INTERNATIONAL CAPITAL TRANSFERS
AND THE CHOICE OF PRODUCTION
TECHNIQUE: A SIMPLE TWO-COUNTRY
MODEL

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by

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ABSTRACT

A two-country, two-factor, two-good world with incomplete specialization is explored in the context of international capital transfers, where the techniques of production of the same good differ between the two countries. It is shown that the terms of trade for the South will worsen with a capital transfer to the South under a wide range of assumptions about technology choice in the North, South, and North-owned sector of the South. The implied redistribution of world income, as well as the implications of a change in the production technique of the North-owned sector of the South are also examined.

RESUME

Cette analyse concerne un modèle où la spécialisation est incomplète et qui comprend deux pays, deux facteurs,et deux produits. L'analyse sera effectuée dans le cadre de transferts de capitaux internationaux, où les techniques de production d'un certain bien diffèrent entre les deux pays. Sera démontré le fait que les termes d'échange pour le Sud empireront si l'on effectue un transfert de capitaux vers le Sud, étant donné de diverses hypothèses concernant le choix de technologie dans le Nord, dans le Sud, et dans le secteur du sud dont le Nord est propriétaire. Seront examinés aussi la redistribution des revenus mondiaux et les implications d'un changement de technique de production dans le secteur du Sud où le Nord est propriétaire.

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I. INTRODUCTION

In this paper a simple model is developed to examine the impact of a capital stock transfer when the techniques of production of the same good differ across sectors of the world economy. The impact of the capital transfer on the terms of trade and real income is discussed. In the model, a two-country, two-factor, two-good world with incomplete specialization is assumed. One country, the South, is characterized by greater difference in technology between commodities (in terms of capital-labor ratios) and by more labor-intensive production techniques. In addition, there is a foreign-owned sector of production in the South which may use a production technique different from that in either the North or the South. It is shown that the terms of trade of the South will worsen with the capital transfer to the South under a wide range of assumptions about technological choice in the foreign-owned sector. With these assumptions and in the absence of taxes, a capital transfer which increases world income also redistributes income from the South to the North and decreases wages relative to the returns to capital in both countries. In addition it is shown that for a given stock of foreign-owned capital in the South, and without other mechanisms for redistributing world income, it is in the interest of the South to impose increased labor-input requirements on foreign-owned production, even if there is full employment. Also, it maybe in the interest of the Northern capitalists to use a production process that is less efficient and uses more capital per unit of output in its foreign-owned sector in the South than in its comparable sector in the North.

Two basic hypotheses regarding direct foreign investment and technology appear frequently in the literature [see Hughes and Ohlin (1980), Moxon (1979), Sen (1980), and Streeten (1971) for an introduction to this vast literature]:

1. Multinational corporations import production techniques to the less developed countries (LDC) that are "inappropriate." That is, they do not adapt their production techniques to the existing factor supplies and other conditions that may exist in less developed countries.

2. Access to modern technology for less developed countries is largely tied to the level of direct foreign investment. However, it is often said that the advanced technologies used by multinationals in less developed countries are rarely disseminated beyond the foreign-owned sector.

In this paper a specific aspect of the "appropriateness" of technology in the foreign-owned sector is investigated, under the assumption that production techniques for the same commodity may differ between different sectors of the world economy.

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Here we address the issues of the impact of the choices of labor-output and capital-output ratios in the foreign-owned sector on real income in the North and South, when capital is transferred from the North to the South. It is assumed that the choice of production technique in the foreign-owned sector of the South has no impact on the production techniques used in other sectors of the South's economy. A critical aspect of the analysis is the consideration of the effect of the transfer on the terms of trade.

The model presented here combines two themes already recognized in the literature. First, there is a growing literature on trade theory in the presence of foreign ownership. [See Jones (1967), Kemp (1966), MacDougall (1960), and in particular, Brecher and Bhagwati (1980, 1981).] It is argued that the results of standard international trade theory, particularly the welfare implications, are frequently quite different in the presence of foreign ownership. In this literature, however, production functions are generally considered to be identical everywhere. The model presented here permits an explicit consideration of not only differences in technology, but factor biases in those differences. The general nature of the production function, however, is sacrificed and the analysis is limited here to fixed coefficients production functions.

The specification of different (but fixed coefficient) production techniques has also been suggested previously in the literature [Chichilnisky (1981), Ranney (1981), and Saavedra-Rivano (1981)], but not in conjunction with the presence of foreign ownership. It is these two aspects of capital, jointly with technology transfer, that are considered here.

In the first section of the paper, a model with import-substituting foreign investment in the South is described. Second, the impact of an additional capital transfer from the North to the South is examined in terms of the technique of production used in that sector. Changes in the terms of trade and real income in the North, South, and world as a whole are considered. The model is then re-examined under two alternative specifications: i) the North-owned sector in the South produces the South's export rather than import good, and ii) there is surplus labor in the South rather than full employment.

II. THE MODEL

In the model, one country represents the less developed country (the South) and the other the more developed country (the North). The same two goods are produced in both countries, but production processes may differ between countries. The South exports Good 1, the more labor-intensive good in both countries. Production of Good 2

in the South occurs in two sectors: a domestically owned sector and a sector which is owned by the capitalists of the North.

We begin with a formal description of the South's economy. Production occurs through fixed-coefficients production functions.

(1)   (a)   Production of Good 1. $X_1 = \min [L_1/a_1, K_1/c_1]$

       (b)   Production of Good 2. $X_2 = \min [L_2/a_2, K_2/c_2]$

       (c)   Production of Good 2, $X'_2 = \min [L_3/a_3, K_3/c_3]$
            Foreign Owned.

It is assumed that the capital-labor ratio is lower in the production of Good 1 than in the domestically owned production of Good 2, so that $c_1/a_1 < c_2/a_2$.

Demand for Good 2 in the South is a function of the relative price and real income. Demand for Good 1 can then be calculated from the income remaining after expenditures on Good 2.

(2)   (a)   Demand for Good 2. $D_2 = D(Y_R, P)$, with $D_Y > 0, D_P > 0$

       (b)   Demand for Good 1. $D_1 = (Y - D_2)/P$

where $Y_R = Y/(PI)$, $P_2 = 1$, and $PI = (PD_{10} + D_{20})/(P_0 D_{10} + D_{20})$, with "0" denoting initial time. Since Good 2 is specified as the <u>numeraire</u>, the demand for Good 2 is an increasing function of both real income and P, the price of Good 1 (and thus the terms of trade for the South).

Income for the South is equal to the value of production in the South, net of profits which are repatriated to the North:

(3)   Income. $Y = PX_1 + X_2 + X'_2 - r_3 K_3$

It is assumed that all profits earned in the foreign-owned production of Good 2 are repatriated.

The price of each unit of output can be divided into wage payments and profits per unit of output.

(4)   Price Equations. $P = a_1 w + c_1 r$

                              $1 = a_2 w + c_2 r$

                              $1 = a_3 w + c_3 r_3$

Wages are equated across all three sectors in the South, and the return to capital is assumed to be equal in the two domestically owned sectors.

Last are the resource constraints.

(5) Resource Constraints. $\bar{L} = L_1 + L_2 + L_3$

$$\bar{K} = K_1 + K_2$$

Labor is perfectly mobile between all three sectors, and full employment is assumed. An excess supply of labor is considered in the last section of this paper. Domestic capital can move freely between sectors 1 and 2, but cannot be used in foreign-owned production. The amount of foreign capital in this third sector is assumed to be exogenous.

A similar set of equations is used for the North, where an asterisk is used to denote the value of a variable for the North. The notation used is summarized in Table I.

In addition to possible differences in input coefficients for production, the North is assumed to differ from the South in the following ways:

i)   There is no foreign-owned sector in the North.

ii) The North exports Good 2.

iii) The North repatriates profits from the South, so its budget constraint can be written as:

(6) $Y^* = P\,X_1^* + X_2^* + r_3 K_3 = P\,D_1^* + D_2^*$

It is assumed that there are no barriers to trade so that relative prices are equated across countries. Thus $P = P^*$. However, rates of return $(r, r^*, \text{and } r_3)$ and wages may differ.

iv) The resource constraints must be rewritten to take into account the potential mobility of capital across countries, and the absence of foreign capital in the North.

(7) $\bar{L}^* = L_1^* + L_2^*$

$$\bar{K}^* = K_1^* + K_2^* + K_3$$

Given the terms of trade, the model for each country is closed, and the quantities produced and demanded of each commodity can be determined. Expressions for the values of endogenous variables for the South as a function of the terms of trade are given in Table II. The analysis is identical for the North, using the appropriate parameter values, except for the resource constraints. In the North, $L_H^* = \bar{L}^*$ and $K_H^* = \bar{K}^* - K_3$. where the subscript H denotes use in domestically owned production in the home country.

One additional equation is required to ensure that world markets of commodities are cleared. This is done by setting the excess demand for Good 2, $E(2)$, equal to zero.

TABLE I.

LIST OF SYMBOLS

D_i	=	demand for Good i, i = 1, 2
$\bar{K}$	=	total capital stock owned
K_H	=	capital stock used in domestically owned production at home
K_i	=	capital used in sector i
$\bar{L}$	=	total labor supply
L_H	=	labor used in domestically owned production at home
L_i	=	labor used in sector i
P	=	price of Good 1
PI	=	price index
X_1	=	production of Good 1
X_2	=	production of Good 2 by domestically owned firms at home
X_2'	=	production of Good 2 by North-owned firms in the South (sector 3)
Y	=	income in terms of Good 2
Y_R	=	real income (Y/(PI))
a_i	=	labor-output ratio in sector i, i = 1, 2, 3
c_i	=	capital-output ratio in sector i
k_i	=	capital-labor ratio in sector i
$\hat{k}$	=	$k_2 - k_1$, which is positive (in both countries) by assumption
r	=	return to domestically owned capital used at home
r_3	=	return to North-owned capital in the South
w	=	wage rate

NOTES: *denotes the equivalent of any of the above variables for the North (where applicable).

W denotes the equivalent of any of the above variables for the world as a whole (where applicable).

TABLE II.

ENDOGENOUS VARIABLES FOR THE SOUTH AS A FUNCTION
OF THE TERMS OF TRADE

Production:

$$X_1 = (k_2 L_H - K_H)/a_1 \hat{k}$$

$$X_2 = (K_H - k_1 L_H)/a_2 \hat{k}$$

$$X'_2 = K_3/c_3$$

Resource Constraints:

$$L_H = \bar{L} - K_3/k_3$$

$$K_H = \bar{K}$$

Factor Returns:

  Wage rate:

$$w = Pk_2/a_1 \hat{k} - k_1/a_2 \hat{k}$$

  Returns to capital:

$$r = 1/a_2 \hat{k} - P/a_1 \hat{k}$$

$$r_3 = 1/c_3 - (k_2 P/a_1 \hat{k} - k_1/a_2 \hat{k})/k_3$$

(8)　$E(2) = D_2^W - X_2^W = 0$, where $D_i^W = D_i + D_i^*$ and $X_i^W = X_i + X_i^* + X'_i$,

for $i = 1, 2$

Walras' Law implies that the market for Good 1 has also cleared when (8) and the budget constraints hold. Imposing the world market clearing equation also requires that we treat the terms of trade as an endogenous variable.

In the analysis, two critical assumptions are made about relative technologies in the North and the domestically owned sector of the South.

1.　Production of each good in the South has a labor-output ratio no smaller than in the production of that good in the North. That is, $a_1 \geq a^*_1$ and $a_2 \geq a^*_2$. There is substantial evidence, particularly anecdotal, that this relationship in fact holds. [See, for example, Baerresen (1971), Baranson (1967), Boon (1975), ILO (1972), Mason (1970), and Strassman (1968).] The difference might occur for two basic reasons: i) There is some (although perhaps very little) adjustment of production techniques to factor availabilities. The South is generally considered to have more labor relative to capital, and thus may use more labor-intensive techniques. ii) Production in the South is less efficient than in the North, implying higher labor-output and higher capital-output ratios. Either reason could be applied to the model presented here.

2.　There is greater technological difference between goods in terms of capital-labor ratios in the South than in the North. That is, $k = k_2 - k_1$ k^*_2 − $k^*_1 = k^*$,[1] where k_i stands for the capital-labor ratio in sector i, i = 1, 2. It is often argued in the literature that, whereas production in the traditional sectors of LDC's is quite labor-intensive, the production of more modern manufacturing goods is generally very capital-intensive -- in fact similar to that found in developed countries. [See White (1978) for an excellent survey on technology choice in LDC manufacturing.] This might be due to lack of other available production techniques, market imperfections and distorted incentives in LDC's, or simple a desire to imitate "modern" production.

III. A TRANSFER OF CAPITAL FROM THE NORTH TO THE SOUTH

A.　The Method of Analysis

To examine the impact of the capital transfer on the terms of trade, the excess demand function for Good 2 shown in equation (8) is used. First notice that the level

of production of each good as indicated in Table II is independent of the terms of production is determined solely by total factor supplies (assuming full employment) and production function parameters. On the demand side, the exposition is simplified by assuming that preferences are homothetic. With this assumption, any redistribution of income between the North and the South will have no net effect on world demand. Thus, we can write a world demand function for Good 2 which depends positively on both real world income (Y_R^W) and the price of Good 1.

(9) $D_2^W = D_2^W(Y_R^W, P)$ where $Y_R^W = Y^W/(PI)^W$, $Y^W = P X_1^W + X_2^W$

and $(PI)^W = (P X_{10}^W + X_{20}^W)/(P_0 X_{10}^W + X_{20}^W)$.

Since an increase in (1/P) decreases the world demand for Good 2 and has no impact on supply, the model is characterized by static Walrasian stability.[2]

To determine the impact of an exogenous capital transfer from the North to the South on the terms of trade in the new equilibrium, the equation for the world excess demand for Good 2 is differentiated and set equal to zero.

(10) $d E(2)/dK_3 = \Omega + D_P^W dP/dK_3 = 0$

where,

(11) (a) $\Omega = D_Y^W dY_R^W/dK_3 - dX_2^W/dK_3$

(b) $D_Y^W = \partial D_2^W/\partial Y_R^W$, $0 < D_Y^W < 1$ as long as both goods are normal,

(c) $D_P^W = \partial D_2^W/\partial P > 0.$

The variable Ω represents the change in excess demand for Good 2 with the capital transfer, holding prices constant. Solving (10) for the change in the terms of trade,

(12) $dP/dK_3 = - \Omega/D_P^W$

The terms of trade for the South will fall with the capital transfer in the new equilibrium as long as Ω is positive. Further examination of the components of Ω is required.

Since the initial world price index is equal to one, the net change in real world income for a small change in K_3 is:

(13) $dY_R^W/dK_3 = P dX_1^W/dK_3 + dX_2^W/dK_3$.

Substituting (13) into the definition of Ω above results in:

(14) $\quad \Omega = D_Y^W P \, dX_1^W/dK_3 - (1-D_Y^W) \, dX_2^W/dK_3$.

Using the equations in Table II and differentiating, changes in output due to a change in K_3 are described by the following expressions:

(15) $\quad dX_1^W/dK_3 = \dfrac{1}{a_1^* \hat{k}^*} - \dfrac{k_2}{k_3 a_1 \hat{k}} \longrightarrow 0$ if

(16) $\quad \dfrac{k_2}{k_3} < \dfrac{a_1 \hat{k}}{a_1^* \hat{k}^*} \quad$ where $\dfrac{a_1 \hat{k}}{a_1^* \hat{k}^*} > 1$.

(17) $\quad dX_2^W/dK_3 = \dfrac{k_1}{k_3 a_2 \hat{k}} - \dfrac{1}{a_2^* \hat{k}^*} + \dfrac{1}{c_3} < 0$ if

(18) $\quad \dfrac{c_2}{c_3} < \dfrac{a_2 \hat{k}}{a_2^* \hat{k}^*} - \dfrac{k_1}{k_3} \dfrac{(1-a_2)}{a_3} \quad$, where $\dfrac{a_2 k}{a_2^* \hat{k}^*} > 1$.

It is assumed throughout the remainder of the paper that conditions (16) and (18) hold. These are sufficient conditions for Ω to be positive, and merit some discussion. First note that these include a more intuitive, stronger set of sufficient conditions for a positive Ω : that foreign-owned production use more capital, but less labor for each unit of output produced.

Observations in the literature, however, are not always consistent with the above stronger conditions. Relative capital-labor ratios is a frequently disputed issue. Strassman (1968) and Pack (1972), for example, find multinational corporations to have more labor-intensive processes than their local counterparts, while Mason (1973) and Radhu (1973) find the reverse.

In addition, the foreign-owned sector's techniques may dominate the South's, that is, use less of both capital and labor. This is due to technological advances occuring first in the North, and only slowly being transferred to the South through direct foreign investment, or perhaps because North-owned firms have superior management capabilities. [See Lall and Streeten (1977) and White (1978) for further discussions.]

Conditions (16) and (18), however, only require that the capital-labor ratio not be "too much" less in the foreign-owned sector than in the South's production, and allow the foreign-owned technique to dominate.[3] The constraint is weaker the greater the technological difference in the South ($\hat{k}$) relative to that of the North ($\hat{k}^*$).

Thus, under the condition that (16) and (18) hold, the capital transfer results in a shift in world production from Good 2 to Good 1, and a worsening of the terms of trade for the South. Also, from the wage and rate of return equations in Table II, it can be seen that nominal (and real) wages decline in both countries, and the rate of return to capital rises in all sectors of the world economy. These results can best be understood by considering several examples.

1. Production techniques are identical in the North and South. The implications of the model become clearer if we begin the discussion with the limiting case where the North and South differ only in their factor supplies. The transfer of capital has no impact on the supply of either good, and thus the terms of trade are unchanged in the new equilibrium. A possible scenario can be described as follows. Capital is initially taken from the production of Good 2 in the North to foreign production in the South. With identical production techniques, these two effects cancel out. Now, however, the North is suffering from unemployment while the South has lost workers to the foreign sector. The disequilibrium is "mollified" by the internal flow of capital and labor from one sector to the other. The North shifts to the production of the more labor-intensive Good 1, while the South produces more of Good 2 in the domestic sector. This continues until there is full employment in both countries. The decrease in the production of Good 2 in the North is exactly equal to the increase in the South if production techniques are identical. Production changes for Good 1 also cancel out, and there is no impact on the terms of trade.

Identical production techniques also imply that factor prices are equated across countries. Since all returns to foreign capital are remitted, the capital transfer results in no change in world income or its distribution.

2. Techniques of production of Good 2 are identical in the North and foreign-owned sector of the South. Suppose that capital is taken from the North's Good 2 sector and put in the South. Then, these two changes in production again net out on the world level. This time, however, the adjustment in the South to this initial shortage of labor will not exactly compensate the adjustment in the North to the excess labor supply. Conditions (16) and (18) can be reduced to:

$$(16') \quad k_2/k_2^* < a_1\hat{k}/a_1^*\hat{k}^* \qquad\qquad (18') \quad k_1/k_1^* < a_2\hat{k}/a_2^*\hat{k}^*$$

That is, the capital-labor ratios in the South cannot be "too much" higher than in the North.

Under these conditions the net effect of the transfer is a decrease in the world supply of Good 2, and increase in Good 1, and thus a worsening of the terms of trade for the South in the new equilibrium. This can be understood by considering the initial labor shortage and surplus in each country. When a unit of capital is transferred it releases labor of amount $1/k_2^*$ in the North, and absorbs exactly the same amount in the South. if we examine the output equations in Table II, production of X_1 in the North increases by $k_2^*/a_1^*\hat{k}^*$ for each additional unit of labor available, while production in the South decreases by $k_2/a_1\hat{k}$ for each unit of labor absorbed. Condition (16') is thus a necessary and sufficient condition for the output of X_1 to increase on the world level. Similarly, equation (18') requires that the world output of X_2 decline.

3. <u>Identical techniques are used in the domestic and foreign-owned production of Good 2 in the South.</u> In this case, from the point of view of production, the capital transfer is equivalent to a transfer directly into domestic production in the South. Conditions (16) and (18) are now simplified to:

$$\text{(16")} \quad 1 < a_1\hat{k}/a_1^*\hat{k}^* \qquad\qquad \text{(18")} \quad 1 < a_2\hat{k}/a_2^*\hat{k}^*$$

These conditions are satisfied by the initial assumptions made about relative technologies in the North and South. Referring again to Table II, a unit decrease in the capital stock in the North results in an increase in the output of X_1 by the amount $1/a_1^*\hat{k}^*$. The equivalent increase in capital in the South implies a decrease in X_1 of the amount $1/a_1\hat{k}$. Thus (16") is again a necessary and sufficient condition for the total output of X_1 to increase with the capital transfer. Similarly, production of X_2 declines, and the terms of trade worsen for the South. Note that this occurs in spite of the fact that capital may be more productive (i.e. have a smaller capital-output ratio) in the Good 2 sector of the South than in the North.

B. <u>The Effects of the Capital Transfer on Income and its Distribution</u>

To analyze the impact of the capital transfer on real income, the real value of production (net of repatriated profits) is differentiated with respect to K_3 for both countries. It should be first noted that wages and returns to capital, as shown in Table II, do not depend directly on factor abundance, but are affected by the capital transfer only through the change in relative prices; an increase in P implies an increase in all wages and a decrease in all returns to capital.[4]

With the initial period as the base period for the price index, differentiation of real income results in (after some substitution):

$$\text{(19)} \quad dY_R^W/dK_3 = r - r^*$$

(20) $dY_R^*/dK_3 = r_3 - r^* - T \, dP/dK_3$

(21) $dY_R/dK_3 = T \, dP/dK_3$

where $T = (X_1 - D_1 - K_3 dr_3/dP) = - (X_1^* - D_1^* + K_3 \, dr_3/dP) > 0$

The capital transfer results in an increase in real world income as long as the return to capital in the foreign-owned sector exceeds that in the North. Since the total supplies of labor and capital are held constant throughout the analysis, any changes in relative prices or factor returns implies only a redistribution of world income.

Since there are no taxes on foreign investment in this model, and average productivity of capital in each sector is held fixed, all of the gains in world income are received by the North. Under the assumptions about technology stated above, the terms of trade for the North improve with the transfer. In addition, as P falls the returns to foreign investment (r_3) increase. Thus, if r_3 exceeds r^*, the North unambiguously realizes an increase in real income. Because of the terms of trade effect, the North could gain even if the direct return to foreign-owned capital is less than that in the North.

The change in the South's real income is determined by the terms of trade effect alone. The worsening terms of trade implies an increase in the outflow of profits and a decline in real income with the capital transfer. In addition, the decrease in P leads to a decline in nominal and real wages and an increase in returns to capital in both countries.

In sum, under the assumptions of the model, the capital transfer results in an increase in world income as long as r_3 exceeds r^*, but a redistribution of world income from workers to capitalists and from the South to the North. In the limiting case of identical technologies across countries there is no change in world income or its distribution.

C. Choice of Technology in the Foreign-owned Sector

For a given allocation of the world capital stock it is also possible to examine the characteristics of technology in the foreign-owned sector which maximize real income -- for the North, South, or world as a whole. To do this we first examine the impact of technology changes in the foreign-owned sector on the terms of trade. Equation (12) can be generalized in the following form:

(12') $dP/dj = -\Omega_j / D_P^W$

where $\quad \Omega_j = D_Y^W P \, dX_1^W/dj - (1 - D_Y^W) \, dX_2^W/dj$

and "j" represents a parameter in the model.

Differentiating the resource constraints and output equations with respect to a_3 and c_3 yields:

$$(22) \quad dX_1^W/da_3 = -k_2 K_3/a_1 \hat{k} c_3 < 0$$

$$(23) \quad dX_2^W/da_3 = k_1 K_3/a_2 \hat{k} c_3 > 0$$

$$(24) \quad dX_1^W/dc_3 = k_2 K_3/k_3 c_3 a_1 \hat{k} > 0$$

$$(25) \quad dX_2^W/dc_3 = -K_3(1 + k_1 a_3/a_2 \hat{k})c_3^2 < 0$$

Substituting into equation (12'), it can be seen that the terms of trade for the South improve with an increase in labor requirements (a_3), but decline with an increase in capital requirements (c_3).

The last step is to again differentiate real income.

$$(26) \quad dY_R^W/da_3 = -wX_2' \qquad\qquad dY_R^W/dc_3 = -r_3 X_2'$$

$$(27) \quad dY_R/da_3 = T \, dP/da_3 \qquad\qquad dY_R/dc_3 = T \, dP/dc_3$$

$$(28) \quad dY_R^*/da_3 = -wX_2' - T \, dP/da_3 \qquad DY_R^*/dc_3 = -r_3 X_2' - T \, dP/dc_3$$

An increase in either a_3 or c_3, not surprisingly, decreases world income. The losss is equal to the implied increase in expenditures on labor or capital that would be necessary to hold production at its initial level.

Again, any change in real income accrues directly to the North, and the South is affected only by changes in the terms of trade. An increase in labor requirements improves the terms of trade for the South. This change decreases labor availability to domestic producers in the South, and this implies a further shift in production from the export good (Good 1), towards the import substitute (Good 2). Thus, the South can increase real income if it is able to impose higher labor requirements in the foreign-owned sector. An increase in capital requirements, however, worsens the terms of trade for the South. It is thus in its interest to encourage a low capital-output ratio in the existing foreign-owned sector.

The change in real income in the North is composed of the net change in world income plus the terms of trade effect. An increase in a_3 unambiguously decreases the North's income, while an increase in c_3 may cause it to rise or fall. An increase in the capital requirement results in a production loss, and thus a decrease in the rate of return on foreign-owned capital, but improving terms of trade for the North.

To summarize, in maximizing the world's real income it is optimal to choose an efficient production technique -- one which does not use both more labor and more capital than another available technique. In a world with side payments, or some costless method of income redistribution, an efficient production technique is preferred to all dominated techniques. Without any redistribution scheme across countries, however, it is in the interest of the South to attempt to increase labor requirements in the foreign-owned sector of its economy, while at the same time it may be in the interest of the North to increase the capital requirements.

Similarly, if there is no method of redistribution between workers and capitalists, it is in the interest of workers in both the North and South to increase labor requirements in the foreign-owned sector of the South, while the South's capitalists would prefer an increase in capital requirements in that sector. The North's capitalists operating in the North would also benefit from the increase in capital requirements, while it is ambiguous whether those operating in the South would prefer an increase or decrease.

IV. ALTERNATIVE MODEL SPECIFICATIONS

A. Export-promoting Foreign Investment

Thus far we have considered only a capital transfer from the North to the South for the production of the import good of the South. Alternatively, foreign capital might be used in the South to produce the export good. The analysis is very similar. Now,

(1c') Production of Good 1, Foreign-Owned $\qquad X'_1 = \min [L_3/a_3, K_3/c_3]$

(4') Price Equation $\qquad P = a_3 w + c_3 r_3$

Also, X'_1 must be substituted for X'_2 in the balance of payments equilibrium conditions. World production of each good is redefined as $X^W_2 = X_2 + X^*_2$ and $X^W_1 = X_1 + X^*_1 + X'_1$.

Then the analysis of the impact of the capital transfer is identical to the import-substituting case up until the point where changes in world production are explicitly examined in equations (15) - (18). These are now replaced with:

$$(29) \quad dX^W_1/dK_3 = \frac{1}{a^*_1 k^*} - \frac{k_2}{k_3 a_1 k} + \frac{1}{c_3} > 0 \quad \text{if}$$

(30) $\dfrac{c_1}{c_3} < \dfrac{a_1\hat{k}}{a_1^*\hat{k}^*} - \dfrac{k_2}{k_3}\dfrac{[1-a_1]}{a_3}$

(31) $dX_2^W/dK_3 = \dfrac{k_1}{k_3 a_2 \hat{k}} - \dfrac{1}{a_2^*\hat{k}^*} < 0$ if

(32) $\dfrac{k_1}{k_3} < \dfrac{a_2\hat{k}}{a_2^*\hat{k}^*}$

The conditions for an increase in X_1 and decrease in X_2 are analogous to the import-substitution case; the capital-labor ratio in the production of Good 1 in the South cannot be "too much" higher than that in the foreign-owned sector. With conditions (30) and (32) met, Ω is positive and the terms of trade for the South will worsen with the capital transfer. The impact of the capital transfer on world income and its distribution then follows as in the import-substituting case.

To examine the issues of technology choice we return to the examination of output changes due to changes in technology in the foreign-owned sector shown in (22) - (25). Only (24) and (25) are different in the new specification:

(24') $dX_1^W/dc_3 = [(a_3/a_1 - 1)k_2 + k_1] K_3/kc_3^2 \gtrless 0$

(25') $dX_2^W/dc_3 = - K_3 k_1/k_3 c_3 a_2 k < 0$

As before, the terms of trade for the South improve with an increase in labor requirements (a_3), holding the stock of foreign-owned capital constant. However, the impact on the terms of trade for an increase in capital requirements becomes ambiguous. An increase in c_3 reduces output of Good 1 in the foreign-owned sector, thereby releasing labor to the domestic sectors in the South. This increase in L_H results in an increase in the production of Good 1 in the South. If the net change in the production of Good 1 is positive, the terms of trade will worsen for the South in the new equilibrium. On the other hand, if labor-input requirements in the foreign-owned production of Good 1 are much smaller than in the South's production, only a small amount of labor will be released, and net production of Good 1 will fall. In this case, it may be possible for the terms of trade to improve for the South with an increase in the capital requirement.

Thus, in the export-promoting case it is less likely that the North would prefer a less efficient, though more capital-intensive technique. It is more likely, however, that a move towards a more efficient technology in the foreign-owned sector will

result in a reduction in real income for the South. Wages still increase and domestic profits decrease with an increase in the labor requirement in the foreign-owned sector, but the impact of a change in the capital requirement is now ambiguous with respect to wages and profits.

B. Surplus Labor in the South

A possible benefit to the South of the capital transfer is an increase in employment under conditions of surplus labor. It can be easily incorporated into the model by assuming a fixed wage in the South, $\bar{w}$, with a perfectly elastic supply of labor at that wage. If $\bar{w}$ is substituted into the formulation for the wage rate in Table II, this equation uniquely determines the terms of trade. Thus P will remain constant throughout a capital transfer. Market adjustment must instead occur through changes in employment in the South.

Formally, the impact of the transfer on employment in the South is analyzed by setting the change in the excess demand for Good 2 equal to zero (returning to the original assumption of import-substituting investment). Changes in world supplies are expressed as the sum of changes, first holding the South's labor supply fixed, and then considering the adjustment of the domestic sectors to the consequent (and to be determined) changes in the labor supply:

$$(33) \quad dX^{W}_{2}/dK_{3} = \partial X^{*}_{2}/\partial K_{3} \big|_{\bar{L}} + dX'_{2}/dK_{3} + (\partial X_{2}/\partial \bar{L})\big|_{L_{3}} (d\bar{L}/dK_{3})$$

$$(34) \quad dX^{*}_{1}/dK_{3} = \partial X^{*}_{1}/\partial K_{3} \big|_{\bar{L}} + (\partial X_{1}/\partial \bar{L})\big|_{L_{3}} (d\bar{L}/dK_{3})$$

Now equation (11), the change in the excess demand for Good 2 with the capital transfer, becomes (since P is fixed):

$$(35) \quad dE(2)/dK_{3} = \Omega + \beta \, d\bar{L}/dK_{3} = 0$$

where $\quad \beta = D^{W}_{Y} \, \partial Y^{W}_{R}/\partial \bar{L} \big|_{L_{3}} - \partial X_{2}/\partial \bar{L} \big|_{L_{3}} = D^{W}_{Y} \, \bar{w} + k_{1}/a_{2}k > 0$.

The variable Ω again represents the change in excess demand holding P and total employment in the South fixed. The second term indicates the change in E(2) due to the change in employment.

Under the assumptions used in the previous analysis of import-substituting foreign investment, Ω is positive. The direct effect of the capital transfer (holding employment in the South and P constant) is an increase in the excess demand for Good 2.

An increase in employment in the South also has the impact of increasing the excess demand for Good 2. An exogenous increase in employment in the South would result in an increase in world income of $\bar{w}$ per new worker (assuming that previously unemployed workers were nonproductive). Assuming normal goods, this implies an increase in the demand for Good 2. Also, an increase in employment (now holding employment in the foreign-owned sector fixed) requires a shift in production towards the more labor-intensive good, or a decrease in the production of Good 2. Thus, as shown in (35), β is also positive.

Solving equation (35), it can be seen that the change in employment with the capital transfer is equal to $-\Omega/\beta$. Under the assumptions of the model, Ω and β are both positive. Thus employment must decrease in the South in the new equilibrium.

Changes in real income with the capital transfer become:

$$(36) \quad dY^W_R/dK_3 = r_3 - r^* + \bar{w}\,(d\bar{L}/dK_3)$$

$$(37) \quad dY^*_R/dK_3 = r_3 - r^*$$

$$(38) \quad dY_R/dK_3 = \bar{w}\,(d\bar{L}/dK_3)$$

For the transfer to improve real world income, the return to capital in the foreign-owned sector must be high enough to compensate both the lost returns to capital in the North and decreased wage bill in the South. Again, if the capital transfer does result in an increase in world income, the North gains and the South loses.

The analysis of technology choice is also changed with the new specification:

$$(39) \quad dY^W_R/da_3 = 0 \qquad\qquad dY^W_R/dc_3 = -r_3 X'_2 + \bar{w}(d\bar{L}/dK_3) < 0$$

$$(40) \quad dY_R/da_3 = \bar{w}\,X'_2 > 0 \qquad dY_R/dc_3 = \bar{w}\,(d\bar{L}/dK_3) < 0$$

$$(41) \quad dY^*_R/da_3 = -\bar{w}\,X'_2 < 0 \qquad dY^*_R/dc_3 = -r_3\,X'_2 < 0$$

An increase in the labor requirements results in no change in world income, since in this version of the model the opportunity cost of labor is zero. The only impact is a transfer of income from the North to the South.

An increase in capital requirements results in a larger decline in world income than in the full employment model. The decline in output due to increased capital requirements also implies a decrease in employment, resulting in a further decline in world income. Thus, in this specification of the model, it is in the interest of both the North and the South to minimize capital requirements.

V. <u>CONCLUSIONS</u>

In this paper a simple two-country model has been constructed in order to examine the impact of capital transfers when technologies differ across sectors of the world economy. In order to focus on the role of differing production techniques, a model is used in which, in the special case of identical technologies, a capital transfer has no impact on the terms of trade, world income, or its distribution.

In general the following assumptions about world technologies are made:

i) there is a greater difference in technology between goods in the South than in the North in terms of capital-labor ratios;

ii) the production process in the South requires no less labor per unit of output than in the North, for each good, and;

iii) the capital-output ratio is not too much higher (or could be lower) nor the labor-output ratio too much lower (or could be higher) in the production of a good in the South relative to the production of the same good in the foreign-owned sector.

Under these assumptions and conditions of full employment, it is shown that a capital transfer from the North to the foreign-owned sector of the South will result in a worsening of the terms of trade and a reduction in real income for the South. If there is no other method for redistributing world income, it is in the interest of the South to attempt to increase labor requirements in the foreign-owned sector of the economy (holding the stock of capital in that sector fixed). It may even be optimal from the North's point of view, particularly the North's capitalists, to increase the capital requirements, and thus decrease the efficiency of the foreign-owned production.

If the foreign-owned sector produces exports rather than imports, it is less likely that the North's capitalists would prefer a less efficient, but more capital-intensive technique. It is, however, more likely that a move towards a more efficient technology in the foreign-owned sector will reduce real income in the South and real wages in both countries.

If we consider wage rigidity and surplus labor in the South, the capital transfer results in an overall <u>decrease</u> in employment in the South in the new equilibrium. In this specification, while the South still has an incentive to impose labor requirements, both countries will want to minimize capital requirements in the foreign-owned sector. It should be noted, however, that changes in output in the informal or subsistence sector are not considered here.

NOTES

1.   A similar assumption is made in Chichilnisky (1981) where a two-country, two-good, fixed-coefficients model is presented.

2.   It is assumed that an equilibrium does exist such that full employment of all factors is possible at positive factor prices. This requires that:

$$c_1/c_2 < P < a_1/a_2 \quad \text{and} \quad c^*_1/c^*_2 < P < a^*_1/a^*_2 \ .$$

3.   This is less obvious in condition (18) than in (16). If the South's labor-input requirement for Good 2 is exactly equal to that in the foreign-owned sector, then the right-hand side of equation (18) is strictly greater than one -- and c_2 may exceed c_3 with the required conditions holding. If a_3 is above a_2, the right-hand side of (18) is decreased, but remains greater than one for some levels of a_3 which are greater than a_2. Thus it is possible to have $a_2 < a_3$ and $c_2 > c_3$ (implying $c_2 a_2 > c_3/a_3$) and still satisfy condition (18). Similarly, there is a range where $a_2 > a_3$ and $c_2 > c_3$ (the foreign-owned technology dominates) and condition (18) is satisfied.

4.   An increase in P also results in an increase in $(r_3 - r^*)$ under condition (16):

$$\frac{d(r_3 - r^*)}{dP} = \frac{-k_2}{k_3 a_1 \hat{k}} + \frac{1}{a^*_1 \hat{k}^*} = \frac{d X^W_1}{d K_3} > 0$$

if condition (16) holds. Thus, under the given assumptions, the capital transfer from the North to South decreases P, and in turn decreases any differential between the rate of return to capital in the North-owned sector of the South and in the North.

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