

Djajić, Slobodan

Working Paper

Foreign aid, infrastructure development and welfare: An intertemporal analysis

WIDER Research Paper, No. 2008/64

Provided in Cooperation with:

United Nations University (UNU), World Institute for Development Economics Research (WIDER)

Suggested Citation: Djajić, Slobodan (2008) : Foreign aid, infrastructure development and welfare: An intertemporal analysis, WIDER Research Paper, No. 2008/64, ISBN 978-92-9230-114-9, The United Nations University World Institute for Development Economics Research (UNU-WIDER), Helsinki

This Version is available at:

<https://hdl.handle.net/10419/45147>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Research Paper No. 2008/64

Foreign Aid, Infrastructure Development, and Welfare

An Intertemporal Analysis

Slobodan Djajić *

June 2008

Abstract

This paper examines the welfare implications of foreign aid within the framework of a two-period, two-country model of international trade. It is up to the donor country to decide what fraction of any given aid package is to be made available for the recipient's immediate, period-one consumption, and what part should be allocated for investment in infrastructure that expands the recipient's production possibilities in period two. The focus of the analysis is on the conditions under which both countries agree or disagree on the manner in which the aid funds should be divided between the two options.

Keywords: foreign aid, trade, model, welfare

JEL classification: F35, H41

Copyright © UNU-WIDER 2008

* Graduate Institute of International Studies, Geneva, Switzerland: slobodan.djajic@graduateinstitute.ch

This study is a revised version of the paper presented at the 16-17 June 2006 WIDER development conference on 'Aid: Principles, Policies, and Performance', directed by George Mavrotas.

UNU-WIDER gratefully acknowledges the financial contribution to the conference by the Finnish Ministry for Foreign Affairs.

UNU-WIDER also acknowledges the financial contributions to the 2006-07 research programme by the governments of Australia (AusAID), Denmark (Royal Ministry of Foreign Affairs), Norway (Royal Ministry of Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida), and the United Kingdom (Department for International Development—DFID).

ISSN 1810-2611

ISBN 978-92-9230-114-9

The World Institute for Development Economics Research (WIDER) was established by the United Nations University (UNU) as its first research and training centre and started work in Helsinki, Finland in 1985. The Institute undertakes applied research and policy analysis on structural changes affecting the developing and transitional economies, provides a forum for the advocacy of policies leading to robust, equitable and environmentally sustainable growth, and promotes capacity strengthening and training in the field of economic and social policy making. Work is carried out by staff researchers and visiting scholars in Helsinki and through networks of collaborating scholars and institutions around the world.

www.wider.unu.edu

publications@wider.unu.edu

UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Typescript prepared by Adam Swallow at UNU-WIDER

The views expressed in this publication are those of the author(s). Publication does not imply endorsement by the Institute or the United Nations University, nor by the programme/project sponsors, of any of the views expressed.

1 Introduction

While providing foreign aid to the less advanced economies, donor countries rarely give it away in the form of a free transfer of income. Instead, conditions are often imposed, specifying the terms on which the funds are provided by the donor to the recipient. This widespread practice of tying aid has stimulated a large volume of research on the welfare implications of transfers that are conditional on some action or policy change being implemented by the recipient.¹

Throughout the theoretical literature on tied aid, the focus of analysis is on the terms-of-trade and welfare consequences of the transfer. Particular attention is typically devoted to the question of the transfer paradox. By contrast, the issue of how various *forms* of aid affect welfare has received much less attention within the usual trade-theoretic framework of analysis. Different forms of aid do have different consequences. Any given amount of aid will thus have different implications for the welfare of both the donor and the recipient, depending on how it is utilized. This raises a number of interesting questions. If both the donor and the recipient seek to maximize own welfare for any given amount of aid, are they likely to agree or disagree on the pattern of aid allocation between the competing needs of the recipient? Under what conditions are they likely to agree?

The analysis of this problem is conducted in the context of a simple two-country, two-period model of trade and aid. Aid is provided by the donor only in the first period. For simplicity, it is assumed that the choice is between funding immediate consumption needs of the recipient country or contributing to its long-term development. A fraction of this temporary aid package is thus earmarked for unrestricted consumption, while the rest is to be invested in infrastructure that serves to increase the efficiency of the recipient's productive factors in period two.

There are two distortions that play a crucial role in the analysis below. First, the poor, recipient country has a suboptimal stock of infrastructure and second, it is unable to borrow in the international capital market. In this environment, it is found that both countries will never agree to reallocate aid to current consumption at the expense of infrastructure development. If one finds it in its interest to do so, the other will not. They may, however, under certain conditions, find themselves in agreement to allocate more of the aid budget to infrastructure at the expense of period-one consumption. When they do agree, it is found that the weight of the first distortion must exceed that of the second.

The remainder of the paper is organized as follows: Section 2 presents the model. Section 3 examines the terms-of-trade and welfare implications of the aid transfer from the perspective of both the donor and the recipient. The implications of altering the

¹ Tied aid, whereby the recipient is required to spend a certain proportion of aid on a specific product or service, typically an export good of the donor, or expand local production of a particular commodity, has been analysed originally by Brecher and Bhagwati (1982), Kemp and Kojima (1985) and Schweinberger (1990). Useful surveys are provided by Kemp (1992) and Brakman and van Marrewijk (1998). See also Lahiri and Raimondos-Moller (1997) and Lahiri et al. (2002) for an analysis of aid linked to commercial policy changes.

composition of any given amount of aid between the two options are examined in Section 4. Finally, Section 5 offers concluding remarks.

2 The model

Let us consider a two-period model in which two countries exchange two goods in each period, but there is no international lending, borrowing, or trade in factor services. The absence of international lending and borrowing may be taken to reflect a situation in which the recipient country is in a debt crisis, unable to borrow from the market. It is assumed that aid is transferred only in period one from the foreign (donor) country to the home (recipient) country.² A fraction x of the transfer, T , is made available to the home country for immediate, unrestricted, period-one consumption. The remaining fraction $1-x$ is earmarked for developing the home country's infrastructure. Conditionality of this type is often justified by donor countries on the grounds that the aid package should not only serve to meet the recipient's immediate consumption needs (covered by the portion of aid which is released for current consumption), but also help address the recipient's long-term development problems by requiring it to use the remaining portion of aid for public projects which expand the economy's production possibilities.

In order to obtain a unit of infrastructure, which is operational in *period two*, it is necessary to use up one unit of the numeraire good in *period one*. For simplicity, let us assume that this transformation is costless and therefore does not absorb any of the productive factors of the recipient country. Accordingly, with $(1-x)T$ units of the numeraire expended on the project in the first period, the home country obtains $(1-x)T$ additional units of infrastructure in the second period. Moreover, let us assume that the recipient country depends on foreign aid for infrastructure development or faces other constraints that prevent it from attaining the optimal stock of infrastructure.³

Having sketched the framework in which the aid transaction occurs, let us turn to a more formal description of both economies. We use capital letters for first-period variables, lower case letters for second-period variables and an asterisk to indicate the variables of the foreign country. The budget constraints and the equilibrium condition

² For the analysis of temporary transfers in intertemporal models of trade, see Djajic, Lahiri, and Raimondos-Moller (1998, 1999, 2004).

³ This model is closely related to the literature on foreign aid in economies with public goods production. Hatzipanayotou and Michael (1995) offer an analysis of an aid transfer in a model with public *consumption* goods. They examine how a transfer absorbs recipient's productive factors in the process of transforming aid into public goods (affecting the supply of private goods) and how it affects expenditure on private goods, to determine the terms-of-trade and welfare implications of the transfer. In another paper, Michael and Hatzipanayotou (1996) examine the implications of a transfer that finances the production of a public input that is used in the production of two internationally traded private goods. I assume, instead, that installation of infrastructure in period one absorbs only the export good of the donor and not any of the productive factors of the recipient. Moreover, the analysis here is conducted in the context of an intertemporal model, where infrastructure absorbs resources in period one and expands the availability of consumption goods in period two in a world economy where international capital markets are distorted. This intertemporal distortion also distinguishes the present model from the one analysed by Schweinberger (2002), where the transfer is in the form of a capital good required for the production of a public *consumption* good in a tariff-ridden economy that also produced nontraded goods. See also Kemp and Abe (1994).

pertaining to the first period are described below using standard expenditure (E) and revenue (R) functions, where the relative price of the non-numeraire good (P) and the domestic and foreign utility levels (U and U*) enter as arguments:

$$E(1,P,U) = R(1,P) + xT \quad (1)$$

$$E^*(1,P,U^*) = R^*(1,P) - T \quad (2)$$

$$E_p(1,P,U) + E_p^*(1,P,U^*) = R_p(1,P) + R_p^*(1,P) \quad (3)$$

Equation (1) is the budget constraints for the home country, reflecting the fact that a part of the transfer (namely xT units of the numeraire good) is distributed to the consumers in the form of a lump-sum subsidy. Similarly, equation (2) represents the budget constraint of the foreign country where the entire transfer of T units is financed by means of a lump-sum tax on foreign households. Equation (3) is the market-clearing condition for the non-numeraire good in period one.⁴ It states that the total world supply of that commodity must equal total world demand, which is the sum of the consumption demand at home and abroad. The market-clearing condition for the numeraire good is omitted due to Walras' Law.

In the second period there are no transfers and the two countries only exchange goods with each other. However, as the units of infrastructure installed in period one bear fruit in the second period, they help expand the home country's production possibilities. The infrastructure is made available to the private sector free of charge and is assumed to increase the efficiency of the country's productive factors. Thus, the equilibrium conditions for the second period can be written as follows:

$$e(1,p,u) = r(1,p,g), \text{ where } r_g > 0, r_{gg} < 0, \text{ and } r_{pg} \approx 0 \quad (4)$$

$$e^*(1,p,u^*) = r^*(1,p) \quad (5)$$

$$e_p(1,p,u) + e_p^*(1,p,u^*) = r_p(1,p,g) + r_p^*(1,p) \quad (6)$$

where the stock of infrastructure, g , of the recipient country in period two reflects the increase in the supply due to foreign aid. Aid is assumed not to be fungible,⁵ so that $dg = (1-x)dT$.

The level of welfare of each economy is defined as a function of period-one and period-two utilities:

$$W(U,u) = U + (1+\delta)^{-1}u \quad (7)$$

$$W^*(U^*,u^*) = U^* + (1+\delta^*)^{-1}u^* \quad (8)$$

⁴ Partial derivative of the revenue (expenditure) function with respect to price gives the supply (compensated demand) function for the good.

⁵ Alternatively, if a fraction $(1-h)$ of infrastructure aid is diverted for other purposes, we would have $dg = h(1-x)dT$. We choose not to complicate the model in this manner. On the issue of fungibility of aid, see Nurkse (1967), Papanek (1974), Pack and Pack (1990, 1993), Gang and Khan (1991), Khan and Hoshino (1992), Khilji and Zampelli (1991, 1994), Feyzioglu et al. (1998), McGillivray (2000), and Mavrotas (2005).

where δ and δ^* are the (constant) rates of time preference at home and abroad. In general, $\delta \neq \delta^*$.

3 Welfare implications of aid

Equations (1) through (8) may be solved for the eight endogenous variables: W , W^* , U , U^* , u , u^* , P , and p , as functions of the aid-policy variables T and x . Thus, on the basis of (1)–(3), we obtain

$$dP = S^{-1}(C^* - xC)dT \quad (9)$$

$$E_U dU = S^{-1}[xZ + (1-x)M^*C^*]dT \quad (10)$$

$$E_{U^*} dU^* = -S^{-1}[(1-x)M^*C + Z]dT \quad (11)$$

where $Z = E_{pp} + E_{pp}^* - R_{pp} - R_{pp}^* < 0$, is the slope of the compensated demand curve for the non-numeraire commodity, $C = E_{pU}/E_U$ and $C^* = E_{pU^*}/E_{U^*}$ are the marginal propensities to consume the non-numeraire at home and abroad, $M^* = -M$ is the quantity of foreign imports (equal to home-country exports) of the non-numeraire commodity, and $S = Z - M^*(C^* - C)$. On the assumption that our model exhibits Walrasian stability, $S < 0$. We shall also assume that $M^* > 0$, so that the donor exports the numeraire good which is required for building infrastructure.

The terms of trade of the recipient thus improve in the first period (i.e., $dP/dT > 0$) only if $xC > C^*$. With $x < 1$, this condition is more stringent than the usual condition, $C > C^*$, that we find in models where all aid is used for immediate consumption. Tying a fraction $(1-x)$ of the aid transfer to development of infrastructure, which under our assumptions absorbs an equal number of units of the donor's export good, makes it more likely that the donor's terms of trade improve in the first period, reducing the burden of the transfer. In the extreme case of $x = 0$, the terms of trade of the donor necessarily improve, while period-one welfare of the recipient, as shown in equation (10), unambiguously declines.

In general, the impact of a \$1 transfer on period-one welfare of the recipient consists of two components: (1) $xZ/S > 0$, which is the standard welfare gain from getting a fraction x of \$1 for unrestricted consumption, and (2) $(1-x)M^*C^*/S$, which corresponds to the negative terms-or-trade effect related to the decline in the foreign demand for home exports as foreign spending falls by a fraction $(1-x)$ of \$1 which is used to finance infrastructure development in the recipient country.

The effect on donor's welfare, shown in equation (11), also has two components: (1) the standard welfare decline, $-Z/S$, associated with a \$1 transfer and (2) the gain $-(1-x)M^*C/S$ associated with the terms-of-trade improvement that stems from the requirement that the recipient country spends the fraction $(1-x)$ of the transfer on infrastructure development (i.e., the donor's exports), rather than spending $(1-x)C$ of it on its own export good. By combining (10) and (11), we note that world welfare in period one declines precisely by the amount $(1-x)dT$, which is allocated to infrastructure development. The benefits of this investment are realized by the world economy only in period two.

The results presented in (9)–(11) are therefore identical to those obtained by Kemp and Wong (1993), who examine the implications of a transfer, a portion x of which is distributed to the households of the recipient country and the remaining amount $(1-x)T$ is lost (in the form of the donor's exportable good) due to waste. In the present setting there is no waste. Instead, the amount $(1-x)T$ is used to increase the recipient's production possibilities in period two. The implications of that for the terms of trade and the levels of welfare of both economies in period two can be seen by solving equations (4)–(6) for p , u , and u^* as functions of x and T .

$$dp = s^{-1}(r_{pg}-cr_g)(1-x)dT \quad (12)$$

$$e_u du = [r_g + s^{-1}(r_{pg}-cr_g)m^*](1-x)dT \quad (13)$$

$$e_u^* du^* = -s^{-1}(r_{pg}-cr_g)m^*(1-x)dT \quad (14)$$

where $s = z - m^*(c^* - c) < 0$ by the assumption of Walrasian stability, $z = e_{pp} + e_{pp}^* - r_{pp} - r_{pp}^* < 0$ is the slope of the compensated excess demand schedule for the non-numeraire good in period two, $c = e_{pu}/e_u$ and $c^* = e_{pu}^*/e_u^*$ are the marginal propensities to consume the non-numeraire good in period two at home and abroad, respectively, and $m^* = -m > 0$ is quantity of foreign imports (equal to home exports) of the non-numeraire commodity in period two.

The effect of the period-one transfer on the terms of trade in period two is given by equation (12). An additional unit of infrastructure that becomes operational in period two generates an increase in income of the recipient country amounting to r_g units and raises its expenditure on the non-numeraire good by the amount cr_g . The increase in factor productivity also affects the supply of the non-numeraire in the recipient country. First, for any allocation of productive factors between the two sectors, the greater availability of infrastructure raises productivity and output. This in itself has a positive effect on the supply of the non-numeraire in the recipient country. The change in productivity may, in addition, cause a reallocation of productive factors between sectors. This will occur if the productivity of one sector (or one productive factor) is more affected than that of another. For our purposes it is not essential to define the precise impact of infrastructure development on the output of each good. It suffices to note that r_{pg} , which measures the impact on output of the non-numeraire commodity at any given p , may be either positive or negative. If infrastructure development has an identical impact on the productivity of all productive factors and sectors of the economy, then the supply of the non-numeraire unambiguously increases (i.e., $r_{pg} > 0$). When preferences are homothetic, this increase in supply exceeds the increase in demand, so that $dp/dT < 0$ and the recipient country suffers a terms-of-trade loss in period two.⁶ However, if the infrastructure project benefits more the import-competing sector, the reallocation of resources in favour of that sector will be at the expense of the export sector, dampening its increase in output and possibly resulting in an actual *decline* in the supply of the non-numeraire. Provided that the supply of the non-

⁶ In this case output of each sector increases in the same proportion as income and expenditure at any given p . With homothetic preferences, demand for the non-numeraire also expands in the same proportion as income. As the non-numeraire is the export good of the home country, its supply exceeds demand and hence the magnitude of the increase in supply is necessarily greater than that of the demand. This gives rise to an excess supply of the commodity on the world market and deterioration in the terms of trade of the recipient country.

numeraire does not increase as much as the demand in the recipient country, its terms of trade will improve.

The effect on period-two welfare of the home country is given by equation (13). An additional unit of infrastructure contributes to a change in welfare through two channels: The positive direct effect of infrastructure expansion on income, r_g , and the terms-of-trade effect $(r_{pg}-cr_g)m^*/s$, which may be either positive or negative. If negative, the case of Bhagwati's immiserizing growth occurs when the direct, positive effect of infrastructure expansion on income is dominated by a large, negative terms-of-trade effect. That is, $r_g+s^{-1}(r_{pg}-cr_g)m^* < 0$.

Period-two welfare of the foreign country is affected, as shown in (14), only by the terms-of-trade change induced by the expansion of infrastructure in the recipient country. Thus in period two, if the terms of trade improve for the donor country, but not so much as to cause immiserizing growth in the recipient country, it is possible for both the donor and the recipient to enjoy higher period-two welfare.

We consider next the impact of the transfer on the welfare of the recipient and the donor over the two periods combined. By substituting (10) and (13) into (7), and (11) and (14) into (8), we obtain the effect of aid on the discounted welfare of the recipient and the donor.

$$E_U dW/dT = S^{-1}[xZ + (1-x)M^*C^*] + [r_g+s^{-1}(r_{pg}-cr_g)m^*](1-x)(1+\rho)^{-1} \quad (15)$$

$$E_U^* dW^*/dT = -S^{-1}[Z + (1-x)M^*C] - s^{-1}(r_{pg}-cr_g)m^*(1-x)(1+\rho^*)^{-1} \quad (16)$$

where ρ and ρ^* are the real rates of interest at home and abroad. That is $1+\rho=(1+\delta)e_u/E_U$ and $1+\rho^*=(1+\delta^*)e_u^*/E_U^*$. Given the assumption that there is no international lending and borrowing, ρ will in general differ from ρ^* . We shall assume in what follows that the recipient's real rate of interest is greater than that of the donor. This can be either because the rates of time preference differ, with $\delta > \delta^*$, or because the marginal utility of income in the first period relative to that in the second is greater in the recipient country than it is in the donor country. A relatively high marginal utility of period-one income may result from a severe shortage of resources available for current consumption of the recipient, as in the case of a crop failure in an economy that lacks internationally marketable assets and is therefore unable to attain a relatively smoother time profile of consumption.

As we have already described all of the components of the change in welfare of both countries, there is no need to repeat that analysis here. Simply note that in obtaining the change in an economy's overall welfare, we have discounted the period-two change in utility by the country's real rate of interest. If we add (15) and (16), we find that the change in world welfare is given by

$$E_U dW/dT + E_U^* dW^*/dT = [r_g (1+\rho)^{-1}-1](1-x) + G_2^* (\rho-\rho^*)(1-x) (1+\rho)^{-1} (1+\rho^*)^{-1} \quad (17)$$

where $G_2^* = -s^{-1}(r_{pg}-cr_g)m^*$ is the current value of the period-two terms-of-trade gain (or loss, if negative) for the donor country.

Equation (17) shows two potential sources of improvement in world welfare as a result of aid being allocated to infrastructure development: First, if the recipient country has a

suboptimal stock of infrastructure (i.e., $r_g > (1+\rho)$), which we assume to be the case, any aid allocated to building infrastructure will have a positive effect on world welfare. World welfare also improves if the period-two change in the terms of trade benefits the economy with the lower real rate of interest. That is, if the country that benefits from the redistribution of period-two income through a change in the terms of trade is the one that attaches a higher valuation to period-two relative to period-one income (i.e., the country with the relatively lower real rate of interest). Under our assumptions, this is the donor country.

As equation (17) makes very clear, the possibility of a transfer-induced welfare improvement for the world economy emerges in this model due to the existence of two distortions. First, the incapacity of the recipient country to attain the optimal stock of infrastructure, where $r_g = (1+\rho)$, and the incapacity of the recipient country to participate in the international capital market and bring ρ into equality with ρ^* . If $\rho = \rho^*$ and $r_g = 1+\rho$, foreign aid only serves to redistribute income from the donor to the recipient in the sense that $E_U dW/dT + E_U^* dW^*/dT = 0$.

4 Dividing foreign aid between consumption and infrastructure

Let us consider next the implications of reallocating aid between immediate period-one consumption and infrastructure development by changing the value of x . How does it affect the welfare of the recipient? By differentiating (15) with respect to x , we have

$$\partial(E_U dW/dT)/\partial x = (Z/S) - (M^*C^*/S) - [r_g/(1+\rho)] + [G_2^*/(1+\rho)] \quad (18)$$

where we recall that $G_2^* = -s^{-1}(r_{pg}-cr_g)m^* \approx 0$ is the period-two terms-of-trade gain for the donor country. The first term of (18) is positive. It represents the standard period-one gain enjoyed by the recipient from \$1 of additional aid used for immediate consumption. The second term, $-M^*C^*/S > 0$, corresponds to the income gain due to the improvement in the terms-of-trade of the recipient in period one as donor households spend more on the recipient's exports when they reduce their contribution for infrastructure development by \$1. The third term is the present value of period-two output and income loss of the recipient due to lower investment in infrastructure. This drop in output and income also affects welfare through a change in the terms of trade in period two, given by the fourth term.

For the donor country, the change in welfare due to an increase in x is given by

$$\partial(E_U^* dW^*/dT)/\partial x = (M^*C/S) - G_2^*/(1+\rho^*) \quad (19)$$

Providing more aid for immediate consumption and less for infrastructure results in a period-one terms-of-trade loss for the donor, M^*C/S , as the recipient shifts spending from infrastructure (i.e., donor's exportable) to a consumption bundle that also includes the donor's importable good. There is also the loss of G_2^* , the period-two terms-of-trade gain for the donor, when aid for infrastructure is reduced by one unit. If

$$(M^*C/S) > G_2^*/(1+\rho^*) \quad (20)$$

the donor prefers to choose a larger value of x . In the context of the present model, where $M^*C/S < 0$, this can occur only if infrastructure development favours sufficiently

the recipient's import-competing sector relative to its export sector, so that $G_2^* < 0$ and larger than M^*C/S in absolute value.

Recalling that $(M^*C/S) - 1 = (M^*C^*/S) - (Z/S)$ by the definition of S , it follows from (18) that the recipient prefers a larger x if

$$-(M^*C/S) > [r_g/(1+\rho)] - 1 - [G_2^*/(1+\rho)] \quad (21)$$

The period-one terms-of-trade improvement from spending \$1 of aid on both goods rather than on infrastructure must be larger than the efficiency gain from investment in infrastructure, $[r_g/(1+\rho)] - 1$, net of any discounted period-two terms-of-trade loss, $G_2^*/(1+\rho)$. By comparing (20) and (21), it can be readily seen that with $\rho > \rho^*$, both countries will never find it in their interest to increase the amount of aid allocated to period-one consumption at the expense of infrastructure development for as long as the stock of infrastructure of the recipient country is not above the optimal level. That is to say, it cannot be the case that $(M^*C/S) > G_2^*/(1+\rho^*)$ and $(M^*C/S) < [G_2^*/(1+\rho)] + 1 - [r_g/(1+\rho)]$ as long as $r_g \geq (1+\rho)$. So while the recipient may wish to have less infrastructure development (as when such development results in immiserizing growth) or the donor may wish to have less aid allocated to infrastructure development (as when it entails a large terms-of-trade loss for the donor in period two), it can never be the case that both parties want a higher value of x when the stock of the recipient's infrastructure is below the efficient level. Should the donor want to reallocate aid in favour of immediate consumption at the expense of infrastructure development, the recipient will wish to move in the opposite direction.

It is, however, possible for both countries to prefer that more aid be allocated to infrastructure at the expense of period-one consumption of the recipient country. The donor wants a smaller x when $(M^*C/S) < G_2^*/(1+\rho^*)$. This is likely to be satisfied under the assumptions of our model as $(M^*C/S) < 0$ and there is strong possibility that $G_2^* > 0$. As we have seen earlier, $G_2^* > 0$, even if infrastructure expansion increases productivity uniformly across sectors in the recipient country.

The recipient prefers more infrastructure over immediate consumption when $(M^*C/S) + [r_g/(1+\rho)] - 1 > [G_2^*/(1+\rho)]$. Thus, for both countries to prefer a lower value of x , it must be the case that

$$(1+\rho)(M^*C/S) + r_g - (1+\rho) > G_2^* \text{ and} \quad (22)$$

$$G_2^* > (1+\rho^*)(M^*C/S) \quad (23)$$

When both inequalities are satisfied, then

$$r_g - (1+\rho) > -(\rho - \rho^*)(M^*C/S) \quad (24)$$

That is, if both countries are in favour of allocating more aid for infrastructure at the expense of current consumption of the recipient, the efficiency gain from an additional unit of infrastructure must be larger in magnitude than the resulting period-one terms-of-trade loss for the recipient country multiplied by the international real interest differential, $\rho - \rho^*$. The real interest differential reflects the weight of one distortion (inability of the recipient to borrow on the world market), while $r_g - (1+\rho)$ reflects the weight of the second distortion (inability of the recipient to attain the optimal stock of infrastructure). When both countries agree to favour infrastructure, then the second

distortion must dominate the first in the sense of inequality (24). By contrast, if inequality (23) is satisfied, so that the donor prefers to allocate a larger fraction of any given aid package for infrastructure, while inequality (22) is not satisfied, then the two countries disagree, with the recipient demanding that a larger fraction of aid be earmarked for immediate consumption. In practice, this kind of disagreement can manifest itself in the recipient's efforts to divert aid from one project to another and counter efforts on the part of the donor to reduce the scope for fungibility of any given aid package.

5 Concluding remarks

Different forms of aid have different consequences for the donor and the recipient. Accordingly, the two countries may either agree or disagree on what is the best way of utilizing any given amount of aid. When distortions are present, resources are missallocated and there is scope for efficiency improvements. This, however, may or may not leave room for finding ways of increasing the welfare of both the donor and the recipient by reallocating any given amount of aid among competing uses.

The focus of the present paper is on intertemporal missallocation of resources due to insufficient means of the recipient country to attain the efficient stock of infrastructure and its inability to achieve that objective through *intertemporal* trade. When the poor country cannot borrow, reallocation of aid from infrastructure projects to current consumption can potentially improve welfare as it serves as a substitute for international borrowing. It enables the recipient to enjoy higher consumption in the present at the expense of future consumption, both directly and due to an improvement in the period-one terms of trade. On the other hand, reallocation of aid from current consumption to infrastructure development can also contribute to an improvement in welfare by bringing the stock of infrastructure closer to the efficient level. What the analysis shows in the context of the present model, is that whenever the donor wants to reallocate aid in favour of current consumption, the recipient will want to reallocate aid in the opposite direction. Alternatively, when the donor wants to reallocate aid in favour of infrastructure, the recipient may or may not wish to move in the same direction. We were able to show that if both the donor and the recipient benefit from reallocation of aid from current consumption to infrastructure, the weight of the distortion associated with the suboptimal stock of infrastructure, $r_g - (1+\rho)$, exceeds the weight of distorted *intertemporal* trade. The latter is measured in the context of the present model by the product of the international real interest differential and income gain of the recipient from the period-one terms-of-trade improvement in response to the reallocation of aid in favour of immediate consumption.

References

- Brecher, Richard and Jagdish N. Bhagwati (1982) 'Immiserizing Transfers from Abroad', *Journal of International Economics*, 13: 353-64.
- Djajic, Slobodan, Sajal Lahiri, and Pascalis Raimondos-Moller (1998) 'The Transfer Problem and the Intertemporal Terms of Trade', *Canadian Journal of Economics*, 31: 427-36.
- Djajic, Slobodan, Sajal Lahiri, and Pascalis Raimondos-Moller (1999) 'Foreign Aid, Domestic Investment and Welfare', *Economic Journal*, 109: 698-707.
- Djajic, Slobodan, Sajal Lahiri, and Pascalis Raimondos-Moller (2004) 'Logic of Aid in an Intertemporal Setting', *Review of International Economics*, 12: 151-61.
- Feyziouglou, Tarhan, Vinay Swaroop, and Min Zhu (1998) 'A Panel Data Analysis of the Fungibility of Foreign Aid', *World Bank Economic Review*, 12: 29-58.
- Gang, Ira N. and Haider Ali Khan (1991) 'Foreign Aid, Taxes and Public Investment', *Journal of Development Economics*, 34: 355-69.
- Hatzipanayotou, Panos and Michael S. Michael (1995) 'Foreign Aid and Public Goods', *Journal of Development Economics*, 47: 455-67.
- Kemp, Murray C. (1992) 'The Static Welfare Economics of Foreign Aid: A Consolidation', in D. Savoie and I. Brecher (eds) *Equity and Efficiency in Economic Development: Essays in Honor of Benjamin Higgins*, Montreal: McGill-Queen's University Press, chapter 13.
- Kemp, Murray C. and Kenzo Abe (1994) 'The Transfer Problem in a Context of Public Goods', *Economic Letters*, 45: 223-26.
- Kemp, Murray C. and Shoichi Kojima (1985) 'Tied Aid and Paradoxes of Donor Enrichment and Recipient Impoverishment', *International Economic Review*, 26: 721-29.
- Kemp, Murray C. and Kar-yiu Wong (1993) 'Paradoxes Associated with the Administration of Foreign Aid', *Journal of Development Economics*, 42: 197-204.
- Khan, Haider Ali and Eiichi Hoshino (1992) 'Impact of Foreign Aid on Fiscal Behavior of LDC Governments', *World Development*, 20: 1481-88.
- Khilji Nasir and Ernest Zampelli (1991) 'The Fungibility of US Assistance to Developing Countries and the Impacts on Recipient Expenditures: A Case Study of Pakistan', *World Development*, 19: 1095-1106.
- Khilji Nasir and Ernest M. Zampelli (1994) 'The Fungibility of US Military and Nonmilitary Assistance and the Impact on Expenditures of Major Aid Recipients', *Journal of Development Economics*, 43: 345-62.
- Lahiri, Sajal and Pascalis Raimondos-Moller (1997) 'On the Tying of Aid to Tariff Reform', *Journal of Development Economics*, 54: 479-91.
- Lahiri, Sajal, Pascalis Raimondos-Moller, Kar-yiu Wong and Alan Woodland (2002) 'Optimal Foreign Aid and Tariffs', *Journal of Development Economics*, 67: 79-99.

- Michael S. Michael and Panos Hatzipanayotou (1996) 'Foreign Aid Tied to Public Inputs', *Keio Economic Studies*, 33: 35-45.
- Mavrotas, George (2005) 'Aid Heterogeneity: Looking at Aid Effectiveness from a Different Angle', *Journal of International Development*, 17: 1019-36.
- McGillivray, Mark (2000) 'Aid and Public Sector Fiscal Behavior', *Review of Development Economics*, 4: 156-63.
- Nurkse, Ragnar (1967) *Problems of Capital Formation in Underdeveloped Countries*, Oxford: Basil Blackwell.
- Pack, Howard and Janet R. Pack (1990) 'Is Foreign Aid Fungible? The Case of Indonesia', *Economic Journal*, 100:188-94.
- Pack, Howard and Janet R. Pack (1993) 'Foreign Aid and the Question of Fungibility', *Review of Economics and Statistics*, 75: 258-65.
- Papanek, Gustav F. (1973) 'Aid, Foreign Private Investment, Savings and Growth in Less Developed Countries', *Journal of Political Economy*, 81: 120-30.
- Schweinberger, Alfred (1990) 'On the Welfare Effects of Tied Aid', *International Economic Review*, 31: 457-62.
- Schweinberger, Alfred (2002) 'Foreign Aid, Tariffs and Nontraded Private and Public Goods', *Journal of Development Economics*, 69: 255-75.