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On the Substitutability between Foreign Aid and International Credit*

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Abstract

We examine the effect of relaxing a binding borrowing constraint for a recipient country on the amount of foreign aid it receives. We do so by developing a two-country, two-period trade-theoretic model. The relaxation of the borrowing constraint reduces the flow of foreign aid, suggesting that the donor views developing nations' access to international credit markets as a substitute for foreign aid.

Keywords: Foreign aid, borrowing constraint, fungibility, public input.
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1 Introduction

Does a more severely credit constrained country receive a larger quantity of foreign aid? We address this question by developing a two-period, two-country (recipient and donor) trade-theoretic model where the recipient country is subject to a binding borrowing constraint.[1,2] Aid is given by the donor in the first period for the provision of a public input in the recipient nation to boost production in the second period. However, foreign aid is fully fungible, and the recipient government optimally chooses to spend only a certain fraction of the aid for the public input, while diverting the rest to its citizens as lump-sum payments. Simultaneously, the altruistic donor government optimally chooses the level of foreign aid.[3] The next section analyzes how a relaxation of the borrowing constraint affects the Nash equilibrium level of foreign aid.

2 The Model

There are two countries, and two periods. In period 1, the recipient country (labeled α) receives T amount of foreign aid from the donor, for the purpose of providing a public input, the level of which is denoted by g. However, foreign aid is fully fungible and the recipient can allocate a proportion $(1-\lambda)$ of it as lump-sum payments to consumers.[4] Thus, the recipient government uses a proportion λ of foreign aid and also an amount $\bar{L}$ obtained by lump-sum taxation of its nationals, to pay for g which increases production in period 2. Given the difficulties in most countries with lump-sum taxation, we take $\bar{L}$ to be exogenous. There are n private goods produced and consumed in both nations. Consumption in the two economies is represented by the inter-temporal expenditure function of a representative consumer: $E^{\alpha}(p, p/(1+r), u^{\alpha})$ and $E^{\beta}(p, p/(1+r^*), u^{\beta} - \theta u^{\alpha})$ respectively. Also, u^{α} and u^{β} , and r and r^* , are the respective utility levels and

[1] Bauer (1971) argued that it should be replaced by free or easier access to the international credit market. Stern (1974) while reviewing Bauer (1971) made a robust defense of foreign aid as an instrument for development.

[2] For extensive evidence suggesting that developing countries face severe credit constraints, see, among others, Galindo and Schiantarelli (2003), Harrison and McMillan (2003), Bigsten *et al.* (2003), and Héricourt and Poncet (2007). Rajan and Zingales (1998) provide evidence of the lack of sector-level financial development for several developed and developing countries.

[3] In reality, donors have many motives for giving foreign aid, and self-interest also plays a major role.

[4] Many studies have found that, for all intents and purposes, aid is fungible. See, for example, Boone, 1996; Swaroop *et al.*, 2000.

interest rates, while p is the price vector. In specifying the consumption side, we have assumed that the donor nation's representative consumer is altruistic toward its counterpart in the recipient country, and θ is the altruism parameter. We assume that both countries are small open economies in the goods market, so p is exogenously given. The revenue functions — which represent the total value added — in the two countries in period 1 are $R^{\alpha 1}(p, \bar{K})$ and $R^{\beta 1}(p)$, where $\bar{K}$ is the level of initial capital stock in the recipient country.[5] In period 2, the revenue functions are $R^{\alpha 2}(p, \bar{K}+I, g)$ and $R^{\beta 2}(p)$ where I is the level of investment made in period 1, $R^{\alpha 2}_{33} \leq 0$, and $R^{\alpha 2}_{22} < 0$. We also assume that private capital and public input are complements ($R^{\alpha 2}_{23} \geq 0$).

The inter-temporal budget constraint for the representative consumers are:

$$E^{\alpha}(p, p/(1+r), u^{\alpha}) + I = R^{\alpha 1}(p, \bar{K}) + \frac{R^{\alpha 2}(p, \bar{K}+I, g)}{1+r} - \bar{L} + (1-\lambda)T, \quad (1)$$

$$E^{\beta}(p, p/(1+r^*), u^{\beta} - \theta u^{\alpha}) = R^{\beta 1}(p) + \frac{R^{\beta 2}(p)}{1+r^*} - T, \quad (2)$$

where $(1-\lambda)T$ is the part of foreign aid that is returned to the representative consumer in recipient country as a lump-sum transfer.

The budget constraint for the government in the recipient country is:

$$g = \bar{L} + \lambda T, \quad (3)$$

i.e., public input is financed by a fixed lump-sum taxation and a proportion of foreign aid.

The level of investment in the recipient country is determined optimally by the representative consumer. It is done by setting $\partial u^{\alpha}/\partial I = 0$, taking r as given. This gives:

$$1 = R^{\alpha 2}_{2}/(1+r). \quad (4)$$

The left-hand side is the marginal cost of investment in the sense of consumption foregone, and the right-hand side is the present value of the marginal return to investment.

[5] Partial derivatives of the revenue and the expenditure functions with respect to the price of a good yield the supply and compensated demand functions for this good, respectively. For properties of these functions, see Dixit and Norman (1980), among others. Endowment other than capital are omitted as they do not vary in our analysis.

The representative consumer in the donor country is assumed to be able to borrow freely from the international capital market at an exogenous interest rate r^*. However, the representative consumer in the recipient country is subject to a binding borrowing constraint, where he/she can borrow up to $\bar{B}$ in period 1 and repay this amount with interest in period 2. Therefore:[6]

$$B^\alpha(r,T,\lambda) \equiv p'E_1^\alpha + I - \left[R^{\alpha 1} - \bar{L} + (1-\lambda)T\right] = \bar{B} = \frac{R^{\alpha 2} - p'E_2^\alpha}{1+r}, \tag{5}$$

where $B^\alpha(\cdot)$ is the demand for loans in period 1 in the recipient country.[7]

This completes the description of the basic model. It has five equations in (1)-(5) and five endogenous variables u^α, u^β, g, I and r.

3 Substitutability between Loans and Foreign Aid

Differentiating (1)-(3) and using (4) and (5), we get:

$$E_3^\alpha \; du^\alpha = -\frac{\bar{B}}{1+r}\cdot dr + \left[\frac{\lambda R_3^{\alpha 2}}{1+r} + (1-\lambda)\right] dT + T\left[\frac{R_3^{\alpha 2}}{1+r} - 1\right] d\lambda, \tag{6}$$

$$E_3^\beta \; d(u^\beta - \theta u^\alpha) = -dT, \tag{7}$$

where E_3^i is the reciprocal of the marginal utility of income in country i $(i = \alpha,\ \beta)$. Also, $E_{33}^i > 0$ $(i = \alpha,\ \beta)$ implying diminishing marginal utility of income.

The first term on the right-hand side of (6) is the intertemporal term-of-trade effect: an increase in r lowers the borrower's utility. For given levels of r and λ, an increase in foreign aid raises the welfare of the recipient in two ways: (i) it increases g and thus u^α through production augmentation, and this effect is proportional to λ, and (ii) it increases the lump-sum income of the recipient from the aid not allocated for the public input. On the other hand, for given T and r, an increase in λ raises recipient utility through an increase in the public input, and reduces the utility as lump-sum

[6]For the treatment of borrowing constraints in similar way see, for example, Djajić (2010).

[7]E_i^α is the partial derivative with respect to the ith argument of the expenditure function. For example, E_1 is the vector of period-1 consumptions. All vectors are column vectors and for a vector x, its transpose is denoted by x'.

transfers are cut. Finally, an increase in aid must reduce the donor's utility, for a given level of recipient utility (see (7)).

Differentiating (4), we get:

$$R_{22}^{\alpha 2} dI = -R_{23}^{\alpha 2} dg + dr. \tag{8}$$

An increase in public input g increases the level of investment because of the complementarity between the public input and private capital, and an increase in r reduces investment by reducing the present value of the rate of return.

Differentiating (5), and using (6), (3) and (8), we find:

$$\begin{aligned} -\frac{\bar{B}\epsilon^{\alpha}}{1+r} \cdot \, dr \quad &= \quad d\bar{B} + \left[-c_y^{\alpha 1} \left\{ \frac{\lambda R_3^{\alpha 2}}{1+r} + (1-\lambda) \right\} + \frac{\lambda R_{23}^{\alpha 2}}{R_{22}^{\alpha 2}} + (1-\lambda) \right] dT \\ & \qquad -T \left[\frac{c_y^{\alpha 1} R_3^{\alpha 2}}{1+r} - \frac{R_{23}^{\alpha 2}}{R_{22}^{\alpha 2}} + (1 - c_y^{\alpha 1}) \right] d\lambda, \end{aligned} \tag{9}$$

where $c_y^{\alpha 1}$ is the marginal propensity to spend on period 1 consumption, *i.e.*,

$$c_y^{\alpha 1} = \frac{\partial (p_1'^{\alpha})}{\partial u^{\alpha}} \cdot \frac{1}{E_3^{\alpha}} = \frac{p_{13}'^{\alpha}}{E_3^{\alpha}} > 0,$$

and ϵ^{α} is the absolute value of the loans demand elasticity with respect to the interest rate:

$$\epsilon^{\alpha} = -\frac{\partial B^{\alpha}}{\partial (1+r)} \cdot \frac{1+r}{\bar{B}} > 0.$$

The first term on the right-hand-side of (9) is the direct effect of the relaxation of the borrowing constraint $\bar{B}$, which must reduce the rate of interest. Turning to the effects of an increase in T , we note the following. First, a rise in the foreign aid increases the utility of the recipient and thus the level of private consumption in period 1. This increases the demand for loans and thus the equilibrium interest rate. This effect is given by the first term in the coefficient of dT in (9). Second, an increase in T increases g, making investments more profitable. This increases the demand for loans, increasing the equilibrium interest rate. This relates to the second term in the coefficient of dT. Finally, the third term in the coefficient of dT shows that as T increases, lump-sum income rises for the recipient, reducing the demand for loans and the equilibrium interest rate. The effects of an increase in λ are similar, except that an increase in λ reduces the lump-sum income of the recipient in period 1 and this increases the demand for loans and the equilibrium interest rate.

Finally, substituting (9) in (6), we get:

$$\begin{aligned} E_3^\alpha \; du^\alpha &= \frac{1}{\epsilon^\alpha} \cdot d\bar{B} + T\left[\left\{\frac{R_3^{\alpha 2}}{1+r} - 1\right\}\left\{\frac{\epsilon^\alpha - c_y^{\alpha 1}}{\epsilon^\alpha}\right\} + \frac{R_{23}^{\alpha 2}}{\epsilon^\alpha R_{22}^{\alpha 2}} - \frac{1}{\epsilon^\alpha}\right] d\lambda \\ &+ \left[\left\{\frac{\lambda R_3^{\alpha 2}}{1+r} + (1-\lambda)\right\}\left\{\frac{\epsilon^\alpha - c_y^{\alpha 1}}{\epsilon^\alpha}\right\} + \frac{\lambda R_{23}^{\alpha 2}}{\epsilon^\alpha R_{22}^{\alpha 2}} + \frac{(1-\lambda)}{\epsilon^\alpha}\right] dT \end{aligned} \tag{10}$$

A relaxation of the borrowing constraint (*i.e.*, an increase in $\bar{B}$) increases welfare by reducing the interest rate. The effects of T and λ on u^α now have, in addition to the ones discussed after (6), the effects via induced changes in the interest rate.

As for the donor country, we substitute (10) in (7) to get:

$$\begin{aligned} E_3^\beta du^\beta = \frac{\theta E_3^\beta}{E_3^\alpha \epsilon^\alpha} \cdot d\bar{B} + \frac{T\theta E_3^\beta}{E_3^\alpha}\left[\left\{\frac{R_3^{\alpha 2}}{1+r} - 1\right\}\left\{\frac{\epsilon^\alpha - c_y^{\alpha 1}}{\epsilon^\alpha}\right\} + \frac{R_{23}^{\alpha 2}}{\epsilon^\alpha R_{22}^{\alpha 2}} + \frac{1}{\epsilon^\alpha}\right] d\lambda \\ + \left[-1 + \frac{\theta E_3^\beta}{E_3^\alpha}\left(\left\{\frac{\lambda R_3^{\alpha 2}}{1+r} + (1-\lambda)\right\}\left\{\frac{\epsilon^\alpha - c_y^{\alpha 1}}{\epsilon^\alpha}\right\} + \frac{\lambda R_{23}^{\alpha 2}}{\epsilon^\alpha R_{22}^{\alpha 2}} + \frac{(1-\lambda)}{\epsilon^\alpha}\right)\right] dT. \end{aligned} \tag{11}$$

Most of the effects in (11) appear via changes in the utility of the recipient and those have been explained before. The only extra effect is the direct negative effect of T on donor welfare (see (7)). This extra effect is the first term in the coefficient of dT above.

We now consider a simultaneous-move game where the recipient government chooses λ and the donor government T. After setting $\partial u^\alpha / \partial \lambda = 0$ and $\partial u^\beta / \partial T = 0$, we get the first order condition for the recipient government's optimization problem as:

$$\left[\epsilon^\alpha - c_y^{\alpha 1} - \frac{\epsilon_{23}^\alpha}{\epsilon_{22}^\alpha}\right] R_3^{\alpha 2} - (1+r)\left(1 + \epsilon^\alpha - c_y^{\alpha 1}\right) = 0, \tag{12}$$

$$\text{where} \quad \epsilon_{23}^{\alpha} = \frac{\partial R_3^{\alpha 2}}{\partial(\bar{K}+I)} \cdot \frac{\bar{K}+I}{R_3^{\alpha 2}} = R_{23}^{\alpha 2} \cdot \frac{\bar{K}+I}{R_3^{\alpha 2}} > 0,$$

$$\epsilon_{22}^{\alpha} = -\frac{\partial R_2^{\alpha 2}}{\partial(\bar{K}+I)} \cdot \frac{\bar{K}+I}{R_2^{\alpha 2}} = -R_{22}^{\alpha 2} \cdot \frac{\bar{K}+I}{R_2^{\alpha 2}} = -R_{22}^{\alpha 2} \cdot \frac{\bar{K}+I}{1+r} > 0,$$

and that of the donor government as:

$$-1 + \frac{\theta E_3^{\beta}}{E_3^{\alpha}} \left(\left\{ \frac{\lambda R_3^{\alpha 2}}{1+r} + (1-\lambda) \right\} \left\{ \frac{\epsilon^{\alpha} - c_y^{\alpha 1}}{\epsilon^{\alpha}} \right\} - \frac{\lambda \epsilon_{23}^{\alpha} R_3^{\alpha 2}}{\epsilon^{\alpha} \epsilon_{22}^{\alpha}(1+r)} + \frac{(1-\lambda)}{\epsilon^{\alpha}} \right) = 0. \tag{13}$$

There are two groups of effects from a rise in λ on the welfare of the recipient. The first is via an increase in the public input provision and these effects are given by the first term in (12). The second group of effects comes via a reduction in the lump-sump income out of foreign aid (induced by an increase in λ), and these effects are given by the second term in (12). For the donor, the first effect is a negative direct one as aid is given by taxing the representative consumer, and the second effects come via the altruism factor.

Equations (12) and (13) simultaneously determine the equilibrium levels of T and λ in terms of $\bar{B}$ and other exogenous variables.

For tractability, we assume that the total effect (after considering effects via changes in T and λ as well as the direct effect) of relaxing the borrowing constraint on the rate of interest is negative (i.e., $dr/d\bar{B} < 0$).

After substituting (12) into (13), the latter simplifies to:

$$\theta E_3^{\beta}(1 + \epsilon^{\alpha} - c_y^{\alpha 1}) = E_3^{\alpha} \epsilon^{\alpha}, \tag{14}$$

and (10) simplifies to

$$E_3^{\alpha}\, du^{\alpha} = \frac{1}{\epsilon^{\alpha}} \cdot d\bar{B} + \left[1 + \frac{1 - c_y^{\alpha 1}}{\epsilon^{\alpha}} \right] dT. \tag{15}$$

Differentiating (14) and using (7) and (15), we get

$$-AdT = Bd\bar{B}, \tag{16}$$

$$
\begin{aligned}
\text{where} \quad A &= \frac{\theta E_{33}^{\beta}(1+\epsilon^{\alpha}-c_y^{\alpha 1})}{E_3^{\beta}} + \frac{E_{33}^{\alpha}(1+\epsilon^{\alpha}-c_y^{\alpha 1})}{E_3^{\alpha}} > 0, \\
B &= \frac{E_{33}^{\alpha}}{E_3^{\alpha}} - \frac{(1-c_y^{\alpha 1})\epsilon^{\alpha} E_3^{\alpha}}{1+r} \cdot \frac{dr}{d\bar{B}} > 0.
\end{aligned}
$$

From (16), our main result follows:

Proposition 1 *A relaxation of the borrowing constraint for a foreign aid recipient country reduces the amount of aid it receives.*

Thus, foreign loan and foreign aid are substitutes. An increase in $\bar{B}$ increases real income in the recipient country, which reduces the marginal utility of income in that country. In turn, this lowers the marginal benefit of giving foreign aid for the donor nation. A reduction in the interest rate induced by the relaxation of the borrowing constraint also reduces the marginal utility of income in the recipient country by increasing the present value of the price of the good in the second period. Thus, both effects work in the same direction to reduce foreign aid.

4 Conclusion

Using a trade-theoretic model with a credit constarined recipient, we find that a relaxation of the borrowing constraint unambiguously reduces the amount of foeign aid that is given by an altruistic donor. This suggests that an altrustic donor views access to international credit markets for poorer nations as a substitute to its foreign aid efforts.

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