Tied to Capital or Untied Foreign Aid?

Michael S. Michael and Charles van Marrewijk*

Abstract

A two-country trade model of foreign aid is developed. The aid-receiving country suffers from Harris–Todaro type unemployment. Aid is either untied, tied to sector-specific capital, or tied to intersectorally mobile capital. These types of aid are compared by examining their terms-of-trade and welfare effects to show that (i) welfare paradoxes are possible, (ii) the world as a whole may gain from aid, (iii) a conflict of interest concerning the type of aid may arise between donor and recipient, and (iv) under plausible conditions untied aid is better for the recipient and the world.

1. Introduction

There exists a large body of international trade literature on the welfare and terms-of-trade effects of unilateral transfers of income. It has long been demonstrated that in a two-country, perfectly competitive, Walras-stable and distortion-free world, foreign aid does not create any paradoxical welfare effects; i.e., donor-enrichment or recipient-impoverishment is not possible. Welfare paradoxes, however, can arise in a two-country, three-agent model (Chichilnisky, 1983), in three-country models (Bhagwati et al., 1983), and in the presence of exogenous or endogenous distortions (Brecher and Bhagwati, 1982).

In recent years, following international practice, the focus of international trade literature on foreign aid has shifted to wholly or partially tied aid. Early writings on tied aid include the work of Kemp and Kojima (1985) and Schweinberger (1990) that examine the welfare effects of foreign aid tied to final goods. Recently, Hatzipanayotou and Michael (1995) examined the welfare effects of foreign aid tied to the provision of public good in the receiving country. Lahiri and Raimondos (1995) examined the welfare effects of tied aid in the presence of quantitative trade restrictions, where aid is tied to the rationed good. Finally, Brakman and van Marrewijk (1995) examined the welfare effects of aid tied to final goods in a model with increasing returns to scale and monopolistic competition.

None of the studies above, however, examines aid tied to capital transfers. Empirical evidence shows that a number of developed countries give aid in the form of specific physical or human capital (Japan gives tractors to Indonesia, The Netherlands sends nurses to Tanzania, etc.) or transfers funds to be used by the recipient country for capital creation (e.g., the European Union (EU) signs financial protocols with Mediterranean and other countries under which the EU, through the European Investment Bank, transfers funds to be used primarily for investment purposes).

We examine the welfare and terms-of-trade effects of aid tied to capital transfers in a two-country general-equilibrium trade model, where capital is either sector-specific or intersectorally mobile. We consider two scenarios for the economy of the aid-receiving developing country: either it has full employment, or unemployment of the

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* Michael: University of Cyprus, PO Box 537, CY1678, Nicosia, Cyprus. Fax: 357-2758099, Email: ecmich@zeus.cc.ucy.ac.cy. Marrewijk: Erasmus University, 3000 DR Rotterdam, The Netherlands. Fax: 31-104525808, Email: vannarrewijk@few.eur.nl. The authors acknowledge the constructive comments by Jan Willem Gunning, Itzhak Zilcha, and Panos Hatzipanayotou on an earlier version of this paper.
Harris–Todaro type. For simplicity, the developed donor country is free of distortions. Within this framework, we analyse sequentially: (i) the effects of untied aid, (ii) the effects of aid tied to intersectorally mobile capital, (iii) the effects of aid tied to sector-specific agricultural capital, (iv) the effects of aid tied to sector-specific manufacturing capital, and (v) the preference, if any, of the donor, the recipient and the world for a particular type of aid. We show, *inter alia*, that welfare paradoxes are possible, that the world as a whole may gain from tied or untied aid.

2. The Model

We model the international transfer problem in two steps. First, we describe briefly the workings of the developing country’s economy in the unemployment case. The full-employment case emerges as a special case of the unemployment case. This description of the unemployment case is based on the well-known Harris–Todaro model and will not be further argued. Second, the developing country’s economy will be submerged in a benchmark description of the world economy based on duality theory to facilitate the analysis of tied and untied aid. To streamline the presentation of our results we make some elementary assumptions. There are two final goods produced under constant returns to scale: manufactures and a basic commodity, called agriculture, which serves as *numéraire*. These are identified below using superscripts “m” and “a”. The production functions in the two countries are assumed the same. The developing country, the recipient of international transfers or tied aid, exports agricultural products, which serves as *numéraire*. Subscripts of functions denote partial derivatives. In the sequel we will use on occasion the following assumption.

**Assumption 1.** Both goods are normal goods for both countries. The donor country’s marginal propensity to consume manufactures is greater than the recipient’s marginal propensity to consume manufactures.

*The Developing Economy*

The Harris–Todaro (1970) model of the developing economy distinguishes between a rural sector, producing “agricultural” products, and an urban sector, producing manufactures. The model’s equations are

\[
\begin{align*}
    w^a &= A_a(K^a, L^a), \\
    \bar{w}^m &= p M_L(K^m, L^m), \\
    r^a &= A_K(K^a, L^a), \\
    r^m &= p M_K(K^m, L^m), \\
    w^a &= L^a w^m \left( \frac{L^a}{L^m} \right) \equiv \gamma w^m, 
\end{align*}
\]

where \(X\) is production in sector \(j\) (for \(j = a, m\)), \(w^j\) is the wage rate in sector \(j\), \(r^j\) is the rental rate in sector \(j\), \(K^j\) is capital in sector \(j\), \(L^j\) is employment in sector \(j\), \(p\) is the relative price of manufactures, and \(\gamma\) is the probability of finding a job in the manufacturing sector. The production function in each sector is concave and homogenous of degree one in \(K\) and \(L\).
Equations (1)–(4) indicate that production in the agricultural and manufacturing sectors is perfectly competitive such that the payment to inputs equals their marginal revenue products. Workers are lured from the rural area into the city because of higher real wages there. The combination of a high fixed wage in the manufacturing industry and the equalization of the expected wage income in the agricultural sector and the manufacturing sector by laborers, equation (5), results in unemployment equal to the fixed supply of labour \( L \) minus employment in the agricultural and manufacturing sectors. Throughout the analysis we assume that the fixed wage in the manufacturing sector is high enough to result in unemployment in the developing country.

The economics underlying the Harris–Todaro model is well-known, so in this subsection we restrict ourselves to simply listing the main results. The most important changes in endogenous variables as a result of changes in exogenous variables is summarized in Table 1.

If capital is sector-specific (Khan, 1982), an increase of sector-specific capital at constant prices increases employment in that sector, reduces or keeps constant employment in the other sector, and increases the agricultural wage rate. An increase of the price of manufactures at constant levels of sector-specific capital increases employment in the manufacturing industry, reduces employment in agriculture, and also drives up the agricultural wage rate.

If capital is intersectorally mobile, the rental rates are the same in the two sectors, and stability is ensured if, and only if, \( \gamma K^m/L^m > K^a/L^a \) (i.e., the urban sector is relatively capital-intensive), which we henceforth assume (Neary, 1981). Under this condition an increase in capital, at constant prices, increases employment in the capital-intensive manufacturing industry, reduces employment in the labor-intensive agricultural industry (Rybczynski effect), and does not affect the agricultural wage rate. An increase in the price of manufactures, at constant capital stock, leads to similar employment effects, but reduces the wage rate in the agricultural sector (Stolper–Samuelson effect).

The World Economy

Consider an open economy with many individuals with identical preferences, and where the economic structure of the developing home country is of the Harris–Todaro type presented earlier. The home country receives a transfer or aid from a developed country, identified by an asterisk, which produces both agricultural goods and manufactures and is free of domestic distortions. The equilibrium of the world economy is characterized by the following equations:

\[
E(p,u) = R[p, K^a(K^m, p), L^m(K^m, p), K^a, K^m] + T, \tag{6}
\]

<table>
<thead>
<tr>
<th>Table 1. Impact of Changes</th>
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<tr>
<td>Sector-specific capital</td>
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<td>( K^a )</td>
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\[ E^*(p, u^*) = R^*[p, K^a, K^m] - T, \] (7)

\[ Z_p[p, u, L^a(K^a, K^m, p), L^m(K^m, p), K^a, K^m] + Z_p^*(p, u^*, K^a^*, K^m^*) = 0, \] (8)

where \( E \) (\( R \)) is the developing country’s expenditure (revenue) function, \( u \) denotes its welfare level, and \( Z \equiv E - R \). The term \( T \) denotes an international transfer of untied aid from the foreign (donor) to the home (recipient) country financed through lump-sum taxes. The home country’s Harris–Todaro type economic structure results in the indirect dependence of sectoral employment on the levels of sector-specific capital and the price of manufactures, as represented in the revenue function. Equations (6) and (7) are the budget constraints in the home and foreign country, respectively. Since there are only two traded final goods, Walras’s Law implies that the world goods market equilibrium is characterized by equation (8), where \( Z_p = E_p - R_p > 0 \) is the home country’s import of manufactures and \( Z_p^* = E_p^* - R_p^* < 0 \) is the donor’s export of manufactures.

We model tied aid in a specific way, namely through the transfer of (sector-specific) capital goods from the donor to the recipient. This represents, for example, the donation by Japan of Japanese tractors to the agricultural industry in Indonesia. Equation (9) represents this tied aid in the form of a donation of capital goods. Equations (10) and (11) define the terms \( \lambda_s \) and \( \eta_s \) for notational convenience. The signs of these terms under various circumstances are given in Table 1, where it should be noted that, using equation (5), the sign of \( \lambda_s \) (\( \eta_s \)) is the same as the sign of \( w^s \) (\( L^m \)) and represents an increase in labour income (indirect supply effect) as a result of a change in the variable \( s \).

\[ dK^j = -dK^{j*}; j = a,m \] (9)

\[ \lambda_s = \sum_j w^j L^j (L - L^a) w_s^j; \quad s = p, K^a, K^m; \quad j = a, m \] (10)

\[ \eta_s = R^m p L^m; s = p, K^a, K^m \] (11)

Equations (6)–(8) simultaneously determine the world market equilibrium price of manufactures \( p \) and the home and foreign country’s welfare levels \( u \) and \( u^* \), respectively. Totally differentiating (6)–(8), defining the change in world excess demand for manufactures due to a change in its relative price \( S_{pp} \equiv Z^p + Z_{pp}^* < 0 \), using the properties of the expenditure and revenue functions and the definitions in (9)–(11), yields the following system of equations:

\[
\begin{bmatrix}
Z_p - \lambda_p & 1 & 0 \\
Z_p^* & 0 & 1 \\
S_{pp} - \eta_p & Z_{pu}^* & Z_{pu}^* \\
\end{bmatrix}
\begin{bmatrix}
dp \\
du \\
du^* \\
\end{bmatrix}
= \sum_{j=a,m} \begin{bmatrix}
r^j + \lambda_K \\
-r^{j*} \\
\eta_K + R_{pK}^j - R_{pK^j}^* \\
\end{bmatrix}
+ \frac{1}{\Delta}
\begin{bmatrix}
dK^j \\
-1 \\
0 \\
\end{bmatrix}dT,
\] (12)

where \( E_u = E^*_u = 1 \), and with \( \det = S_{pp} - Z_{pu}Z_{pu}^* - Z_{pp}^* - \eta_p + \lambda_p Z_{pu} \equiv (1/\Delta) < 0 \).

If the world market for manufactures is Walras-stable, the determinant \( (1/\Delta) \) of the coefficient matrix on the left-hand side of equation (12) is negative. The sequel of the paper will use system (12) and the results in Table 1 to discuss the various effects of tied and untied aid if the recipient is suffering from unemployment of the Harris–Todaro type. By setting \( \lambda_p, \eta_{kj} \) and \( \eta_p \) all equal to zero in equation (12), we obtain the terms-of-trade and welfare effects of the transfer in the case where full employment prevails in the aid-receiving developing country.
3. Untied Aid

Suppose the donor gives untied aid to the recipient country financed through lump-sum taxes. This translates to \( dT > 0 \) and \( dK_j = 0 \) for \( j = a, m \) in system (12). Solving this system gives

\[
\left(\frac{dp}{dT}\right) = \left(Z_{pu}^* - Z_{pu}\right) \Delta. \tag{13}
\]

\[
\left(\frac{du}{dT}\right) = 1 - \left(Z_p - \lambda_p\right) \left(\frac{dp}{dT}\right) = \left(S_{pp} - \eta_p + \lambda_p Z_{pu}^*\right) \Delta, \tag{14}
\]

\[
\left(\frac{du^*}{dT}\right) = -1 - Z_p^* \left(\frac{dp}{dT}\right) = \left(-S_{pp} + \eta_p - \lambda_p Z_{pu}^*\right) \Delta, \tag{15}
\]

\[
\left(\frac{du}{dT}\right) + \left(\frac{du^*}{dT}\right) = \lambda_p \left(\frac{dp}{dT}\right) = \lambda_p \left(Z_{pu}^* - Z_{pu}\right) \Delta. \tag{16}
\]

In a distortion-free and Walras-stable two-country world, three results with respect to untied aid are well-known from the literature: (i) untied aid does not lead to welfare paradoxes, i.e., donor-enrichment and/or recipient-impoverishment, (ii) world welfare does not change, and (iii) the donor’s terms-of-trade deteriorate if, and only if, the recipient’s marginal propensity to consume the donor’s export good is lower than the donor’s marginal propensity to consume this good. Equation (13) shows that result (iii) on the donor’s terms-of-trade still holds in this framework that allows for Harris–Todaro type unemployment in the recipient country. Equation (16) shows that result (ii), i.e., world welfare is unaffected, definitely does not hold in this framework. Finally, equations (14) and (15) indicate that the welfare effects for the donor and recipient country of untied aid, and therefore the answer to result (i) on the absence of welfare paradoxes, depend on the response of labor income to a rise in the price of manufactures \( (\lambda_p) \) and on the (positive) supply response of manufactures through a change in employment as a result of this price rise \( (\eta_p > 0) \). The labor income response to a price change, in turn, depends on whether or not capital is intersectorally mobile, as discussed below. Note that the basic influence of Harris–Todaro type unemployment for the recipient’s welfare is manifested in an additional influence of a change in the terms-of-trade, namely on labor income, that is \( (du/dT) = 1 - (Z_p - \lambda_p) (dp/dT) \) rather than the standard \( (du/dT) = 1 - Z_p (dp/dT) \) in the full-employment case.

**Capital Mobility (Long-Run)**

If capital is intersectorally mobile, which we interpret as a long-run situation in this section, an increase in the relative price of manufactures decreases labor income through a Stolper–Samuelson effect; that is \( \lambda_p \) is negative. Combining this with \( \eta_p > 0 \) and \( S_{pp} < 0 \) in equations (14) and (15) reveals an unambiguous welfare decline for the donor and a welfare increase for the recipient. Thus, result (i) mentioned above on the absence of transfer paradoxes holds even under Harris–Todaro type unemployment, if capital is intersectorally mobile. World welfare increases if, and only if, the marginal propensity to consume manufactures is higher for the donor than for the recipient. Intuitively, if a transfer of income reduces the price of manufactures, this leads to a Stolper–Samuelson effect which raises labor income for the recipient and results in a positive effect on world welfare.

**Sector-Specific Capital (Short-Run)**

If capital is sector-specific, an increase in the price of manufactures draws laborers out of the agricultural sector into the manufacturing sector. The reduction in agricultural
employment combined with a constant stock of sector-specific capital increases the agricultural wage rate; that is \( \lambda_p \) is positive. Recall that this term is negative if capital is intersectorally mobile (see earlier). From equation (16) it is clear that world welfare now falls, rather than increases, if the price of manufactures falls. Thus, under Assumption 1 it appears that untied aid decreases world welfare in the short run, but increases world welfare in the long run. With sector-specific capital the donor’s welfare will decline under Assumption 1, but might increase if the price of manufactures rises, and in particular if the wage response in the recipient’s agricultural sector following a price rise of manufactures is large. Thus, transfer paradoxes are possible if capital is sector-specific. Even under Assumption 1, recipient-impoverishment is possible in the short run since a change in the terms-of-trade can either hurt or benefit the recipient, depending on the sign of \( Z_p - \lambda_p \) (see equation (14)). Intuitively, as the price of manufactures falls the recipient’s labor income declines, an effect which can outweigh the positive direct terms-of-trade effect.

In the full-employment case, by setting \( \eta_p \) and \( \lambda_p \) equal to zero, we obtain the well-known traditional results. Our results so far are summarized in Proposition 1.

**Proposition 1.** If capital is intersectorally mobile, untied aid increases the recipient’s welfare and reduces the donor’s welfare. Under Assumption 1 and capital mobility, the price of manufactures falls and world welfare increases. Under Assumption 1 and sector-specific capital, the price of manufactures, the donor’s welfare and world welfare will fall while recipient-impoverishment is possible.

### 4. Transfer of Intersectorally Mobile Capital

The donor country gives tied aid by transferring capital that is intersectorally mobile. That is, it gives money to be used by the recipient country for investment in any sector. Solving equations (12) and noting that a transfer of capital, at constant prices, does not affect wage income (\( \lambda_K = 0 \)), gives

\[
\frac{dp}{dK} = \left[ r^* Z^*_p - r Z_p \right] + \left( R^*_p K_p - R^*_p K + \eta_p \right) \Delta, \quad \text{or} \quad (17a)
\]

\[
\frac{pdp}{dK} = \left[ r^* \left( e^{m*} - e^*_p \right) - r (e^m - e^*_p) \right] \Delta, \quad (17b)
\]

\[
\frac{du}{dK} = r - \left( Z_p - \lambda_p \right) \left( \frac{dp}{dK} \right) = \left\{ p \left( S_{pp} - \eta_p \right) \right\} r^* - \frac{e^{m*}}{p} \left[ Z_p (r - r^*) + r^* \lambda_p \right] \\
Z_p (r - r^*) \Delta / p, \quad (18)
\]

\[
\frac{du^*}{dK} = -r^* Z^*_p \left( \frac{dp}{dK} \right) = \left\{ - p \left( S_{pp} - \eta_p \right) \right\} r^* - \frac{e^{m*}}{p} \left[ Z_p (r - r^*) + r^* \lambda_p \right] \\
+ Z_p^* \left( r^* e^*_p - r e^*_p \right) \Delta / p, \quad (19)
\]

\[
\frac{du}{dK} + \left( \frac{du^*}{dK} \right) = (r - r^*) + \lambda_p \left( \frac{dp}{dK} \right) = \left\{ p \left( S_{pp} - \eta_p \right) \right\} (r - r^*) \\
+ \left( e^m - e^{m*} \right) \left[ Z_p (r - r^*) - r^* \lambda_p \right] - \lambda_p \left( r^* e^*_p - r e^*_p \right) \Delta / p, \quad (20)
\]

where \( e^m (e^{m*}) \) is the marginal propensity to consume manufactures in the recipient (donor) country. Let \( R[p, L^s(K, p), L^m(K, p), K] = G(p, K) \); then \( G^p_K = r_p \) and \( e^*_p = \frac{\partial r}{\partial p} \). Thus, \( e^*_p \) and \( e^*_p \) are the elasticities of the rental rate with respect to the price of the manufactured good in the recipient and donor country, and each one is...
greater than one (Stolper–Samuelson, magnification effect). Note that we assume that the manufacturing sector is capital-intensive as this is required for stability in the developing country (see section 2). When full employment exists, using equations (1)–(4), where now the rental rates and the wage rates are the same in the two sectors, we can show that \( e_{rp} = \frac{\kappa_m + (w/r)}{(\kappa^m - \kappa^c)} \) where \( \kappa_j \) is the capital/labor ratio in sector \( j \). We expect \( \kappa^m > \kappa^c \) and \( (w/r) \) to be higher in the capital-rich donor country. Thus, if \( \kappa^m - \kappa^c \) is approximately equal to \( \kappa^m - \kappa^c^* \), then we expect that \( e_{rp}^* > e_{rp} \). In the case with unemployment, it can be shown that the elasticity is smaller compared with the full-employment case, if everything else is the same.\(^6\) Thus, it is expected that \( e_{rp} \) is smaller than \( e_{rp}^* \). It is important to keep in mind that \( \eta_K \) and \( \eta_p \) are positive, while \( \lambda_p \) is negative if capital is intersectorally mobile.

Terms-of-Trade Effect

A transfer of intersectorally mobile capital has both income (i.e., demand) and supply effects for the terms-of-trade. A transfer of one unit of capital reduces the donor’s income by \( r^* \), while increasing the recipient’s income by the marginal revenue product of capital (\( r \)). Thus, equation (17a) indicates that the recipient’s increase in income increases world demand for manufactures by \( rZ_{pu} \), while the donor’s reduction in income reduces world demand for manufactures by \( r^*Z_{pu}^* \). If the first effect dominates (is smaller than) the second effect, the world demand for manufactures will rise (fall).

The transfer of intersectorally mobile capital also affects the supply of manufactures. For the recipient, supply increases directly by \( R_{pk} \) and indirectly, through the increase in manufacturing employment, by \( \eta_p \). Note that \( R_{pk} + \eta_p = G_{pk} \). For the donor, supply is reduced by \( R_{pk}^* \). The total effect on world supply is generally unknown, but the discussion of the previous section reveals that under plausible conditions it is expected that \( e_{rp} \) is smaller than \( e_{rp}^* \), and thus it is expected that world supply will be reduced.

The total effect on world excess demand is generally uncertain. The world price of the manufactured good increases and the donor’s terms of trade improve if the marginal propensities to consume the two goods and the rental rates are the same in both countries.

Welfare Effects

As equation (18) shows, a transfer of one unit of capital increases the recipient’s welfare by \( r \). The recipient’s welfare is also affected by changes in its terms of trade. If its terms of trade deteriorate, then it is possible that its welfare will be reduced as a result of the transfer.

Equation (19) shows that the donor’s welfare is reduced directly as a result of the transfer and it is also affected by changes in its terms of trade. If its terms of trade improve, then it is likely that the total effect of its welfare as a result of the transfer to be positive.

The effect of the transfer on world welfare is again unknown. World welfare increases if the rental rate is higher in the recipient country and if the recipient country’s terms of trade improve. Intuitively, the fall in the price of manufactures raises the recipient’s labor income (see equation (20)). If the price of the manufactures rises, then the effect on world welfare is uncertain. Note that if the rental rates and the marginal propensities to consume in the two countries are the same, then the donor country’s terms of trade improve and world welfare is reduced as a result of the transfer.
5. Transfer of Sector-Specific Capital

Suppose that the donor gives tied aid to the recipient country, through the transfer of sector-specific agricultural capital goods (e.g., the donation of tractors, shovels or sorting machinery), or through the transfer of sector-specific manufacturing capital goods (e.g., the donation of steel mill equipment, forklift trucks or packing machinery). This translates to \(dT = dK^a = 0\) and \(dK^m > 0\) in system (12) when the donor transfers capital specific in manufacturing, and to \(dT = dK^m = 0\) and \(dK^a > 0\) when it transfers capital specific in agriculture. Solving equations (12) gives

\[
\begin{align*}
(dp/dK^j) &= \left[ r^j*Z_{pu} - \left( r^j + \lambda^j_K \right)Z_{pu} + \left( R^*_{pK} + \eta^j_K \right) - R^*_{pK} \right] \Delta, \\
(pdK/dK^j) &= \left[ r^m* \left( e^m* - e_{r,p}^m \right) - r^j \left( e^m - e_{r,p}^m \right) - \eta^j_K \lambda^j_K \right] \Delta, \\
(du/dK^j) &= \left( r^j + \lambda^j_K \right) - \left( Z_p - \eta^j_K \right) \left( dp/dK^j \right) = \left\{ p(S_{pp} - \eta^j_K) \right\} \left( r^j + \lambda^j_K \right) \\
&\quad + \left[ Z_p \left( r^j - r^j* + \lambda^j_K \right) + r^j* \lambda^j_p \right] + \left( Z_p - \eta^j_K \right) \left( r^j* e_{r,p}^j - r^j e_{r,p}^j \right) \Delta/p, \\
(du^* / dK^j) &= -r^j* - Z_p \left( dp/dK^j \right) = \left\{ -p(S_{pp} - \eta^j_K) \right\} r^j* \\
&\quad - \eta^j_K \left[ Z_p \left( r^j - r^j* + \lambda^j_K \right) - r^j* \lambda^j_p \right] - \left( Z_p - \eta^j_K \right) \left( r^j* e_{r,p}^j - r^j e_{r,p}^j \right) \Delta/p, \\
(du^*/dK^j) + (du^*/dK^j) &= \left( r^j - r^j* + \lambda^j_K \right) + \lambda^j_p \left( dp/dT \right) = \left\{ p(S_{pp} - \eta^j_K) \right\} \\
&\quad \left( r^j - r^j* + \lambda^j_K \right) + \left( e^m - e^m* \right) \left[ Z_p \left( r^j* - r^j \right) - \lambda^j_K \right] - r^j* \lambda^j_p \right] \\
&\quad - \lambda^j_p \left( r^j* e_{r,p}^j - r^j e_{r,p}^j \right) \Delta/p,
\end{align*}
\]

where \(e_{r,j}(\eta^j_K)\) is the elasticity of the rental rate in the jth sector (\(j = a, m\)) with respect to \(p\) in the recipient (donor) country.

Let \(H(p, K^a, K^m) = R(p, L^a(K^a, K^m, p), L^m(K^m, p), K^a, K^m)\). Then \(H_{pK} = r^j_p + e_{r,p}^j = (\partial r^j_p / \partial p)\). Note also that \(R^*_{pK} = r^j*_{pK} + e_{r,p}^j = (\partial r^j*_{pK} / \partial p)\). For the discussion below it is important to keep in mind that \(\lambda^j_p, \lambda^j_K, \text{ and } \eta^j_K\) are all positive if capital is sector-specific.

Transfer of Capital Specific in Agriculture

First, consider the case where the donor transfers capital specific in agriculture. The terms-of-trade and welfare effects of the transfer are given by equations (21)–(24), where now \(j = a\). When unemployment exists in the recipient country, the transfer of capital specific in agriculture does not affect the production of the manufactured good (i.e., \(e_{r,j} = 0\), \(R^*_{pK} = 0\)). Note also that \(R^*_{pK} = r^j*_{pK} + e_{r,p}^j = (\partial r^j*_{pK} / \partial p)\). Since full employment exists in the donor country, the elasticity \(e_{r,p}^j\) is negative. In the case where full employment exists in the recipient country, \(e_{r,p}^j\) is also negative.

Terms-of-trade effects A transfer of one unit of capital specific in agriculture reduces the donor’s income by \(r^j*_{pK}\), while increasing the recipient’s income directly by the marginal revenue product of capital \((r^j)\) and indirectly through the increase in employment in the agricultural sector and concomitant increase in labor income \((\lambda^j_K)\). Thus,
equation (21a) indicates that the recipient’s increase in income increases world demand for manufactures by \((r^a + \lambda K^a)Z_{pu}\), while the donor’s reduction in income reduces world demand for manufactures by \(r^{a*}Z_{pu}^*\). If the first effect dominates the second effect, the world demand for manufactures will rise. One expects the return to capital in the developed, aid-donating country (with high capital–labor ratio) not to be greater than the return to capital in the developing, aid-receiving country (with low capital–labor ratio) such that the world demand for manufactures will likely rise, unless the marginal propensity to consume manufactures is much lower for the recipient than for the donor country.

The transfer of capital sector-specific in agriculture does not affect the production of manufactures in the recipient country (see Table 1), but increases their production in the donor country. Intuitively, the transfer of capital specific in agriculture reduces the marginal revenue product of labor in this sector in the donor country, causing labor flows into the manufacturing sector, until the marginal revenue product of labor is equal in both sectors, and thus the production of manufactures is increased. Thus, world supply of manufactures increases.

The effect of a transfer of capital specific in agriculture on world excess demand is generally uncertain. Under Assumption 1, world excess supply of manufactures is expected to increase and its price to decrease if the returns to capital in agriculture in both countries are equal, and the increase in labor income is small.

**Welfare effects** As equation (22) shows, a transfer of one unit of capital specific in agriculture increases the recipient’s welfare directly by \(r^a\) and indirectly by increasing employment and labor income by \(\lambda K^a\). The recipient’s welfare is also affected by changes in its terms of trade. As explained above, a transfer of capital specific in agriculture has an uncertain effect on its terms of trade, and is likely to improve. Even if the recipient’s terms of trade deteriorate, the detrimental effect on welfare of this deterioration as a result of more expensive imports is softened, or even dominated, by the positive welfare effect of a rise in labor income resulting from a rise in the price of manufactures. It is possible, however, for the terms-of-trade deterioration to cause its welfare to decrease as a result of the transfer.

A transfer of one unit of specific capital in agriculture reduces the donor’s income by the marginal revenue product of capital \(r^{a*}\) and affects the donor’s terms of trade. If the latter deteriorate, the donor’s welfare decreases (see equation (23)). However, if the donor’s terms of trade improve as a result of the transfer of capital specific in agriculture, then it is possible that this positive terms-of-trade effect outweighs the direct negative income effect such that the donor’s welfare may actually increase as a result of the transfer.

Equation (24) shows that world welfare is likely to improve in the absence of price changes. A sufficient, but not necessary, condition is the plausible assumption that the return to capital is at least as high in the developing receiving country as in the developed donating country. Including price changes, world welfare improves under this condition if the donor’s terms of trade improve. A close examination of equation (24) reveals that sufficient conditions for world welfare to improve are (i) the return to capital in the recipient country is equal or greater than the return to capital in the donor country, and (ii) the marginal propensity to consume the manufactured good in the recipient is equal or greater than the marginal propensity to consume the same good in the donor, and (iii) the increase in the labor income in the recipient country is quite small. Consequently, welfare improvement in both countries as a result of the transfer of sector-specific capital goods in agriculture is possible.
Transfer of Sector-Specific Manufacturing Capital

The terms-of-trade and welfare effects when the donor gives tied aid to the recipient through the transfer of sector-specific manufacturing capital goods (e.g., the donation of steel mill equipment, forklift trucks or packing machinery) is given by equations (21)–(24), where now \( j = m \). For the discussion below it is important to keep in mind that \( \lambda_p, \lambda_K^m, \) and \( \eta_K^m \) are all positive if capital is sector-specific.

In the unemployment case, using equations (1)–(5), it can be shown that \( e_{m,p} = 1 + (w^m/r^m\kappa^m) \), where \( \kappa^m \) is the capital/labor ratio in the manufacturing sector. Thus, in the unemployment case \( e_{m,p} \) is positive and greater than one. When unemployment exists as in the present model, the elasticity is greater than in the case where full employment exists, assuming everything else is the same.

Terms-of-trade effect  A transfer of capital specific in the manufacturing sector has both income (i.e., demand) and supply effects for the terms of trade. The demand effects are similar to those described in an earlier subsection, such that world demand increases by \( (r^m + \lambda_K^m)Z_{pu} \), and decreases by \( r^mZ_{pu}^* \). Thus, world demand for manufactures is again expected to increase, provided the marginal propensity to consume manufactures is not much higher for the donor than for the recipient.

The transfer of sector-specific manufacturing capital also affects the supply of manufactures. For the recipient, supply increases directly by \( R_pK^m \), and indirectly, through the increase in manufacturing employment, by \( \eta_K^m \). Note that \( R_pK^m + \eta_K^m = G_pK^m \). For the donor, supply is reduced by \( R^*_pK^m \). The discussion of the previous subsection shows that it is likely that \( e_{m,p} \) is larger than \( e^*_m \), and thus it is expected that the world supply of manufactures increases as a result of the transfer.

The increased supply of manufactures tends to reduce its price, while the likely increase in demand tends to increase the price of manufactures. The total effect on world excess demand and world price is generally uncertain.

Welfare effects From equation (22), and analogous to before, it follows that the transfer of a unit of capital specific in manufacturing increases the recipient’s welfare directly by the marginal revenue product of capital \( (r^m) \) and indirectly by increasing labor income \( (\lambda_K^m) \). If the recipient’s terms of trade improve (a fall in \( p \)), this improvement reduces the cost of the recipient’s imports, but simultaneously also reduces labor income. Thus, the effect on welfare of the improvement in the recipient’s terms of trade is ambiguous. Similarly, if its terms of trade deteriorate, this deterioration has an uncertain effect on its welfare. The donor’s welfare is reduced directly by the rental rate of capital and, indirectly decreases (increases) if its terms of trade deteriorate (improve). Finally the transfer of a unit of capital has a direct positive effect on world welfare, if \( r \) is greater than \( r^* \), from the higher productivity of capital and the rise in labor income, but an indirect ambiguous effect from the change in the price of manufactures which changes labor income for the recipient country. Thus, the total effect of the transfer of capital specific in manufacturing on world welfare is ambiguous.

6. Full Employment in the Developing Country

Next we consider the case where we have two identical developing countries. The only difference is that one country has full employment and the other has unemployment. Then, we compare the terms-of-trade and welfare effects of tied aid from the developed country with full employment to either the recipient developing country with unemployment, or to an identical recipient developing country with full employment.
The terms-of-trade and welfare effects of a transfer of capital when full employment exists in both the recipient and the donor country can be obtained from the system of equations (12) when the terms $\lambda_{kj}$, $\eta_{kj}$, $\lambda_{p}$, and $\eta_{p}$ are all zero.

**Transfer of Intersectorally Mobile Capital**

The terms-of-trade effects of the transfer of intersectorally mobile capital is given by equation (17a) or (17b). The terms in brackets for the unemployment and full-employment cases are the same. When full employment exists, however, the supply elasticity in the recipient country is greater than in the unemployment case. The absolute value of $\Delta$ is greater when full employment exists. Thus, assuming everything else is the same, the transfer of intersectorally mobile capital increases more the supply of the manufactured good in the recipient country, and thus is more likely to improve its terms of trade compared with the case where unemployment exists. Since the recipient country’s terms of trade are more likely to improve in the full-employment case, its welfare is more likely to improve with the transfer, compared with the unemployment case, while the welfare of the donor is more likely to get worse. Thus, if the donor country wants to give aid that is more likely to improve the recipient’s welfare, it will give aid to the country with full employment. If, however, it wants to give aid that is less likely to decrease its welfare, it will give aid to a country with unemployment.

When $r = r^*$, world welfare is not affected in the full-employment case, while it is reduced in the unemployment case if $e_m^* \geq e_m^*$.

**Transfer of Capital Specific in Agriculture**

The terms-of-trade effect of a transfer of capital specific in agriculture is given by equation (21a) or (21b). Compared with the unemployment case, the terms in the brackets show that there is an additional supply effect in the recipient country. That is, the transfer of capital specific in agriculture decreases the supply of the manufactured good in the recipient country, while the increase in demand due to the increase in labor income is absent. Comparing the effect of the transfer in the full-employment case with the unemployment case, we see that in the former case there is an additional term that decreases the supply of the manufactured good (positive effect on $p$), while in the latter case there is an additional term that increases its demand (positive effect on $p$). We cannot determine, therefore, if the value of $\Delta$ is greater or smaller compared with the unemployment case. Thus, we cannot tell if the terms of trade of the recipient country are more or less likely to improve in the full-employment case compared with the unemployment case.

The effect of the transfer of capital specific in agriculture on the recipient country’s welfare is given by equation (22), where in the present full-employment case $\lambda_{ka}$, $\eta_{p}$, and $\lambda_{p}$ are all zero. Assuming that the terms-of-trade effect is the same in both the unemployment and the full-employment cases, and that the terms of trade of the recipient country get worse as a result of the transfer, the welfare effect of the transfer for the recipient is greater (larger positive, or smaller negative) in the unemployment case compared with the full-employment case. When the recipient country’s terms of trade improve its welfare definitely improves, but we cannot tell, however, if the increase is greater compared with the unemployment case.

Equation (24) shows that when $r = r^*$, world welfare is not affected in the full-employment case while there is an uncertain effect in the unemployment case even if $e_m^* \geq e_m^*$. 

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Transfer of Capital Specific in Manufacturing

The terms-of-trade effect of the transfer of capital specific in manufacturing is given by equation (21a) or (21b), where now the term $\lambda_{km} = 0$. Compared with the unemployment case, now the effect of the increase in labor income is absent, and thus the demand for the manufacturing good is lower (negative effect on $p$). On the other hand, the supply effect in the recipient country is smaller in the full-employment case compared with the unemployment case (see earlier; positive effect on $p$). Thus, again we cannot tell whether or not it is more or less likely for the terms of trade of the recipient country to improve in the full-employment case compared with the unemployment case.

The welfare effect of the transfer of capital specific in manufacturing for the recipient country is given by equation (22), where in the present full-employment case $\lambda_{km}$ and $\lambda_p$ are both zero. The conditions under which the welfare of the recipient country increases more or less are exactly the same as in the case of the transfer of capital specific in agriculture.

7. Tied or Untied Aid?

The Case with Unemployment in the Recipient Country

We now compare the welfare effects of the three types of tied aid to the welfare effects of untied aid for each country and for the world as a whole. First, we compare untied aid to tied aid when capital is intersectorally mobile. To make the comparison possible we normalize, such that the value of the capital transfer in terms of the numéraire is the same for tied and untied aid for the donor. Thus, for the recipient, for example, dividing $(du/dK)$ by $r^*$ and subtracting $(du/dT)$ gives

$$
\frac{(du/r^* dK) - (du/dT)}{r^* pr^*} = \left[ \frac{p}{\eta^*_p - \eta_p} + e^{m_p} Z_p \right] \Delta / pr^* \\
+ \left[ e^{r^*_p - r_p^*} \right] \Delta / pr^*
$$

Equation (25) shows that a transfer of the same value of aid yields higher benefits for the recipient when this aid is untied than when it is tied to intersectorally mobile capital if the rental rates are the same in both countries. If not, the result is unclear. Similarly, comparing the effect of aid tied to intersectorally mobile capital to untied aid for the donor’s welfare level gives

$$
\frac{(du/r^* dK) - (du^*/dT)}{r^* pr^*} = \left[ e^{m_p} (r^* - r) - (r^* e^{r^*_p} - r e^r_p) \right] \Delta / pr^*.
$$

Equation (26) shows that from the donor’s perspective, aid tied to intersectorally mobile capital is better than untied aid, if the rental rates are the same in the two countries; otherwise the effect is unclear. Adding equations (25) and (26) shows that, from the world’s welfare perspective, a transfer of aid tied to intersectorally mobile capital is worse than untied aid, if the rental rates are the same in the two countries; otherwise the result is unclear. Thus, there is a likelihood for a conflict of interest between donor and recipient countries about the type of aid to be transferred.

A similar analysis for untied aid and aid tied to sector-specific capital in agriculture and tied aid to sector-specific capital in manufacturing leads to inconclusive results.
The Case with Full Employment in the Developing Country

Next, the same type of analysis is done when the recipient country has full employment. The welfare effects of tied versus untied aid for the recipient country when capital is intersectorally mobile is given by equation (25) if we set $\lambda_p = 0$ and $\eta_p = 0$. The answer is again ambiguous. If, however, the rental rates in the two countries are the same, then a transfer of the same value of aid yields higher benefits for the recipient country if this aid is untied than if it is tied. From the donor’s perspective, aid tied to intersectorally mobile capital is again better than untied aid.

Adding the adjusted equations (25) and (26), and when the rental rates in the two countries are the same, from the world welfare perspective untied or aid tied to intersectorally mobile capital has the same effect. If, however, the rental rate in the recipient country is greater than the rental rate in the donor country, and the marginal propensity to consume the manufactured good in the donor country is not greater than that of the recipient country, then from the world welfare perspective tied aid is better than untied aid.

8. Concluding Remarks

A number of developed countries, groups of countries, and international organizations give aid in the form of specific physical or human capital, or funds to be used for investment in any sector by the recipient country. The welfare and terms-of-trade effects of such aid policies are largely unexplored in the international trade and development literature. To investigate the rationale for such policies and fill this gap in the literature, we have developed a two-country general-equilibrium model in which the developed donor gives aid tied to either sector-specific capital or intersectorally mobile capital. The recipient’s economy is characterized either by full employment or by unemployment of the Harris–Todaro type, while full employment prevails in the donating country.

In the presence of unemployment in the recipient country, the paper considers the effects of untied aid and under plausible assumptions shows that in the short run, where capital is sector-specific, untied aid reduces welfare for the donor and the world. The recipient’s welfare may also be reduced, owing to a reduction in labor income, even though its terms of trade improve. In the long run, where capital is intersectorally mobile, however, untied aid unambiguously increases welfare for the recipient and the world, but reduces welfare for the donor.

When the donor country gives aid tied to intersectorally mobile capital (i.e., funds to be used for investment in any sector), or transfers sector-specific capital (i.e., transfers machines, tractors, etc.), then the terms of trade and welfare effects are generally ambiguous and it is possible to have paradoxical welfare effects (i.e., donor enrichment and/or recipient impoverishment). In the special case where the rental rates and the marginal propensities to consume are the same in the two countries, then the transfer of intersectorally mobile capital improves the donor’s terms of trade and reduces world welfare.

We considered the case where there are two identical developing countries, the only difference being that one country has full employment and the other has unemployment. Within this framework, and when aid is tied to intersectorally mobile capital, we have shown that if the donor country wants to give aid that is more likely to improve the recipient’s welfare, it will give aid to the country with full employment. If, however,
it wants to give aid that is less likely to decrease its own welfare, it will give aid to a country with unemployment.

Finally, we compared the welfare effects of untied aid versus tied aid in the full-employment and unemployment cases. In both cases, when capital is intersectorally mobile and the rental rates are the same in both countries, a transfer of the same value of aid (i) yields higher benefits for the recipient if this aid is untied than if it is tied to intersectorally mobile capital, (ii) from the donor’s perspective aid tied to capital is better than untied aid, (iii) from the world welfare perspective aid tied to capital transfers is worse than untied aid in the case of unemployment, and it does not make any difference in the case of full employment. Thus, a possible conflict of interests exist between the donor and recipient countries on the type of aid to be transferred.

Given that the average rates of return to capital seems to be roughly similar between rich and poor countries, this paper suggests that untied aid is better for the poor countries and the world as a whole than is aid tied to intersectorally mobile capital (i.e., transfer of funds to be used for investment in any sector).

References


Notes

1. According to Unicef (1995), Official Development Assistance (ODA) amounted to approximately $56 billion in 1993. Some two-thirds of ODA is bilateral. On average about 32% of
bilateral aid is tied aid, varying from a low of 11% for The Netherlands to a high of 86% for Spain.

2. An early exception not mentioned above is the work by Caves and Jones (1977, ch. 22) investigating the effect of transferring productive resources on the terms of trade and income.

3. Other examples of a transfer of capital are the relocation of German capital equipment at the end of the Second World War to the countries of Eastern Europe and the Soviet Union, and the Marshall Plan to reconstruct Europe after the Second World War.

4. An alternative specification of this form of tied aid in which the capital goods are first produced by the donor’s economy (in the manufacturing industry) has no major consequences for the analysis in the sequel except of replacing \( r^* \) with \( p \) for the welfare effects and, by construction, making it more likely that the donor’s terms of trade improve.

5. Beladi (1990) focuses on the employment effects of a small transfer of income in a classical model with sector-specific land and unemployment in both countries due to a minimum wage.

6. This can be proven using the unit cost = unit price conditions.

7. This can be proven using equations (1)–(5) and for the full-employment case the conditions (1)–(4), where now the wages in the two sectors are equal.

8. Bardhan (1996) tries to explain why the average rates of return to capital in the poor countries seems to be roughly the same as the return to capital in the rich countries, while wages in rich countries are much higher.