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# FDI AND FACTOR INTENSITY: A CLASSICAL VIEW

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*Abstract*: There is a rationale within the classical context for the argument that a policy of international aids and grants financed by the countries who gain from foreign direct investment (FDI) could be beneficial to the promotion of free trade and investment and to all participants, even when the potential aids recipients observe improvement in their terms of trade as a consequence of FDI. Specifically, FDI in an extended classical (Heckscher-Ohlin) context could be a stimulus for an income-reducing improvement in the terms of trade of a participating country. However, the real income gains by the participating countries do not form a zero sum and the net effect on the world income is positive.

**JEL Classification Number:** F2, O19
**Key words:** General equilibrium analysis, trade, foreign investment, economic development

## 1. INTRODUCTION

The last two decades have witnessed a significant advance in globalization of production in form of a large number of cross-country movements of production processes, especially from industrialized countries to developing countries (Froot, 1993; UNCTAD, 1994, 1996, 1999). These movements have been primarily motivated by cross-country factor reward differentials accompanied by advances of market orientation and reduction in political risk factors in most developing countries. The empirical studies on factor content of output generated by foreign direct investment (FDI) and multinational firms (transnational corporations) reveal that when a production process is moved from one country to another, the factor content of output often changes.[1] This is not overly surprising when one considers cross-country reward differential as a primary motive

[1] For a survey of empirical studies on factor content and factor intensity of trade see Leamer and Levinsohn (1995) and Bowen, Hollander, and Viaene (1998). Also UNCTAD (1994, 1996, 1999).

for FDI. Also, in the presence of two factors, a production technology determines the proportion of each factor used in the production, thus determines the factor intensity of the output as the ratio of the two factors in unit output. Hence, a change in factor content often implies a change in production technology and factor intensity. Such a change in factor intensity of output is especially likely when FDI flows from an industrialized country with relative shortage of labor to a developing country with a relative abundance of labor. In the presence of two goods and two factors, the notion of relative factor intensity is determined by the factor intensity of the two production processes. In a given country, if an output is relatively intensive in one factor, then the other output necessarily has relative intensity in the other factor. In addition, the degree of relative factor intensity of the same output may differ cross countries, as the stated observations imply. In fact, a production that is relatively labor-intensive in one country may well be a relatively capital-intensive production in another country. The case in point may be exhibited by the large spectrum of so-called "maquiladora" plants in Mexico established by the U.S. firms. Another example is the manufacturing branches set up by the European, Japanese, and U.S. firms in China and other east Asian countries. As the stated observations show, it is highly conceivable that the labor content of output rises when a production process moves from the U.S. to Mexico. Furthermore, a production that is relatively labor-intensive in the U.S. may well be a relatively capital-intensive production in Mexico. Any consequence of such phenomena for the national economic measures of the countries involved could be substantial in light of the fact that the last two decades have witnessed a large flow of FDI from industrialized countries to developing countries. Beside being motivated by cross-country reward differential and exhibit a change in factor intensity, the stated FDI have an additional characteristic that their output is not only to satisfy the host country's demand but the demand in other countries as well, including the demand in the FDI home country. However, most countries remain diversified in production in the sense that export of production often does not terminate domestic production. Such aspects of trade and investment are partially responsible for the substantial increase in the volume of commodity trade between industrialized and developing countries along with the rise in FDI among them in the last two decades (Markusen and Venables, 1995; Feenstra, Lipsey, and Bowen, 1997; UNCTAD, 1994, 1996, 1999).

The extensive literature that has studied the consequences of FDI by multinationals in various contexts includes kemp (1966), Jones (1967), Ruffin (1984), Ethier (1986), Froot (1993), Grossman and Helpman (1995), Markusen (1995), and Bowen, Hollander, and Viaene (1998), and many references therein. The models that provide most general settings for such studies are primarily those of the classical (Heckscher-Ohlin) general equilibrium literature. These models allow investigation of not only partial equilibrium issues but aggregate consequences and policy issues for the participating countries. In fact, general equilibrium models are often needed for a reasonable study of international policy issues. Clearly, the level of generality of a model is often directly related to the level complexities in a subsequent analysis. Although the classical general equilibrium models of trade allow a general setting, the existing models lack sufficient generality to

investigate the crucial consequences that the presence of cross-country factor intensity differential could generate for the terms of trade and national income effect of FDI.

In light of the stated observations, the primary objective of the present study is to investigate how the presence of cross-country factor intensity differential may alter the effect of FDI on the terms of trade and national income of the participating countries in a general equilibrium setting under free trade and investment. The model is an extension of the classical trade model, which is essentially a two-sector general equilibrium model of incomplete specialization (diversification) by both countries with two limiting assumptions: factors of production are not internationally mobile and there is no cross-country factor intensity differential (identical cross-country technologies). This model will be extended by removing the two stated assumptions. It should be pointed out that there are a number of features that connect the present model of FDI and its subsequent results to the theory of multinational enterprise in a rigorous setting. When a multinational sets up a new production plant in a target country, it is in effect implementing an FDI. The multinational may have a number of motives for its FDI decision and may enter into the target production market through various entry modes such as new plant, joint venture, or merger with domestic producers (Markusen, 1995; Bowen, Hollander, and Viaene, 1998; UNCTAD, 1996, 1999; and references there in). The present model considers the case where the multinational's motive for entry can be summarized by a cross-country reward differential. Furthermore, the focus is on the case where entry by the multinational is in form of new plant. Other entry modes such as joint venture and merger can be studied in the present context with modifications of the income pattern that defines the domestic and foreign incomes.

Since the model will be an extended version of the standard classical (Heckscher-Ohlin) $2\times2\times2$ model of trade, certain controversial aspects of this model that persist in our setting need to be pointed out. A leading controversy that has occupied trade researchers for nearly four decades is related to the problem of translating the classical hypotheses and propositions into empirically testable hypotheses. Leontief (1953) performed a pioneering empirical evaluation of a fundamental theorem of the classical model, namely the Heckscher-Ohlin theorem stating that capital-abundant countries import labor-intensive output. The empirical contradiction to this theorem, the so-called "Leontief's paradox", has been the subject of many studies as the controversy continues.[2] Two of the studies that focused on empirical testing of various propositions emerging from the standard classical model of trade are Bowen, Leamer, and Sviekauskaus (1987) and Trefler (1995). They showed that the model performed poorly, but in their analyses both studies suggested that allowing cross-country technological differences is very important in trying to explain why the standard model performs so poorly in empirical predictions. Another underlying difficulty is to extend the model and its propositions to a world of many countries, many goods, and many factors. For instance, the essential concepts of "factor abundance" and "factor intensity" become ambiguous in dimensions higher than 2. Furthermore, the classical model does not

[2] For a comprehensive review see Leamer and Levinsohn (1995).

specifically address a number of issues associated with the impact of multinational enterprise on the host countries, such as knowledge spill-over and entry modes, e.g., joint venture and merger with local firms. A reasonable analysis of these issues falls outside the scope of the present study. An extensive review of the literature that deals with these and other empirical issues in testing the trade-theoretic statements of the classical model can be found in Leamer and Levinsohn (1995) and Bowen, Hollander, and Viaene (1998) and references therein. Despite the stated on-going controversies, the classical $2\times2\times2$ model remains as one of the significant cornerstones of the modern trade theory. Jones (2000) defends the core of the classical $2\times2\times2$ model of trade and suggests that its extensions and variants continue to play a crucial role in the new century and points out the importance of cross-country technological differences and factor intensity reversal. Jones, Beladi, and Marjit (1999) argue that very few concepts have played such a key role in the development of international trade theory as that of factor intensity and demonstrate certain aspects of factor intensity for trade.[3] Given such qualifications, if one accepts the core of the classical setting with any reservations, then the trip to the extensions and results in the present study is rather short.

A number of results emerge. Several studies have investigated the case of immiserizing (income or welfare-reducing) FDI. Studies on immiserization due to FDI and terms of trade deterioration include Bhagwati and Brecher (1980), Bhagwati and Tironi (1980), Hamilton and Svensson (1982), Brecher and Findlay (1983), Jones (1984), Krugman (1989), Lahiri and Ono (1989), Cuddington (1992), Bowen, Hollander, and Viaene (1998). Some of these studies have shown that FDI could be detrimental to a participant because it deteriorates the participant's terms of trade. Some have focused on income consequences without terms of trade implications, and others are partial equilibrium studies with focus on one country. Although there are fundamental differences among the models employed in these studies, the existing models lack sufficient generality to study the international implications of FDI in an environment of free trade and investment with cross-country factor intensity differential, diversification, and variable terms of trade. Within an extended classical model with such characteristics, the present study shows that an FDI initiated by a cross-country reward differential could lead to an improvement in the terms of trade and a simultaneous fall in the real national income of a participating country. Furthermore, the generality of the setting allows an in-depth analysis of two fundamental questions regarding the consequences of FDI: (i) whether the real income gains by the participating countries form a zero sum and could the world income gain be negative, and (ii) whether there is a role for an international agency overseeing free trade and investment. The model is developed in the next section. Section 3 evaluates the terms of trade and income effects of cross-country capital

[3] In a portion of their study, Jones, Beladi, and Marjit (1999) use the classical logic of determining a country's pattern of trade to argue that the ranking of factor intensities for a country with 2 inputs and more than 2 outputs may be such that a capital-abundant country exports labor-intensive output, thus generating a theoretical justification for Leontief's paradox. However, general equilibrium implications are absent. Of course, taking such partial views within the standard $2\times2\times2$ model, one could also generate a case of Leontief's paradox by allowing factor intensity reversal.

flows. The case of adverse improvement in the terms of trade and the world income effects are discussed in Section 4. Some concluding remarks appear in the last section.

## 2. THE SETTING

The construction of the 2×2×2 trade and investment model in this section is essentially parallel to the construction of the classical general equilibrium model of Kemp (1966) and Jones (1967). The flow of capital from one country to the other will be initiated by a cross-country rental rate (capital return) differential.[4] The focus is on the case of free commodity trade and output diversification by both countries.[5] A two-country world consists of a home country (H) and a foreign country (F) with fixed endowments of two factors, labor and capital, where each factor is in homogenous units and mobile across the sectors within each country. Furthermore, capital is internationally mobile and moves to the country that offers higher reward. The factors are utilized in the production of two commodities and, under incomplete specialization, each country produces positive quantities of both commodities. For the home country, let $E_i = D_i - X_i$ denote the excess demand for $i$th commodity where $D_i$ and $X_i$ represent the levels of consumption and production, $i = 1, 2$. The real rental rate of capital is $r$ (measured in terms of commodity 1, the numeraire) and the commodity terms of trade is $p = p_2/p_1$. The corresponding values for the foreign country are denoted by the starred variables $E_i^*$, $D_i^*$, $X_i^*$, $r^*$, and $p^*$. Let $K$ denote the home country's net capital stock employed abroad. Therefore, $K > 0$ implies that H is the net exporter of capital, and $K < 0$ shows that H is the net importer of capital. Capital receives local rewards that add to aggregate income in the country of origin. Furthermore, trade equilibrium prevails so that $E_i + E_i^* = 0$, $i = 1, 2$. With unrestricted commodity trade, the terms of trade and its movements are identical in the two countries ($p = p^*$, $dp = dp^*$). Optimal consumption and production apply in both countries.

Full employment and competitive markets prevail in each country such that the rental rate represents the marginal product of capital. In the two technologically different countries, each of the production functions $X_i$ and $X_i^*$, $i = 1, 2$, satisfies the classical

[4] The set of underlying changes that could bring a cross-country reward differential is rather large. It includes various economic, political, and social factors such as cross-country divergences in domestic economic policies, environmental regulations, social time preferences, and various risk factors. In the present study, an initial cross-country return differential motivates the international capital flow. In the study of Jones (1967), however, the cross-country return rates are initially identical and any cross-country capital flow is entirely policy-initiated, i.e., any international capital flow is encouraged or discouraged via a tax/subsidy aimed at the internationally mobile capital. Clearly, the terms of trade and income effects of a capital flow evaluated by Jones do not apply when cross-country rental rates are not initially identical. The Jones' results will emerge as a special case in the present environment.

[5] Jones (1967, p. 19, Footnote 2) initially took the position that the chance that both countries incompletely specialize is almost nil. This position was abandoned in Jones and Ruffin (1975) after it was challenged by a number of studies. Chipman (1971) developed sufficient conditions and an example showing the existence of world equilibrium in the Jones environment under diversification by both countries. The conditions are also elaborated in Inada and Kemp (1969) and Uekawa (1972). The stability of such an equilibrium is discussed in Brecher and Feenstra (1983).

assumptions, e.g. constant returns and diminishing marginal products. Under diversification by both countries, the Rybczynski theorem implies $\partial r/\partial K|_p = \partial r^*/\partial K|_p = 0$.[6] The rental rates respond to changes in terms of trade in accord with the Stolper-Samuelson theorem.[7] Such responses will be evaluated through changes in the relations $r = r(p)$ and $r^* = r^*(p)$. Production responses will be measured through changes in the relation $X_i = X_i(p, K)$ and $X_i^* = X_i^*(p, K)$, $i = 1, 2$.

The welfare functions in the two countries are denoted by $U = U(D_1, D_2)$ and $U^* = U^*(D_1^*, D_2^*)$ such that the welfare in H is indexed directly to its real national income ($y$) via $(dU)/U_1 = dy$, where $U_1 = \partial U/\partial D_1$. Hence, as in the literature, the terms "income effect" and "welfare effect" may be used interchangeably.

## 3. TERMS OF TRADE AND NATIONAL INCOME

This section evaluates the terms of trade and real national income (welfare) effects of an international capital flow ($dK$). The income effect in H will be evaluated via differentiation of the function $y = y(p, K)$:

$$dy/dK = (\partial y/\partial p)(dp/dK) + (\partial y/\partial K)\,. \tag{1}$$

It is clear that the national income response in H to a capital flow has two components: (i) the indirect income effect (the effect via the terms of trade) measured by $(\partial y/\partial p)(dp/dK)$, and (ii) the direct income effect (the effect via the transferred capital income) measured by $(\partial y/\partial K)$. To evaluate these effects, the following definitions will be utilized. Let the terms of trade elasticities of rental rates be denoted by $\gamma = (\partial r/\partial p)(p/r)$ and $\gamma^* = (\partial r^*/\partial p)(p/r^*)$. The signs of $\partial r/\partial p$ and $\partial r^*/\partial p$, hence, the signs of $\gamma$ and $\gamma^*$, are determined by the factor intensities of productions (technologies) in each country in accord with the Stolper-Samuelson theorem. For instance, if the production of commodity 2 is relatively capital-intensive in H and relatively labor-intensive in F, then $\gamma > 0$ and $\gamma^* < 0$.

The trade shares of transferred capital are defined by $\mu = [rK/(pE_2^*)]$ and $\mu^* = [r^*K/(pE_2^*)]$. It is clear that $\mu$ and $\mu^*$ share the same sign, which is determined by the pattern of trade (sign of $E_2^*$) and the net foreign investment position (sign of $K$). For example, if H is initially the net exporter of commodity 2 ($E_2^* > 0$) and the net exporter of capital ($K > 0$), then both $\mu$ and $\mu^*$ are positive. Let $\eta_2 = p/E_2^*[\partial D_2/\partial p|_y - \partial X_2/\partial p|_K]$, where the term inside the brackets is the sum of the substitution effects of a change in $p$ on $D_2$ and $X_2$, hence a negative term. Similarly, $\eta_2^* = p/E_2^*[\partial D_2^*/\partial p|_{y^*} -$

[6] The Rybczynski theorem of the classical model relates factor endowments to output levels. The theorem is endogenous to a country and independent of cross-country technological or factor intensity differences, thus holds in the present setting. An implication of the Rybczynski theorem is that with fixed relative prices and incomplete specialization, changes in endowments have no direct impact on factor rewards (Silberberg, 1990, p. 561).

[7] The Stolper-Samuelson theorem of the classical model states that when relative price of an output rises, the reward to the factor that is relatively intensive in the output's production will rise. This theorem is endogenous to a country and independent of cross-country technological or factor intensity differences, thus remains valid in the present setting.

$\partial X_2^*/\partial p|_K]$. If H is the net exporter of commodity 2 ($E_2^* > 0$), then $\eta_2 < 0$ and $\eta_2^* < 0$. Let $m_2$ and $m_2^*$ be the marginal propensities to consume commodity 2 in H and F in terms of the numeraire, $m_2 = p(\partial D_2/\partial y)$ and $m_2^* = p(\partial D_2^*/\partial y^*)$, and define $\Delta$ as:

$$\Delta = -[(\eta_2 + \eta_2^*) + (m_2 - m_2^*)(1 + \mu^*\gamma^*)]\,.$$

The world markets are said to be stable when the world excess demand for commodity 2 is inversely related to its international price. It is shown in the Appendix that the stability holds when $E_2^*\Delta > 0$.

The following two propositions are established in the Appendix for the case where H is initially the net exporter of capital ($K > 0$):[8]

PROPOSITION 1. *The commodity terms of trade responds to an international capital flow* ($dK$) *according to*:

$$dp/dK = [1/(E_2^*\Delta)][m_2(r^* - r) + (r\gamma - r^*\gamma^*)]\,. \tag{2}$$

PROPOSITION 2. *The real national income in H responds to an international capital flow* ($dK$) *according to*:[9]

$$dy/dK = (1/\Delta)[m_2(r^* - r) + (r\gamma - r^*\gamma^*)][1 + \mu^*\gamma^*] + (r^* - r)\,. \tag{3}$$

As elaborated following Equation (1), the income effect $dy/dK$ can be decomposed into two components, the indirect and direct effects. The proof of Proposition 2 reveals that the first term in Equation (3) is the specification of the indirect income effect $(\partial y/\partial p)(dp/dK)$ and the second term is the direct income effect $(\partial y/\partial K)$. Additional intuitive explanations will be given shortly.

## 4. ADVERSE IMPROVEMENT IN TERMS OF TRADE AND WORLD INCOME

This section demonstrates a case where an international capital flow in the presence of factor intensity reversal results in an improvement in the terms of trade and a simultaneous fall in the real national income of a country. Some results regarding the effect on the world income are also shown.

*Specification*: Consider the case where commodity 2 is produced with a relatively capital-intensive technology in H and with a relatively labor-intensive technology in F ($\gamma > 0$ and $\gamma^* < 0$), hence, cross-country factor intensity reversal is present in production of commodity 2. Furthermore, H is initially the net exporter of both capital

[8] Similar results can be derived analogously for the case where initially $K < 0$.

[9] When the rental rates in the two countries are identical ($r^* = r$), the income effect (3) reduces to $dy/dK = (r^*/\Delta)[(\gamma - \gamma^*)(1 + \mu^*\gamma^*)]$, which is equivalent to the income effect measured by Jones (1967, p. 19, Eq. (17)) under incomplete specialization. (In the notation of Jones, 1967, p. 7, Footnote 2, and p. 10, incomplete specialization implies $\delta^* = 0$). It is clear that when the cross-country rental rates are not initially identical, the second-best (optimal under unrestricted commodity trade) international capital flow policies suggested by Jones (1967) may not be optimal (see Footnote 4).

and commodity 2 ($K > 0$, $E_2^* > 0$, hence, $\mu^* > 0$).[10] The stability condition $E_2^* \Delta > 0$ holds, which implies $\Delta > 0$. Suppose that the rental rate in F is larger than the rate in H ($r^* > r$); therefore, the flow of capital is from H to F.

*Terms of Trade Effect*: It is clear that in the present case $(r^* - r) > 0$, $(r\gamma - r^*\gamma^*) > 0$, and $[m_2(r^* - r) + (r\gamma - r^*\gamma^*)] > 0$. It follows from Proposition 1 that $dP/dK > 0$, therefore, a flow of capital from H to F ($dK > 0$) leads to an improvement in terms of trade in favor of H. The intuitive explanation for such a change in terms of trade is straightforward; since the production of commodity 2 in F is relatively labor intensive, an augmentation of the capital stock in F resulting from the capital inflow leads to a rise in the production of commodity 1 and a fall in the production of commodity 2 in F (by the Rybczynski theorem). By the same token, since the production of commodity 2 is relatively capital intensive in H, the capital outflow leads to a reduction in the output of commodity 2 in H as well. The reduction in the world output of commodity 2 leads to a rise in its international relative price, which is an improvement in terms of trade in favor of H.

*Income Effect*: The real income effect of a capital flow from H to F is less straightforward. The net income effect $dy/dK$ and its decomposition are specified in Equation (3). Under the present specification, the direct effect $\partial y/\partial K = r^* - r$ is positive. To evaluate the indirect effect $(\partial y/\partial p)(dp/dK)$, note that $(1/\Delta) > 0$ and $[m_2(r^* - r) + (r\gamma - r^*\gamma^*)] > 0$. Thus, the crucial determinant of the sign of the indirect effect is the term $[1 + \mu^*\gamma^*]$, where $\mu^* > 0$ and $\gamma^* < 0$. By the magnification effect, the value of $\gamma^*$ in the present case must satisfy $\gamma^* < -1$.[11] Therefore, $0 < |1/\gamma^*| < 1$.

Consider the case where the initial export of capital by H (measured by $r^*K$) is sufficiently large relative to its initial export of commodity 2 (measured by $pE_2^*$) such that the transferred capital trade share $\mu^*$ satisfies $\mu^* > |1/\gamma^*|$. In this case $[1 + \mu^*\gamma^*] < 0$ and, hence, the indirect income effect of an additional capital flow from H to F is negative, despite that its terms of trade effect is positive. The net income effect is the sum of the negative indirect effect and the positive direct effect. The results are summarized in the following proposition.

PROPOSITION 3. *Under the stated specification, suppose the initial export of capital by H is sufficiently large relative to its initial export of commodity 2 such that* $\mu^* > |1/\gamma^*|$. *The export of additional capital by H initiated by a cross-country return differential leads to the following*:

(a) *The terms of trade improves in favor of H.*[12]

(b) *The resulting improvement in the terms of trade by itself has a negative impact on the real national income in H, i.e., the capital outflow has a negative indirect income*

[10] No presumption regarding the pattern of trade in commodity 1 is required. The derivations utilized the trade equilibrium condition $E_i + E_i^* = 0$, $i = 1, 2$; the trade balance ($pE_1 + E_2 = 0$, $pE_1^* + E_2^* = 0$) may or may not hold.

[11] When relative price of a commodity rises, the proportional fall (rise) in the price of its less intensive (more intensive) factor will be larger than the proportional rise in the commodity price. This magnification effect is reflected by $|\gamma| > 1$ and $|\gamma^*| > 1$. See Jones (1965) and Jones (1967, p. 6, Footnotes 7 and 8).

[12] The result (a) does not require $\mu^* > |1/\gamma^*|$.

*effect*:

$$(\partial y/\partial p)(dp/dK) = (1/\Delta)[m_2(r^* - r) + (r\gamma - r^*\gamma^*)][1 + \mu^*\gamma^*] < 0\,.$$

(c) *The net real income effect of the capital outflow in H is negative if the negative indirect effect dominates the positive direct effect, i.e.*:

$$|(1/\Delta)[m_2(r^* - r) + (r\gamma - r^*\gamma^*)][1 + \mu^*\gamma^*]| > (r^* - r)\,.$$

To explain the above result intuitively, note that the condition $\mu^* > |1/\gamma^*|$ is equivalent to $[1 + \mu^*\gamma^*] < 0$, which can be written as $K(\partial r^*/\partial p) < -E_2^*$ (utilizing the definitions of $\mu^*$ and $\gamma^*$). Since the production of commodity 2 is relatively labor-intensive in F, the Stolper-Samuelson theorem shows that an improvement in terms of trade in favor of H (a rise in the relative price of commodity 2) leads to a fall in the rental rate in F ($\partial r^*/\partial p < 0$). Hence, the condition can be written as:

$$K|\partial r^*/\partial p| > E_2^* \tag{4}$$

where H is initially the net exporter of capital and commodity 2 ($K > 0$, $E_2^* > 0$). Suppose there is a marginal improvement in terms of trade in favor of H. This improvement affects the real national income of H in two fronts: (i) an increase in the commodity exports income measured by $E_2^*$, which is the right-hand side quantity in (4), and (ii) a reduction in the income of domestic capital employed abroad (resulting from a fall in the rental rate $r^*$ in F) measured by $K|\partial r^*/\partial p|$, which is the left-hand side quantity in (4). Given that the initial export of capital by H is sufficiently large, the effect (ii) exceeds the effect (i), as indicated by (4); hence, the net income effect of the improvement in terms of trade is negative. Proposition 3 has now established that a foreign direct investment by H initiated by a cross-country return differential could lead to an income-reducing improvement in terms of trade. In a manner parallel to the construction and analysis of the specification above, a number of other cases can be constructed and studies within the present model. Some of these cases depict situations where capital flows from H to F generate income-reducing improvement in the terms of trade in F.

Suppose that some means of policy intervention in foreign direct investment are available under free comodity trade and that the objective of the policy making body in H is to raise its real national income. Given the stated specification, it is clear that the optimal policy direction is to encourage capital inflows and discourage capital outflows. The policy measures may include any available indirect or direct means of FDI control under free commodity trade, e.g. a tax on income of domestic capital employed abroad and/or a subsidy to the repatriated or foreign capital employed in H.

The world income effect of a cross-country capital flow can now be evaluated in the general environment. Lemma 2 in the Appendix shows that the real national income effects of such a flow in the two countries satisfy $dy + dy^* = (r^* - r)dK$. Note that the direction of capital flow (the sign of $dK$) is determined by the rental rate differential (the sign of $r^* - r$) so that the term $(r^* - r)dK$ is always positive. The implications are summarized in the following proposition.

PROPOSITION 4. *The income implication of an international capital flow initiated by a cross-country reward differential has the following properties*:

(a) *The real national income gains in the two countries do not form a zero sum.*

(b) *The world income rises, despite that the real national income in one country may fall.*

## 5. CONCLUDING REMARKS

A substantial portion of the recent literature on globalization of production has focused on the characteristics of FDI and its consequences for the countries involved. When FDI is motivated by a cross-country reward differential and flows from an industrialized capital-abundant country to a developing labor-abundant country, the factor intensity of output often changes, and this change can bear a significant impact on the consequences of FDI. An extended form of the classical general equilibrium model where capital is internationally mobile and the countries are technologically different in terms of factor intensities of production allows an analysis of FDI in such contexts with free trade and investment. An implication of cross-country factor intensity differential is that FDI initiated by a cross-country reward differential could be a stimulus for income-reducing improvement in the terms of trade of a participating country. However, the net impact of such capital flows on the world real income is always positive. Hence, the real national income gains of FDI in the two countries not only do not form a zero sum but the positive gain by one country is always greater than the negative gain by the other. Of course, FDI could also generate positive real income gains in all countries. In the presence of negative gain by a participating country, one option for an international overseeing agency is to compensate the losing country with proceeds from the gaining country thus protecting an environment of free trade and investment and materialize the benefits of such an environment for all participants. With respect to the world income, this option is clearly superior relative to the one that leaves the losing country with the motivation to introduce prohibitive policy measures. It is clear that there is a rational basis within the classical context for the argument that a policy of international aids and grants financed by the countries who gain from FDI is beneficial to the promotion of free trade and investment and to all participants. The case of income-reducing improvement in the terms of trade shows that such a policy could still be valid even when the potential aids recipients observe improvement in their terms of trade as a consequence of FDI. The case represents the fact that an observed improvement in the terms of trade as a consequence of FDI is not sufficient to conclude that a participant gains from FDI.

As usual, the results are subject to the characteristics of the underlying model. As elaborated in Section 1, many controversial issues such as measurement related to the classical model persist in the present study, in addition to the crucial subsequent issue of optimal implementation of policy. Although the model is fairly general, it is conceivable that a more comprehensive model could incorporate additional issues without losing tractability. In relation to the theory of multinational enterprise, the model considered the case where the multinational's motive to implement an FDI is summarized in a cross-

country reward differential and entry mode is in form of new plant. Other entry modes such as joint venture and merger can be studied in the present context with modifications of the income pattern that defines the domestic and foreign incomes.

## APPENDIX

This appendix contains the proofs for Propositions 1 and 2 and the stability condition $E_2^*\Delta > 0$. Some preliminary results are established first. Differentiation of $U = U(D_1, D_2)$ and the consumption optimality condition in H lead to:[13]

$$dy = dD_1 + pdD_2 \tag{A-1}$$

A similar procedure in F leads to:

$$dy^* = dD_1^* + pdD_2^* \tag{A-2}$$

LEMMA 1. *The output responses to an international capital flow* $(dK)$ *satisfy*:

$$dX_1^* + pdX_2^* = r^*dK \tag{A-3}$$

$$dX_1 + pdX_2 = -rdK \tag{A-4}$$

*Proof.* The production responses in F are evaluated through changes in the relations $X_1^* = X_1^*(p, K)$ and $X_2^* = X_2^*(p, K)$. Total differentiation of $X_1^*$ and $X_2^*$ yield:

$$\begin{aligned} dX_1^* + pdX_2^* = {} & [(\partial X_1^*/\partial p) + p(\partial X_2^*/\partial p)dp \\ & + [(\partial X_1^*/\partial K) + p(\partial X_2^*/\partial K)]dK \end{aligned} \tag{A-5}$$

The production optimality condition in F requires movements along the transformation curve satisfying:

$$(\partial X_1^*/\partial p) + p(\partial X_2^*/\partial p) = 0 \tag{A-6}$$

The rental rate measures the rise in aggregate output in terms of commodity 1 (the numeraire) per unit augmentation in capital. Since $K$ is capital inflow into F:

$$(\partial X_1^*/\partial K) + p(\partial X_2^*/\partial K) = r^* \tag{A-7}$$

The result (A-3) follows from applying (A-6) and (A-7) in (A-5). A similar procedure applied to $X_1 = X_1(p, K)$ and $X_2 = X_2(p, K)$ yields (A-4).[14] ■

LEMMA 2. *The real national income responses in the two countries to an international capital flow* $(dK)$ *satisfy* $dy = -dy^* + (r^* - r)dK$.

*Proof.* Applying Equations (A-3) and (A-2) to differentials of $E_1^* = D_1^* - X_1^*$ and $E_2^* = D_2^* - X_2^*$ leads to:

$$dE_1^* + pdE_2^* = (dD_1^* + pdD_2^*) - (dX_1^* + pdX_2^*) = dy^* - r^*dK \tag{A-8}$$

[13] Total differentiation of $U$ leads to $(dU/U_1) = dD_1 + (U_2/U_1)dD_2 = dD_1 + pdD_2$, where optimal consumption requires $U_2/U_1 = p$.

[14] In the proof for (A-3), the star superscript is dropped from all variables and $r^*$ in (A-7) is replaced by $-r$. The result (A-4) follows.

The trade equilibrium condition $E_i + E_i^* = 0$ implies $D_i = X_i - E_i^*$, $i = 1, 2$. Differentials of $D_i$ are utilized in (A-1) to produce:

$$dy = dD_1 + pdD_2 = (dX_1 + pdX_2) - (dE_1^* + pdE_2^*) = -dy^* + (r^* - r)dK$$

where the last equality is due to Equations (A-4) and (A-8). ■

The following results are proved for the case where H is initially the net exporter of capital ($K > 0$). Similar results follow analogously for the case where H is initially the net importer of capital ($K < 0$).

LEMMA 3. *The direct income effects of a change in terms of trade and an international capital flow are specified by*:

$$\partial y/\partial p|_K = E_2^*[1 + \mu^*\gamma^*]$$
$$\partial y/\partial K|_p = r^* - r$$

*Proof.* The budget constraint in F is (when $K > 0$):[15]

$$D_1^* + pD_2^* = X_1^* + pX_2^* - r^*K \tag{A-9}$$

Differentiation of (A-9) with applications of (A-2) and (A-3) yield:[16]

$$dy^* = -E_2^*dp - Kdr^*$$

Application of this expression in Lemma 2 and the definitions for $\gamma^*$ and $\mu^*$ lead to:

$$\begin{aligned} dy &= E_2^*dp + Kdr^* + (r^* - r)dK \\ &= E_2^*dp + (r^*K/p)\gamma^*dp + (r^* - r)dK \\ &= E_2^*(1 + \mu^*\gamma^*)dp + (r^* - r)dK \end{aligned} \tag{A-10}$$

from which the specifications for $\partial y/\partial p$ and $\partial y/\partial K$ follow. ■

PROOF OF PROPOSITION 1. $E_2 = D_2(p, y) - X_2(p, K) = E_2(p, y, K)$. Total differentiation of $E_2$ yields:

$$\begin{aligned} dE_2 &= (\partial E_2/\partial p)dp + (\partial E_2/\partial y)dy + (\partial E_2/\partial K)dK \\ &= E_2^*[(\partial E_2/\partial p)(p/E_2^*)]dp/p + E_2^*[(\partial E_2/\partial y)(1/E_2^*)]dy \\ &\quad + E_2^*[(\partial E_2/\partial K)(K/E_2^*)]dK/K \end{aligned} \tag{A-11}$$

Next, evaluate the terms in the brackets. Utilizing the definitions $\eta_2$ and $m_2$ in the partial of $E_2 = D_2 - X_2$ yields:

$$\partial E_2/\partial p = (\partial D_2/\partial p) - (\partial X_2/\partial p) = (E_2^*/p)\eta_2$$
$$\partial E_2/\partial y = \partial D_2/\partial y = m_2/p$$

[15] If H is initially the net importer of capital ($K < 0$), the budget constraint (A-9) is replaced by $D_1^* + pD_2^* = X_1^* + pX_2^* + rK$.

[16] Total differentiation of (A-9) leads to:

$$(dD_1^* + pdD_2^*) = -(D_2^* - X_2^*)dp + (dX_1^* + pdX_2^*) - r^*dK - Kdr^*$$

which reduces to $dy^* = -E_2^*dp - Kdr^*$ with applications of (A-2), $E_2^* = D_2^* - X_2^*$, and (A-3).

The duality relations between the Rybczynski theorem and the Stolper-Samuelson theorem are given by $\partial X_2/\partial K = -\partial r/\partial p$ and $\partial X_2^*/\partial K = \partial r^*/\partial p$.[17] It follows that:

$$(\partial E_2/\partial K)(K/E_2^*) = (-\partial X_2/\partial K)(K/E_2^*)$$
$$= (\partial r/\partial p)(p/r)(rK/pE_2^*) = \gamma\mu$$

Substitution into (A-11) yields:

$$dE_2 = E_2^*[\eta_2(dp/p) + (m_2/(pE_2^*))dy + \gamma\mu(dK/K)]$$

Similar procedure applied to $E_2^* = E_2^*(p, y^*, K)$ leads to:[18]

$$dE_2^* = E_2^*[\eta_2^*(dp/p) + (m_2^*/(pE_2^*))dy^* - \gamma^*\mu^*(dK/K)]$$

Utilizing Lemma 2, substitute $[-dy + (r^* - r)dK]$ for $dy^*$:

$$dE_2^* = E_2^*\{\eta_2^*(dp/p) + [m_2^*/(pE_2^*)][-dy + (r^* - r)dK] - \gamma^*\mu^*(dK/K)\}$$

Adding $dE_2$ and $dE_2^*$ yields:

$$d(E_2 + E_2^*) = E_2^*\{(1/p)(\eta_2 + \eta_2^*)dp + [(m_2 - m_2^*)/(pE_2^*)]dy$$
$$+ [(m_2^*/(pE_2^*))(r^* - r) + (\mu\gamma - \mu^*\gamma^*)/K]dK\}$$

Substitution of (A-10) for $dy$ leads to:

$$\begin{aligned} d(E_2 + E_2^*) &= E_2^*\{(1/p)(\eta_2 + \eta_2^*)dp \\ &\quad + [(m_2 - m_2^*)/(pE_2^*)][E_2^*(1 + \mu^*\gamma^*)dp + (r^* - r)dK] \\ &\quad + [(m_2^*/(pE_2^*))(r^* - r) + (\mu\gamma - \mu^*\gamma^*)/K]dK\} \\ &= E_2^*\{(1/p)[(\eta_2 + \eta_2^*) + (m_2 - m_2^*)(1 + \mu^*\gamma^*)]dp \\ &\quad + [(m_2/(pE_2^*))(r^* - r) + (\mu\gamma - \mu^*\gamma^*)/K]dK\} \\ &= -(E_2^*/p)\Delta dp + (1/p)[m_2(r^* - r) + (pE_2^*/K)(\mu\gamma - \mu^*\gamma^*)]dK \end{aligned}$$

Utilizing the definitions for $\mu$ and $\mu^*$:

$$d(E_2 + E_2^*) = (1/p)\{-E_2^*\Delta dp + [m_2(r^* - r) + (r\gamma - r^*\gamma^*)]dK\} \qquad \text{(A-12)}$$

An application of the trade equilibrium condition $d(E_2 + E_2^*) = 0$ yields:

$$E_2^*\Delta dp = [m_2(r^* - r) + (r\gamma - r^*\gamma^*)]dK$$

from which the result (2) emerges. ■

STABILITY. The world market for commodity 2 is said to be stable if the change in excess demand $d(E_2 + E_2^*)$ is inversely related to the international price-change $dp$. Equation (A-12) shows that the stability holds if and only if $E_2^*\Delta > 0$.

PROOF OF PROPOSITION 2. The result (3) follows immediately from applying Lemma 3 and Proposition 1 in Equation (1). ■

[17] Such duality relations were first shown by Samuelson (1953). Other proofs appear in Kemp (1966, p. 807) and Silberberg (1990, p. 562).

[18] In contrasting the expression for $dE_2$ and $dE_2^*$, the difference in signs in the last two terms is due to the duality relations.

## REFERENCES


Bhagwati, J. and R. Brecher (1980), "National Welfare in an Open Economy in the Presence of Foreign-Owned Factors of Production," *Journal of International Economics*, 10, 103–115.

Bhagwati, J. and E. Tironi (1980), "Tariff Changes, Foreign Capital and Immiserization," *Journal of Development Economics*, 7, 71–83.

Bowen, H., A. Hollander, and J. Viaene (1998), *Applied International Trade Analysis*, University of Michigan Press, Ann Arbor.

Bowen, H., E. Leamer, and L. Sviekauskaus (1987), "Multicountry, Multifactor Tests of the Factor Abundance Theory," *American Economic Review*, 77, 5, 791–801.

Brecher, R. and R. C. Feenstra (1983), "International Trade and Capital Mobility between Diversified Economics," *Journal of International Economics*, 14, 321–339.

Brecher, R. and R. Findlay (1983), "Tariffs, Foreign Capital and National Welfare," *Journal of International Economics*, 14, 277–288.

Chipman, J. (1971), "International Trade with Capital Mobility: A Substitution Theorem," in Bhagwati, Jones, Mundell, and Vanek (eds.), *Trade, Balance of Payments and Growth*, NY: North-Holland, 201–237.

Cuddington, J. (1992), "Long-Run Trends in 26 Primary Commodity Prices: A Disaggregated Look at the Prebisch-Singer Hypothesis," *Journal of Development Economics*, 39, 207–227.

Ethier, W. (1986), "The Multinational Firm," *Quarterly Journal of Economics*, 4, November, 805–833.

Feenstra, R., R. Lipsey, and H. Bowen (1997), "World Trade Flows, 1970–1992, with Production and Tariff Data," *NBER Working Paper*, 5910.

Froot, K., ed. (1993), *Foreign Direct Investment*, University of Chicago Press.

Grossman, g. and E. Helpman (1995), "Technology and Trade," in G. Grossman and K. Rogoff (eds.), *Handbook of International Economics*, v. III, ch. 25, North-Holland, 1279–1337.

Hamilton, C. and L. Svensson (1982), "On the Welfare Effects of a Duty Free Zone," *Journal of International Economics*, 4, 225–241.

Inada, K. and M. Kemp (1969), "International Capital Movements and the Theory of Tariffs and Trade: Comment," *Quarterly Journal of Economics*, 83, 524–528.

Jones, R. (1965), "The Structure of Simple General Equilibrium Models," *Journal of Political Economy*, 73, 557–572.

Jones, R. (1967), "International Capital Movements and the Theory of Tariffs and Trade," *Quarterly Journal of Economics*, 81, 1–38.

Jones, R. (1984), "Protection and the Harmful Effects of Endogenous Capital Flows," *Economics Letters*, 15, 325–330.

Jones, R. (2000), "Heckcher-Ohlin Trade Models for the New Century," Department of Econimics, University of Rochester.

Jones, R., H. Beladi, and S. Marjit (1999), "The Three Faces of Factor Intensities," *Journal of International Economics*, 48, 413–420.

Jones, R. and R. Ruffin (1975), "Trade Patterns with Capital Mobility," in M. Parkin and A. R. Nobay, eds. (Association of University Teachers of Economics), *Current Economic Problems*, NY: Cambridge University Press, 307–332.

Kemp, M. (1966), "The Gain from International Trade and Investment: A Neo-Heckscher-Ohlin Approach," *American Economic Review*, 56, 788–809.

Krugman, P. (1989), "Differences in Income Elasticities and Trends in Real Exchange Rates," *European Economic Review*, 33, 1031–1054.

Lahiri, S. and Y. Ono (1989), "Terms of Trade and Welfare: A General Analysis," *Economic Record*, 65, 27–31.

Leamer, E. and J. Levinsohn (1995), "International Trade Theory: The Evidence," in G. Grossman and K. Rogoff (eds.), *Handbook of International Economics*, v. III, ch. 26, North-Holland, 1339–1394.

Leontief, W. (1953), "Domestic Production and Foreign Trade: The American Capital Position Reexamined," *Proceedings of the American Philosophical Society*, 97, 332–349.

Markusen, J. (1995), "The Boundaries of Multinational Enterprises and the Theory of International Trade," *Journal of Economic Perspective*, 9, 2, 169–189.

Markusen, J. and A. Venables (1995), Multinational Firms and the New Trade Theory, *NBER Working Paper*, 5036.

Ruffin, R. (1984), "International Factor Movements," in R. Jones and P. Kenen, eds., *Handbook of International Economics*, North Holland, 237–288.

Samuelson, P. (1953), "Prices of Factors and Goods in General Equilibrium," *Review of Economic Studies*, 21, 1–20.

Silberberg, E. (1990), *The Structure of Economics: A Mathematical Analysis*, NY: McGraw-Hill.

Trefler, D. (1995), "The Case of Missing Trade and Other Mysteries," *American Economic Review*, 85, 5, 1029–1046.

Uekawa, Y. (1972), "On the Existence of Incomplete Specialization in International Trade with Capital Mobility," *Journal of International Economics*, 2, 1–23.

United National Conference on Trade and Development (UCTAD, 1994, 1996, 1999), *World Investment Report*, United Nations, NY.