase in food for education in increasing e (compare $de/d\sigma$ with de/dz) and, as shown above, may actually decrease it.[28,29] The following proposition summarizes these results. The first part qualitatively describes the respective impact of each instrument under different credit market conditions; the second compares the magnitudes of these impacts:

PROPOSITION 1a: *An externally financed increase in food-for-education subsidies unambiguously reduces child labour in any scenario regarding the credit market. An externally financed improvement in school quality reduces child labour if the supply curve of credit is sufficiently elastic, but if the supply of credit becomes sufficiently inelastic, improving school quality can have the pathological effect of exacerbating child labour.*

b: *At the extreme where the supply of credit is perfectly elastic, an externally financed increase in expenditures on school quality and an income-equivalent increase in food-for-education subsidies are equally effective in reducing child labour.*

27 It is worth noting the similarity of this result with the well-known Transfer Paradox in international trade theory, whereby a free transfer of income from one country to another can reduce the welfare level in the recipient country and raise it in the donor country (for a recent paper on the transfer paradox, see Lahiri et al. 2002). The main reason why such a perverse result may hold is that the transfer may move the *international* terms of trade against the recipient country, depending on the relative sizes of the marginal propensity to consume in the two countries. In our case, the *intertemporal* terms of trade move against the borrower as a result of an increase in investment in education.

28 This is not to say that for the same amount of money spent on the two instruments, investment in education is less effective than food for education. Much will depend, inter alia, on the productivity of investment in education, that is, on $\phi'(z)$. Certain types of investment in education (such as new curriculum design) is likely to have low costs and high returns, and therefore money spent on those types of investment in education can be more effective than the same amount spent on food for education.

29 The possibility of such a perverse outcome for the case of no intergenerational transfers of income was noted by Rosenzweig (1990, S46).

With an imperfectly elastic supply of credit, however, an externally financed increase in food-for-education subsidies is more effective in reducing child labour than an income-equivalent increase in expenditures on school quality.[30]

Since an externally financed food-for-education subsidy unambiguously increases e and reduces the demand for borrowing at given values of e, the expectation arises that a food subsidy will be most effective as the supply of credit becomes most inelastic. In evaluating the comparative static expressions for $de/d\sigma$, however, this is not straightforward. Starting from a given initial equilibrium, both the numerator and the denominator will be larger as the interest elasticity of the supply of credit decreases. It can nonetheless be established that $AKe - B\Theta < 0$ is necessary and sufficient for the effectiveness of a food-for-education subsidy to become *smaller* as the elasticity of the supply of credit falls.

This condition can be interpreted by relating it to the shift in the demand for loans that is induced by a food subsidy. Such a shift can be expressed as $dr/d\sigma\,|_{\bar{b}}$, that is, the change in the interest factor (and thus the household's subjective discount rate) that would result if the level of borrowing was held fixed at its original value. A positive change indicates an increase in the demand for loans, since it implies that the interest rate at which the household is willing to borrow rises at the given level of borrowing. Referring to equation (12), note that while a subsidy reduces demand at a given values of e, it also induces an indirect effect through the increase in e which contributes a positive influence on the overall demand for loans.

After substituting de from (14) into equation (12) and setting $S' = 0$, we obtain

$$\tilde{\Omega}\left.\frac{dr}{d\sigma}\right|_{\bar{b}} = \frac{N\tilde{\Omega}(B\Theta - AKe)}{A\tilde{\Omega} + NG\Theta},$$

where $\tilde{\Omega} = \Omega - S'$. It is obvious that $B\Theta > AKe$ is also necessary and sufficient for $dr/d\sigma\,|_{\bar{b}} > 0$, that is, for a food subsidy to increase the demand for loans. Further simplification shows that a sufficient condition for $B\Theta > AKe$ is $g' + g''Ne > 0$. If, for example, the disutility over child labour is represented by $g(Ne) = (Ne)^{\gamma}$, the above condition is automatically satisfied for any positive

30 In the absence of subjective parental preference for education, that is, the presence of e explicitly in the utility function of the family, proposition 1B still holds. To see this note that when $g(Ne) \equiv 0$, we have

$$\frac{N(\phi - \phi^u)^2}{\Omega r^3}\cdot\frac{de}{d\sigma} = 1 + \frac{N(\phi - \phi^u)eK}{r^2\Omega} \text{ and } \frac{N(\phi - \phi^u)^2}{\Omega r^3}\cdot\frac{de}{dz} = \frac{\phi'}{r}\cdot\left(1 - \frac{N(\phi - \phi^u)e(1-K)}{r^2\Omega}\right).$$

Thus, $\dfrac{de}{d\sigma} > \dfrac{\phi'}{r}\dfrac{de}{dz}$.

.

value of γ. This makes it possible for an increase in σ to increase the demand for loans via the indirect effect on e. Hence, a food-for-education subsidy becomes more effective as the elasticity of the supply of credit falls if, and only if, it leads to a reduction in the demand for credit. In case it leads to an increase in the demand for credit, then it becomes more effective as the elasticity of the supply of credit increases.

To further understand this result, consider figure 1. The first panel of figure 1 depicts an initial credit market equilibrium at E. BB represents the initial demand for credit, and SS represents the supply of credit. The initial equilibrium interest factor is denoted by r_w. The second panel of figure 1 portrays the relationship between e and r for the initial value of σ. This is downward sloping, since an increase in r reduces the present value of the benefits from education and induces a lower value of e (see Jafarey and Lahiri 2002 for details). The fourth panel depicts the combinations of e and b that coincide at given values of r.

In the initial equilibrium, e_0 in the second panel depicts the choice of education. If there is now an externally financed increase in σ, the e-r relationship in panel 2 will shift to the left, to $A'A'$. At the same time, the demand for credit may shift either way. The diagram depicts the case in which the demand curve shifts to the right, to $B'B'$. In the extreme case of a perfectly elastic supply of credit, this will have no impact upon the interest factor, so that e will increase by the full horizontal shift in the e-r relationship, to e_w. At the other extreme of a binding restriction on borrowing, the interest factor will rise to r_b, which will lead to an offsetting effect on e, so that e will increase to e_b. In the intermediate case, the interest factor still will rise, but only to an intermediate extent, for example, to r_d. Hence, e will rise to e_d. Obviously, if the demand curve had shifted in the other direction, the comparisons would have been reversed. This result is summarised by the following proposition.

PROPOSITION 2. *The effectiveness of an externally financed investment in education in reducing child labour unambiguously increases with the supply elasticity of credit. However, the effectiveness of the food-for-education subsidy in reducing child labour increases with the supply elasticity of credit if, and only if, the subsidy leads to an increased demand for credit.*

We now consider two departures from the assumption that rich households are not affected, ex ante, by changes in either policy instrument. First, suppose that an increase in food subsidies is domestically financed by a lump-sum tax on rich households. This tax will shift the supply curve to the left, while the subsidy to poor households can shift the demand curve either way. The possibility arises for the interest factor to rise by a magnitude that is even greater than if the supply of credit were perfectly inelastic at the margin. This can complicate the comparison of a subsidy's relative effectiveness under the two scenarios, but other than that, domestic financing of the subsidy leads to similar results as external financing.

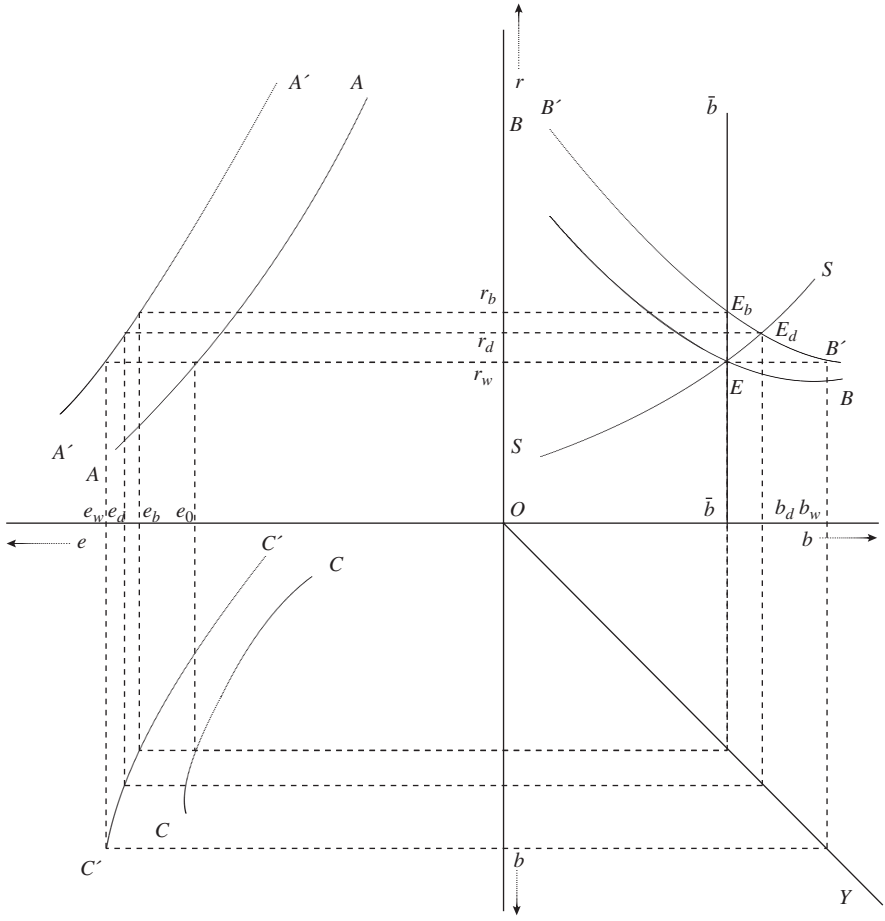

FIGURE 1 Comparative statics

Second, suppose that part of the investment in education quality is paid out in the first period to schoolteachers who, inasmuch as they educate all their children and save rather than borrow, are counted as rich. This would cause the supply of credit to shift to the right and make a perverse effect from such investment less likely.

We shall conclude this section by discussing a comparative static exercise in which an exogenous technological advance increases the skill wage ϕ and reduces the unskilled wage ϕ^u.[31] Given our analysis above, we shall provide only a heuristic proof of the results of this exercise.

31 Some recent reports of the U.S. Department of Education clearly suggests such effects of technological progress (see the third editorial of the *Wall Street Journal*, 30 May 2002).

From child labour equilibrium condition (4), it is clear that an increase in ϕ and a decrease in ϕ^u decreases the marginal cost of education (the right-hand side of (4)) and increases the skill premium (the third term on the left-hand side of (4)) and thus the marginal benefit of education. Both these direct effects would increase e. For a given value of r, there will an additional income effect via changes in E_3 (the reciprocal of marginal utility of income). The sign of the income effect would depend on what happens to the left-hand side of (3). The income of parents and that of unskilled children in both periods will decrease, but the children who go to school in period 1 would receive a higher income in period 2. This effect is in general ambiguous. If the technological progress is such that the percentage changes in the two wages are the same, that is, $-d\phi^u/\phi^u = d\phi/\phi$, it can be shown that, for given levels of e and r, the income effect will be positive if and only if $\phi^u/(\phi+\phi^u) < Ne/(N+1+r(1+N(1-e)))$; that is, the skilled wage is sufficiently higher than the unskilled wage.

It remains only for us to explain how technological progress affects e via changes in r. The change in the two wages decreases income in period 1 and therefore tends to raise the demand for loans. But the overall demand also depends on period 2 income, the change in which is also ambiguous. However, it can be shown that if the change in the two wages is equi-proportional in magnitude, period 2 income (for given values of e and r) increases if, and only if, $\phi^u/(\phi+\phi^u) < Ne/(N+1)$, and in this case the demand for credit will increase. Therefore, if the condition $\phi^u/(\phi+\phi^u) < Ne/(N+1)$ is satisfied, the demand for credit will increase, raising the equilibrium value of r, and thus the effect on e via changes in r will be negative. Thus, in general, technological progress that leads to a reduction in the unskilled wage is likely to have ambiguous effects on the incidence of child labour.

4. Optimal mix of policies

In this section we shall examine the question of how given resources can be optimally allocated between the two policy instruments, viz. food for education (σ) and investment in education quality (z). In particular, we consider the problem facing an international institution, such as the World Bank, that wants to minimize the use of child labour (i.e., maximize e) subject to its budget constraint, equation (7). We shall relate the optimal mix of policies to the different scenarios concerning credit markets.

Let us denote by λ the proportion of total resources, F, allocated to the food-for-education program. From (7) it then follows that

$$\lambda F = MNe\sigma, \quad \text{and} \quad (1-\lambda)F = z, \tag{15}$$

and therefore that

$$dz = -Fd\lambda, \quad d\sigma = \frac{F}{MNe}\, d\lambda - \frac{\sigma}{e}\, de. \tag{16}$$

The problem facing the international agency can be formally stated as

$$\max_{\lambda} \; e,$$

subject to equations (3), (4) (with equality), (5), (6), (7), and (15).

In section 3, we derived equation (14) to relate changes in e to separate changes in the two policy instruments. Equation (16) links changes in these instruments to each other, given an amount of resources, F. Substituting dz and $d\sigma$ from (16) into (14), we get

$$\frac{rMNe\bar{A}}{F\sum} \frac{de}{d\lambda} = [r - \phi' eMN] + \frac{\phi' e^2 GN^2 M}{B\Omega + GNeK}, \tag{17}$$

where

$$\bar{A} = A + \frac{NG\Theta}{\Omega} + \frac{\sigma \sum}{e} > 0.$$

We can now use the above equation to characterize how optimal λ varies along with the elasticity of the supply of credit.

In the limit S' approaches infinity; that is, when the interest factor r is exogenous, (17) simplifies to:[32]

$$\frac{rMNe}{FB}\left[A + \frac{\sigma B}{e}\right] \frac{de}{d\lambda} = [r - \phi' eMN]. \tag{18}$$

It can be easily shown that, for every λ, e is a decreasing function of r, and therefore that the right-hand side of (17) is increasing in r for a given value of λ, and is negative when r is close to zero. It therefore follows that there exists an $\hat{r} > 0$ such that $\hat{r} - \phi'(F)e(\hat{r})MN = 0$ and for for all $r \leq \hat{r}$, $\hat{r} - \phi'(F)e(\hat{r})MN \leq 0$. We then get

$$\left.\frac{de}{d\lambda}\right|_{\lambda=0} \gtrless 0 \quad \text{accordingly as} \quad r \gtrless \hat{r}.$$

In other words, if r is sufficiently small, the entire resource should be invested in the quality of education, and for an interior solution it is necessary

32 In the limit itself, $S' = \infty$, the solution for e is likely to be a corner one, and therefore the analysis leading up to proposition 3 is, strictly speaking, not valid for the limiting case. However, the spirit of the result derived below still holds. This is because when $S' = \infty$, e is a step-wise linear and non-increasing function of r. In particular, for r sufficiently low, that is, if $r \leq \tilde{r}$ (say), the equilibrium value for e is 1 and $e = 0$ for $r > \tilde{r}$.

that $r > \hat{r}$.[33] Assuming that the solution is in the interior, the optimal value of λ, denoted by λ_w^*, is found by setting

$$r = \phi'((1-\lambda)F)e(r)MN.$$

Since $e'(r) < 0$ at a given value of λ and $\phi'' < 0$, it follows that the optimal value of λ increases with r. Hence, resources should be shifted from food for education to investment in education quality as the interest factor falls. Formally,

PROPOSITION 3. *Given an exogenous interest rate, the optimal allocation of fixed resources should shift towards investment in education (at the expense of food for education) as the interest rate falls.*

The intuition for the above result is simple. As pointed out in the preceding section, improved education quality increases the income from educating children only in the future and induces a higher demand for loans in period 1. On the other hand, the income from the alternative policy option, namely food for education, is immediate. Therefore, if the interest rate is lowered, the food-for-education program becomes relatively less attractive at the margin.

Next, we compare the optimal value of λ under a perfectly elastic supply of credit with that under the opposite extreme, that is, a perfectly inelastic supply of credit. In order to do so, let us interpret the case of a perfectly inelastic supply of credit as representing an explicit borrowing constraint, while the other extreme represents the unrestricted ability of domestic households to borrow on international credit markets. To make the comparison between the two extremes meaningful, then, the borrowing constraint would have to restrict the amount borrowed relative to what would be freely chosen in a perfect credit market.

Because the demand for loans is downward sloping in r, the household's marginal rate of intertemporal substitution under the borrowing constraint, r_b, will be greater than the interest factor in the world credit market, r_w.[34] It can be shown that e will therefore be higher under a perfectly elastic supply of credit than under a borrowing constraint. Therefore, for every value of λ, the term $r - \phi' eMN$ takes a higher value under a binding borrowing constraint than under a perfect international credit market. Furthermore, the expression for $de/d\lambda$ has an extra positive term (the second term on the right-hand side of (17)) in the case of a borrowing constraint as opposed to the case of a perfectly elastic supply of credit ((18)). All these imply that, in the case of a borrowing

33 Assuming the Inada condition on the function $\phi(z)$, that is, $\lim_{z\to 0} \phi'(z) = \infty$, we can rule out the share of resources going to quality of education becoming zero as r gets too large.

34 Note that, as in fn. 19, the variable defined as r_b has to be interpreted directly as the household's marginal rate of intertemporal substitution or, equivalently, the hypothetical market interest factor at which the household would be barely content with the amount borrowed under the constraint.

constraint, the value of $de/d\lambda$ evaluated at $\lambda = \lambda_w^*$ is positive. This, together with the second-order condition (concavity of e with respect to λ), implies that $\lambda_b^* > \lambda_w^*$, where λ_b^* is the optimal level of λ under the perfectly inelastic supply of credit.

It can also be argued that $r_d > r_w$, where r_d is the interest factor that would result from there being a purely domestic credit market. This condition simply reflects the realistic possibility that the country is a net borrower on world credit markets. It can then be shown using similar arguments that $\lambda_d^* > \lambda_w^*$, where λ_d^* is the optimal level of λ in the general case of a purely domestic credit market with an intermediate elasticity of the supply of credit. This result can be summarized as,

PROPOSITION 4. *The optimal share of investment in education quality (at the expense of food for education) is greater when poor households can borrow directly from international credit markets than when they face a purely domestic credit market in which equilibrium interest rates are higher than world interest rates.*

A comparison between the optimal λ under the intermediate case and under a perfectly inelastic supply of credit is similar, although not unambiguous. If we assume again that a perfectly inelastic supply corresponds to a binding borrowing constraint at the margin, r will be lower and e higher in the intermediate case of $S' > 0$ than under the constraint, $S' = 0$. The first term on the right-hand side of (17) will therefore be larger, for every value of λ, in the latter case than in the former. The denominator of the second term in (17) also has an extra positive term in the case of a domestic credit market. Thus, it is likely that, for the case of borrowing constraint, the value of $de/d\lambda$ evaluated at $\lambda = \lambda_d^*$ is positive and therefore that $\lambda_b^* > \lambda_d^*$.[35]

We shall conclude this section by diagrammatically illustrating the comparison between the two extreme cases regarding the supply of credit. In figure 2, the line HH gives the relationship between exogenously given values of r and the optimal levels of λ. We know from proposition 3 that this relationship is upward sloping. In the same quadrant, we have drawn iso-borrowing lines that are combinations of (λ, r) yielding the same demand for loans. These lines are downward sloping, at least close to the locus HH. In this region, an increase in λ has no effect on e but reduces the demand for loans by shifting family income from period 2 to period 1. This leads to a fall in the household's subjective discount rate, thereby implying the downward slope. Higher iso-borrowing lines represent lower levels of borrowing, since, for a given λ, an increase in r reduces the demand for loans; as we move away from the origin, the iso-borrowing lines correspond to lower levels of borrowing.

35 We cannot be absolutely sure, since there are other endogenous terms in the second term of (17).

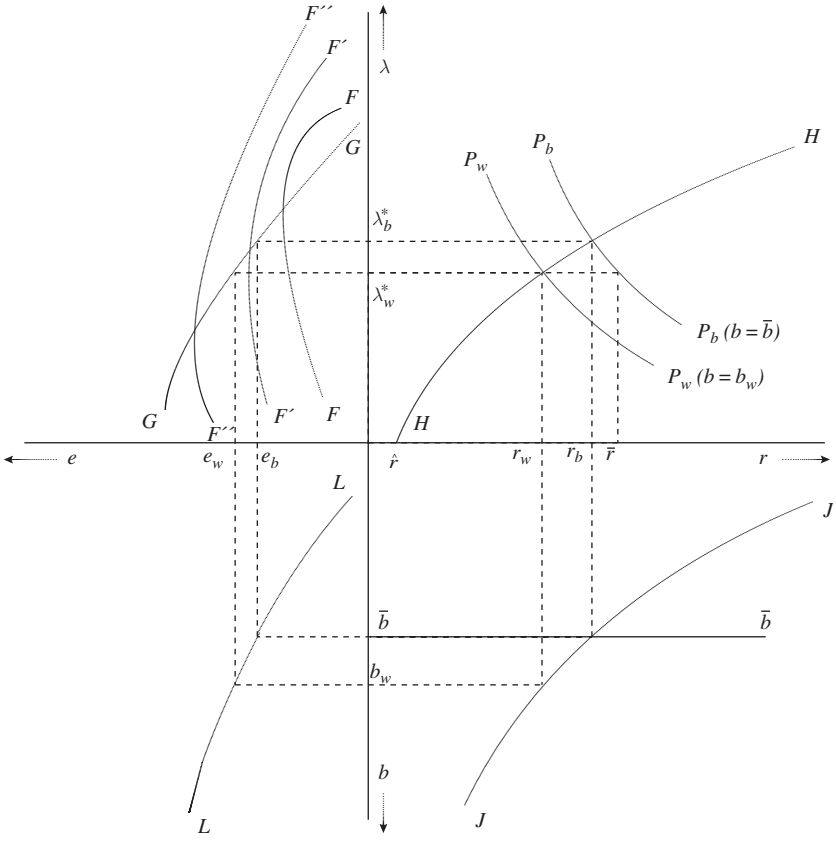

FIGURE 2 Optimal mix of policies

The downward-sloping line *JJ* is the reduced-form demand for loan curve. It is reduced form in the sense that the demand is taken to adjust to changes in the optimal level of λ. The line *GG* gives the relationship between e and optimal λ, corresponding to each value of r. We know that an increase in r reduces e for a given value of λ. We also know that an increase in r increases the optimal level of λ. However, the indirect effect on e via changes in λ is zero as λ is optimally chosen. Therefore, the *GG* locus is downward sloping. The concave lines *FF*, $F'F'$ and $F''F''$ are representations of equation (18), that is, the relationship between λ and e at given values of r. The lower the value of r, the further out these lines are from the origin. Finally, the locus *LL* gives the reduced-form relationship between e and b.

In the case of a perfectly elastic supply of credit, the interest factor is fixed at r_w. The level of borrowing is determined from the *JJ* line as b_w, and the optimal level of λ from the *HH* locus as λ_w^*. Having obtained λ_w^*, the corresponding education participation rate e_w is derived from the *GG* locus. If a binding

borrowing constraint is now imposed, exogenously set at a level $\overline{b} < b_w$, and the policy maker does not adjust λ, the resulting value of r will be at $\bar{r}$, which is 'too high' to attain the maximum possible e. The policy maker can lower r by raising λ to λ_b^*, and this allows the new choice of education, e_b, to be optimal given the borrowing constraint. Of course, as result of the binding borrowing constraint, the child labour incidence rate $1 - e_b$ is higher than that under the perfectly elastic supply of credit, $1 - e_w$.

Finally, concentrating on the upper two panels of figure 2, note that the loci *GG* and *HH* represent combinations of e - λ^* and r - λ^* under all credit market situations. The comparisons between various cases involving the credit market, that is, $S' = 0$, $0 < S' < \infty$ and $S' \to \infty$, is therefore a matter of comparing where along the *HH* line the economy might end up (for a given value of *F*) in each case. In comparing the intermediate case with a perfectly inelastic supply of credit that is caused by an exogenous, binding constraint, it is clear that r will be no lower under a constraint than in a freely competitive domestic market with an upward-sloping supply of credit. This suggests that the outcome will be further out along the *HH* curve under the former scenario than under the latter.[36] This further supports the conjecture that $\lambda_b^* > \lambda_d^*$. Note, once again, that the educational choice will be higher under free access to credit from rich households than under a binding constraint (given that σ and z are optimally set in each scenario).

5. Conclusion

We examined the effects of two policy options, namely, food for education and improvements in education quality, in a two-period model. We found that an earmarked increase (financed with foreign aid) in spending on school quality becomes more effective in reducing child labour as credit opportunities facing poor families improve in the sense of a greater elasticity of supply of credit. A policy of subsidizing food for education always reduces child labour with the concomitant availability of credit having an ambiguous influence on the effectiveness of this policy.

We also examined the question of the optimal mix of the two policies, given a fixed amount of resources. This is a reasonable question to ask since international agencies like the World Bank are given a limited amount of resources to address the issue at hand. We found that more resources should be placed in the food-for-education program when the supply of credit is severely inelastic, as occurs when a binding borrowing constraint prevents further borrowing. However, as such constraints are relaxed and the supply becomes more elastic, the optimal share of resources shifts towards investment in education.

36 Note that in the case of a domestic credit market, instead of iso-borrowing lines there will be 'iso-excess-demand' lines. These will remain negatively sloped, but will be steeper than the iso-borrowing lines.

To summarize, we found that the effectiveness of the two policy options is not independent of other concomitant policies. In particular, it is important to reform credit markets in order for an optimal mix of the two policy instruments to have the best effect. Of course, as the credit market situation improves, policy makers would need to adjust their relative spending towards improving the quality of education.

Appendix

Suppose the preferences of the unskilled families are given by

$$v = \frac{(c_1)^{-5}}{-5} + \frac{(c_2)^{-5}}{-5} + 10(Ne)^{0.9},$$

and that $M = 1$, $N = 2$, $\phi^u = 0.5$, while ϕ is varied between examples. For the case of perfectly inelastic credit, equilibrium is represented by equations (3), (4), and (5) with the borrowing constraint arbitrarily set at zero.

The equilibrium values are found by using the fsolve subroutine of the software MATLAB after a value has been selected for ϕ:

Setting $\phi = 0.7$, the equilibrium values are as follows:
$c_1 = 0.623460$, $c_2 = 1.805616$, $r = 684\%$, $e = 0.876540$.
Setting $\phi = 0.75$, the equilibrium values are as follows:
$c_1 = 0.623464$, $c_2 = 1.93827$, $r = 902\%$, $e = 0.876536$.

Hence, an increase in the quality parameter lowers e in the presence of a binding borrowing constraint.

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