TEL-AVIV

Working paper 26-82

THE FOERDER INSTITUTE FOR ECONOMIC RESEARCH

TEL-AVIV UNIVERSITY

RAMAT AVIV ISRAEL

מכון למחקר כלכלי ע״ש ד״ר ישעיהו פורדר ז״ל

ע״י אוניברסיטת תל־אביב

INCREASING RETURNS, MONOPOLISTIC COMPETITION, AND FACTOR MOVEMENTS: A WELFARE ANALYSIS*

by

Elhanan Helpman and Assaf Razin

Working Paper No. 26-82

May, 1 9 8 2

FOERDER INSTITUTE FOR ECONOMIC RESEARCH,
Faculty of Social Sciences, Tel Aviv University,
Ramat Aviv, I s r a e l.

INCREASING RETURNS, MONOPOLISTIC COMPETITION, AND FACTOR MOVEMENTS: A WELFARE ANALYSIS *

by

Elhanan Helpman and Assaf Razin
Tel Aviv University

1. INTRODUCTION

The welfare economics of international factor movements have been widely discussed in the literature. In private ownership economies factor owners choose the location of employment of their factors of production according to the highest reward and when permitted this includes locations in different countries. In competitive economies with convex technologies these private considerations coincide with social welfare (except for monopolistic considerations of large countries). As one might suspect, this coincidence of goals does not necessarily hold in economies which are characterized by industries which operate with increasing returns to scale and in which firms engage in monopolistic competition. The aim of this study is to identify the channels of influence of factor movements on social welfare which are special to such market structures, and in view of their existence to evaluate in welfare terms the performance of the private sector's decisions about the international allocation of productive resources. In the main analysis we will use foreign investment as a case study, but it should be clear that our findings apply to all factor movements except for labor migration. An analysis of labor migration requires as an input the results reported below, but since migration is guided by utility differentials rather than wage differentials it requires a separate treatment (see, for example, the discussion in Helpman and Razin (1980)).

Our main concern is with welfare aspects. For this reason we will assume that reward differentials exist (thereby inducing factor movements) without specifying the factors that generate these reward differentials. In the case discussed in this paper primary inputs can be differently priced in different countries for the same reasons that are advanced in the standard trade models (see, for example, Jones (1967)). It should only be pointed out that in the present framework they can also be differentially priced due to pure size differences among countries (see Helpman and Razin (1980)).

In order to have a benchmark for our main findings, we present in Section 2 a standard analysis of the welfare effects of capital mobility. In Section 3 we provide a detailed analysis of the effects of changes in the capital stock on a country's gross domestic product for economies with an increasing returns to scale sector in which firms engage in average cost pricing. The results of this analysis are then used in Section 4 to perform a cost-benefit analysis of international capital movements for an economy which produces differentiated products under increasing returns to scale. Concluding comments are provided in Section 5.

2. THE STANDARD WELFARE ANALYSIS OF FACTOR MOVEMENTS

As a prelude to our main discussion, we present in this section an analysis of welfare gains from factor movements for a competitive economy with a convex technology. For simplicity, we aggregate all traded goods into a single commodity Y and choose $p_Y = 1$ as its price. The aggregation is based on the assumption that relative prices of traded goods do not change as a result of factor movements (the small country assumption in commodity markets) in order to avoid welfare changes that result from adjustments in the terms of trade, because our main analysis sheds no new light on this issue. We also assume that there is a single nontraded good X whose price in terms of Y is p (an extension to many nontraded goods is straightforward).

Assuming the existence of a representative consumer, or a social welfare function which is maximized with costless income redistribution, our country's welfare level can be represented by an indirect utility function $v(p,GNP)$, where GNP stands for gross national product measured in units of Y, which equals net national product due to the lack of depreciation of the capital stock. Assuming that all foreign source income stems from international mobility of capital, GNP equals GDP minus rental payments on domestically employed foreign capital. Hence,

$$GNP = GDP(p,L,K+\Delta) - \rho\Delta \tag{1}$$

where GDP(·) is the gross domestic product function (which has the standard properties of a restricted profit function as discussed, for example, in Varian (1978)), L and K stand for domestically owned labor and capital (assumed to be inelastically supplied), Δ stands for foreign capital employed in the home country when $\Delta > 0$ and domestic capital employed abroad when $\Delta < 0$. Finally, ρ represents the rental rate on Δ.

When foreign capital is employed in the home country $\rho = r$, where r is the domestic rental rate on capital and it equals the domestic marginal product value of capital $\partial GDP(\cdot)/\partial K$. Here the assumption is that foreignly owned capital commands the same rental rate as domestically owned capital. On the other hand, when domestic capital is employed abroad its rental rate in the foreign country is ρ, which may be a function of the size of foreign investment.

Choosing a transformation of the utility function such that in equilibrium the marginal utility of income (i.e., $\partial v/\partial GNP$) equals one, differentiation of $v(\cdot)$, using (1) and the properties of the indirect utility and GDP functions yield:

$$dU = (r - \rho)d\Delta - \Delta d\rho + (X - D_X)dp$$

where X is the output level of sector X and D_X is consumption of X. Since X is not traded, in equilibrium $X = D_X$, and we obtain:

(2) $$dU = (r - \rho)d\Delta - \Delta d\rho$$

Suppose that r is smaller than the rental rate that domestic capital can obtain abroad. Then owners of domestic capital will shift part of it into foreign operations thereby increasing domestic welfare due to the first term on the right-hand-side of (2) (since $r < \rho$ and $d\Delta < 0$). If the foreign rental rate is unaffected by the home country's investment abroad, the second term on the right-hand-side of (2) equals zero. If, on the other hand, the foreign rental rate on domestic capital invested abroad declines with the size of the investment and we start with a positive investment level ($\Delta < 0$), the second term generates a negative welfare effect, but this negative welfare effect is negligible for small investment levels. In the case under discussion dU evaluated at $\Delta = 0$ is positive, so that it pays to invest abroad at least a little. The negative welfare effect (which doesn't exist at $\Delta = 0$) stems from monopoly power in foreign investment and we will disregard it in what follows because our main analysis sheds no new light on this particular aspect of international capital mobility.

Now suppose that r exceeds the rental rate that foreign capital receives abroad. Then foreigners will invest in the home country. In this case $r \equiv \rho$ and (2) reduces to $dU = -\Delta dr$. However, due to the concavity of the GDP function in the employed levels of factors of production the rental rate on capital declines with capital inflows so that for positive investment levels ($\Delta > 0$) welfare increases. This shows that private considerations about the location of capital coincide with social benefits in the sense that social welfare increases as a result of private decisions to shift capital to the high return location.

3. INCREASING RETURNS AND INCOME EFFECTS OF CAPITAL MOVEMENTS

We have seen in the previous section that in a competitive economy with convex technologies private decisions about the location of capital coincide with the goal of social welfare maximization. An important ingredient in that analysis was the effect of capital movements on GDP. In particular, an inflow of one unit of capital increases GDP by exactly the market rental rate on capital ($r = \partial GDP/\partial K$), thus making the private and social returns on capital coincide. This is achieved in a competitive economy due to marginal cost pricing.

In sectors with increasing returns to scale marginal cost pricing is incompatible with profitable production. In such cases free entry drives firms to engage in average cost pricing and indeed this assumption is common in much of the recent literature on international trade in the presence of economies of scale (see the literature surveyed in Helpman (1982)). If this is the case, an inflow of one unit of capital (or an increase in the employed capital stock due to, say, investment) will not increase GDP by the market rental rate on capital. A similar argument also applies to other factors of production. However, for every welfare analysis of factor movements their effect on GDP will be of major importance. For this reason we provide in this section the relevant analysis (which we believe to be of interest in its own right) which will be used in the next section for welfare evaluations.

The following analysis applies to models in which sectors with economies of scale are populated by firms which have identical technologies. They charge the same price and, due to free entry, engage in average cost pricing. For example, recent models of monopolistic competition in differentiated products which confine attention to symmetric equilibria satisfy these requirements (see Helpman (1982)). Assuming again that there are two goods, X and Y, which are produced with labor and capital, where this time Y is produced with constant returns to scale and X is produced with increasing returns to scale, the equilibrium conditions in production can be represented as follows:

$$1 = c_Y(w,r) \tag{3}$$

$$p = C_X(w,r,x)/x \tag{4}$$

$$a_{LY}(w,r)Y + \ell_X(w,r,x)N = L \tag{5}$$

$$a_{KY}(w,r)Y + k_X(w,r,x)N = K + \Delta \tag{6}$$

where $c_Y(\cdot)$ is the marginal cost function of Y, w and r are the wage rate and the rental rate on capital, $C_X(\cdot)$ is a single firm's cost function in industry X, x is the output level of a single firm in industry X, $a_{LY}(\cdot)$ $(= \partial c_Y/\partial w)$ is the employed labor-output ratio in the production of Y, $a_{KY}(\cdot)$ $(=\partial c_Y/\partial r)$ is the employed capital-output ratio in the production of Y, $\ell_X(\cdot)$ $(=\partial C_X/\partial w)$ is the employment of labor by a single firm in industry X, $k_X(\cdot)$ $(=\partial C_X/\partial r)$ is the employment of capital by a single firm in industry X, Y is the output of product Y and N is the number of firms in industry X.

Equation (3) represents the condition of marginal cost pricing in the production of Y (the price of Y equals one) while equation (4) represents the condition of average cost pricing in the production of X. Equations (5) and (6) represent equilibrium conditions in factor markets. The demand for labor and capital by a firm in sector X and its cost function are not proportional to its output level x due to economies of scale. In fact, the elasticity of $C_X(\cdot)$ with respect to x is smaller than one, because due to scale economies the standard measure of economies of scale:

$$\theta(w,r,x) \equiv \frac{C_X(w,r,x)/x}{\partial C_X(w,r,x)/\partial x} \tag{7}$$

is larger than one.

Given a single firm's output level x, the price of output in the X sector p, and the employment of factors of production L and $K+\Delta$, equations (3)-(6) provide a solution to factor prices w and r, the output level Y and the number of firms N in the industry producing with increasing returns to scale. We can use equations (3)-(6) to derive a GDP function for the economy under analysis, which is an analogue of the GDP function used in the previous section. For this purpose we transform these equations as follows. Let:

$c_X(w,r;x) \equiv C_X(w,r,x)/x$ = average cost function of a firm in sector X

$a_{LX}(w,r;x) \equiv \ell_X(w,r,x)/x$ = labor-output ratio in sector X

$a_{KX}(w,r;x) \equiv k_X(w,r,x)/x$ = capital-output ratio in sector X

$X \equiv Nx$ = output level in sector X .

Using the new variables, equations (3)-(6) can be rewritten as:

(3') $\quad 1 = c_Y(w,r)$

(4') $\quad p = c_X(w,r;x)$

(5') $\quad a_{LY}(w,r)Y + a_{LX}(w,r;x)X = L$

(6') $\quad a_{KY}(w,r)Y + a_{KX}(w,r;x)X = K + \Delta$

Equations (3')-(6') have the standard form of the production equilibrium conditions in a competitive constant returns to scale economy as long as x is given. In particular, $c_X(\cdot)$ has the usual properties of a unit cost function as far as its dependence on factor prices is concerned. Moreover, $a_{LX}(\cdot) = \partial c_X(\cdot)/\partial w$ and $a_{KX}(\cdot) = \partial c_X(\cdot)/\partial r$, so that by duality there exists a sectoral constant returns to scale production function of X from which $c_X(\cdot)$, $a_{LX}(\cdot)$ and $a_{KX}(\cdot)$ are derivable.[1] Hence, system (3')-(6') implies the existence of a GDP function, $GDP(p,L,K+\Delta;x)$, such that it has the usual properties with respect to

$(p,L,K+\Delta)$. In particular, $\partial GDP/\partial p = X = Nx$ $\partial GDP/\partial L = w$, $\partial GDP/\partial K = r$ and GDP is convex in p and concave in $(L,K+\Delta)$. The difference between this GDP function and that used in the previous section is the dependence of the present one on x, the individual firm's output level. It is obvious from (5')-(6') that x operates like technical progress an increase in x reduces unit output costs $c_X(\cdot)$ -- because due to (7) the elasticity of $c_X(\cdot)$ with respect to x is $-1 + 1/\theta(.) < 0$. Let $b = 1 - 1/\theta$ be the absolute value of the elasticity of $c_X(\cdot)$ with respect to x, then following the analysis of technical progress in Jones (1965) $b = \theta_{LX}b_L + \theta_{KX}b_K$ where b_L is minus the elasticity of $a_{LX}(\cdot)$ with respect to x, b_K is minus the elasticity of $a_{KX}(\cdot)$ with respect to x, and θ_{jX} is the share of factor j in costs of production; $j = L,K$. As Jones (1965) has shown, a one percentage point increase in x has the same effect on <u>output</u> levels as a b percent increase in the price p plus a $\lambda_{LX}b_L$ percent increase in the labor force plus a $\lambda_{KX}b_K$ percent increase in the capital stock, where λ_{LX} is the share of labor employed in the production of X and λ_{KX} is the share of the capital stock employed in the production of X.[2] This can be explained as follows. Suppose x is increased by a one percentage point and the number of firms N is reduced by a one percentage point so that aggregate output in sector X does not change. As a result of the increase in x each firm will increase its employment of labor by ε_{LX} percent, where ε_{LX} is its elasticity of labor demand with respect to output, so that the sector's demand for labor will increase by ε_{LX} percent. On the other hand, due to the decline in the number of firms in the industry, the industry's labor demand will fall by one percent, so that $b_L \equiv 1 - \varepsilon_{LX}$ is the proportion of the industry's labor force that is being released as a result of these changes. Since the industry employs the proportion λ_{LX} of the total labor force, $\lambda_{LX}b_L$ is the industry's saving of labor as a proportion of the total labor force. Similarly, $\lambda_{KX}b_K$ is the proportion of total capital saved by industry X as a result of a one percent increase in x, holding aggregate output X constant (with the adjustment being made by means of an increase in the number of firms in the industry). In addition to these factor supply effects, a one percentage point increase in x reduces unit production costs by b percent.

Using the above described relationship between the effects on output levels of a one percentage point increase in x and a b percent increase in the price of p plus $\lambda_{jX}b_j$, $j = L,K$, percent increases in the supply of factors of production, one can calculate the change in GDP as a result of a one percentage point increase in x as follows:

$$\frac{\partial GDP}{\partial x}x = (p\frac{\partial X}{\partial p} + \frac{\partial Y}{\partial p})pb + (p\frac{\partial X}{\partial L} + \frac{\partial Y}{\partial L})L\lambda_{LX}b_L + (p\frac{\partial X}{\partial K} + \frac{\partial Y}{\partial K})K\lambda_{KX}b_K$$

The term in the first bracket on the right hand side equals zero (due to the standard tangency condition between the GDP line and the transformation curve), the term in the second bracket is the wage rate w and the term in the third bracket is the rental rate on capital r. Hence, using the definition of λ_{jX}, $j = L,K$, we obtain:

$$\frac{\partial GDP}{\partial x}x = w\, a_{LX} X\, b_L + r\, a_{KX} X\, b_K = pX(\theta_{LX} b_L + \theta_{KX} b_K) = pXb$$

and

$$\frac{\partial}{\partial x} GDP(p,L,K+\Delta;x) = pN(1-\theta^{-1})$$

where use has been made of the relationships $X = Nx$ and $b = (1 - \theta^{-1})$.

Now define r^* to be the increase in GDP that results from an increase in Δ holding p constant. In the competitive case with convex technologies this was shown to equal r -- the market rental rate on capital. In the case considered here it is:

$$r^* = \frac{\partial}{\partial \Delta} GDP(\cdot) + \frac{\partial}{\partial x} GDP(\cdot)\frac{dx}{d\Delta}$$

where $dx/d\Delta$ is a total derivative. Using the previous result this can be written as:

$$(8) \qquad r^* = r + pN(1 - \theta^{-1})\frac{dx}{d\Delta}$$

Since $\theta > 1$ (economies of scale), (8) tells us that an inflow of one unit of capital will increase GDP by more than the market rental rate on capital if it brings about an expansion of every firm's output level in sector X and it will increase GDP by less than the market rental rate on capital or even reduce GDP (as we will show) if it brings about a contraction of every firm's output level in sector X. This means that the private sector may undervalue or overvalue the marginal productivity of capital (and labor) as far as GDP is concerned, depending on its marginal effect on the size of operation of firms in the sector with economies of scale (with constant returns to scale $\theta = 1$ and $r^* = r$). However, this is but one consideration in the cost-benefit analysis of international capital movements, although it is an important one. A complete welfare analysis for an economy that produces differentiated products is presented in the next section.

4. DIFFERENTIATED PRODUCTS AND THE WELFARE ECONOMICS OF CAPITAL MOVEMENTS

A complete analysis of the welfare effects of international movements of factors of production in the presence of economies of scale and monopolistic competition requires a complete specification of the economy's structure. We chose to analyze an economy in which sector X produces differentiated products and we model it along the lines suggested in Lancaster (1980) and Helpman (1981). However, here we assume that Y is a composite traded good while the differentiated products are nontraded goods. The assumption of nontradedness of the differentiated products simplifies the analysis by enabling us to employ the small country assumption without having to deal explicitly with the effects of factor movements on the number of varieties supplied on world markets. Moreover, it is an assumption of interest in its own right because many services (such as restaurant meals) are nontraded differentiated products.

Following Lancaster (1979) we assume that every consumer has a utility function $u(\cdot)$ defined on the consumption level of good Y, α_Y, and the consumption level of his most preferred differentiated product X, α_X. We assume that these preferences can be represented by a Cobb-Douglas utility function:

$$u = s^{-s}(1-s)^{s-1} A\alpha_X^{s}\alpha_Y^{1-s} \quad , 0 < s < 1, \quad A > 0 \tag{9}$$

If an individual has to consume a variety which is at distance δ from his ideal product then $\alpha_X(\delta)$ units of this variety provide him with the same level of utility as $\alpha_X(\delta)/h(\delta)$ units of the ideal product, where $h(.)$ is Lancaster's compensation function. This means that the effective price a consumer pays for a unit of his ideal product is $p(\delta)h(\delta)$ if he buys for the price $p(\delta)$ a variety which is at distance δ from his ideal product. Given his income level I in terms of Y and measuring $p(\delta)$ in units of Y his demand functions are:

$$\alpha_X = \frac{sI}{p(\delta)h(\delta)}$$

$$\alpha_Y = (1-s)I$$

and his indirect utility function is:

$$v = AI[p(\delta)h(\delta)]^{-s} \tag{10}$$

All consumers are assumed to be identical except for their most preferred variety. They are, however, uniformly distributed over the set of varieties in terms of their preferences, where this set is assumed to consist of a circumference of a circle whose length is one (see Helpman (1981)).

Assuming that Y is produced with constant returns to scale while every variety in sector X is produced with the same increasing returns to scale technology, and assuming that firms in industry X engage in monopolistic competition with free entry which enforces average cost pricing, we can describe a symmetric equilibrium of this economy (in a symmetric equilibrium all varieties are equally priced and produced in equal quantities) which translates in the present case into equations (3)-(6) plus the following two conditions (see Helpman (1981)):

$$R(N) = \theta(w,r,x) \tag{11}$$

$$s(pxN + Y - \rho\Delta) = pxN \tag{12}$$

The production conditions (3)-(6) were discussed already. It should only be pointed out that due to the economies of scale every firm in sector X produces a different variety so that N stands for both the number of firms and the number of varieties supplied by local firms. Since X-goods are not traded, N is also the number of varieties that are consumed. Condition (11) stems from monopolistic competition which leads every firm in sector X to equate marginal costs to marginal revenue, and from average cost pricing. These two imply the equality of the degree of monopoly power represented by $R(\cdot)$ to the degree of economies of scale $\theta(\cdot)$. The degree of monopoly power is measured by the ratio of average revenue to marginal revenue which equals in the case of a Cobb-Douglas utility function (and a unit length of the circumference of the circle) to one plus twice the elasticity of $h(\cdot)$ evaluated at $\delta = 1/N$ (see equation (49) in Helpman (1981)). Finally, equation (12) describes the equilibrium condition in the market for nontraded goods -- proportion s of GNP is spent on X-products. From the system of equations (3)-(6) and (11)-(12) we can calculate the effect of capital movements on all endogeneous variables, and in particular on x which is required in order to find out whether the market rental rate on capital r under-values or overvalues the GDP effect of capital movements.

Producers in sector X supply in equilibrium N varieties. Since every product is sold for the same price, consumers whose ideal product is one of the N that are being produced are better off than other consumers. Using the indirect utility function (10), the fact that all varieties are equally priced and the fact that a proportion $1/N$ of consumers is served by a single firm in sector X, the average utility level is calculated to be:

$$AIp^{-s}N\int_0^{1/N}[h(\delta)]^{-s}d\delta$$

If the produced varieties are drawn from a uniform distribution this represents the ex-ante expected utility level of <u>every</u> consumer. Multiplying the average welfare level by L and taking advantage of the accounting equation $LI = GDP - \rho\Delta$, we obtain the following measure of the economy's aggregate welfare level:

$$U = Ap^{-s}[GDP(p,L,K+\Delta\,;x) - \rho\Delta]\phi(N) \tag{13}$$

where $GDP(\cdot)$ is a function with the properties discussed in the previous section and $\phi(N) \equiv N\int_0^{1/N}[h(\delta)]^{-s}d\delta$ is an increasing function of N.

It is seen from (13) that the welfare effects of capital movements (a change in Δ) can be decomposed into four parts; two traditional effects and two new ones. The traditional effects are the direct effect of Δ

on GNP both through its effect on GDP and on repatriation payments and the indirect effect through an induced change in the price p of X-goods. These were discussed in Section 2 in which we presented the traditional analysis and we showed that the price effect is nil due to the nontradedness of X-goods. This will be shown to be true also in the present case. The new channels of influence that appear in (13) are an induced change in the scale of operation of firms in the differentiated product industry, that was discussed in detail in Section 3, and an induced change in the number of varieties that are available to consumers, whose welfare implications are similar to those of public goods.

Total differentiation of (13), using properties of the $GDP(p,L,K+\Delta;x)$ function that were derived in the previous section and the definition of r^* in (8), we obtain:

$$dU = \frac{U}{\phi}\phi' dN + \frac{U}{GNP}[(r^* - \rho)d\Delta - d\rho\Delta] + \frac{U}{p}(\frac{pxN}{GNP} - s)dp$$

where $\phi' > 0$ is the derivative of ϕ with respect to N. Due to the equilibrium condition in the market for nontraded goods the last term -- which captures the induced price effect -- equals zero, just as in the standard analysis. Choosing the constant A so that $U = GNP$ at the initial equilibrium point (which means that the marginal utility of income equals one), the change in welfare is:

$$dU = \frac{U}{\phi}\phi' dN + (r^* - \rho)d\Delta - d\rho\Delta \tag{14}$$

where (from (8))

$$r^* = r + pN(1 - \theta^{-1})\frac{dx}{d\Delta}$$

Comparing this equation to (2) we see immediately the two novel elements in the present welfare analysis of capital flows; the effect on the number of varieties and the difference between the social value of capital as a contributor to GDP, r^*, and the private value r, which do not coincide unless the scale of operation of firms in sector X does not change.

The above described considerations suggest that private decision to locate capital in the highest private return location may have negative social welfare effects. This is demonstrated by the following two cases.

<u>Case 1</u>. Suppose that a capital outflow reduces the number of varieties supplied in the investing country and it reduces the scale of operation of a representative firm in sector X (i.e., $dN/d\Delta > 0$ and $dx/d\Delta > 0$). In this case $r^* > r$. Suppose also that foreigners offer a rental rate on domestic capital ρ which exceeds r but falls short of the social productivity of domestically employed capital r^*. Disregarding the effect of foreign investment on ρ, it is seen that in this case private owners of capital will invest abroad ($d\Delta < 0$) bringing about a reduction of domestic welfare ($dU < 0$). The reduction of welfare stems from the fact that the rental rate on capital offered by foreigners falls short of the domestic social productivity of capital in terms of GDP and that a capital outflow makes less varieties available to consumers. Nevertheless, atomistic individuals will invest abroad because they maximize their own income.

Case 2. Suppose that a capital inflow reduces the number of varieties produced in the home country and the scale of operation of a representative firm in industry X. In this case $r^* < r$, which means that the domestic market rental rate on capital overstates its marginal product value. Suppose also that $r^* < \rho < r$. Then foreigners will find it profitable to invest in the home country (because $\rho < r$), but domestic welfare will decline because the capital inflow will reduce GNP and the number of varieties available to domestic consumers.

The two cases discussed above show that an investing country as well as a recipient country may lose from foreign investment, provided the number of varieties and the scale of operation of firms producing these varieties can respond to capital flows as indicated in the suppositions of these cases. Generally, the response of x and N to changes in Δ can be calculated from the general equilibrium system described by equations (3)-(6) and (11)-(12). For present purposes it is sufficient to bring examples to the effects discussed in Cases 1 and 2, which we do below.

Case 1. Let Y be produced only by means of labor and let X be produced only by means of capital. Let the production function of X be:

$$x = \begin{cases} 0 & \text{for } k_X < \overline{\beta}_X \\ & \qquad \overline{\beta}_X, \beta_X > 0 \\ (K_X - \overline{\beta}_X)/\beta_X & \text{for } k_X \geq \overline{\beta}_X \end{cases}$$

This is a production function with increasing returns to scale which has associated with it the linear cost function:

$$C_X = r(\overline{\beta}_X + \beta_X x) \quad \text{for} \quad x > 0$$

and the measure of economies of scale:

$$\theta = 1 + \overline{\beta}_X/(\beta_X x) \quad \text{for} \quad x > 0$$

In this case equilibrium conditions (6) and (11) become:

(6a) $(\overline{\beta}_X + \beta_X x)N = K + \Delta$

(11a) $R(N) = 1 + \overline{\beta}_X/(\beta_X x)$

Choosing a compensation function $h(\delta)$ whose elasticity is increasing in δ at $\delta = 1/N$ assures that $R(N)$ declines in N. In this case (6.a) and (11.a) imply $dN/d\Delta > 0$ and $dx/d\Delta > 0$; i.e., a capital outflow reduces the number of varieties and the scale of operation of a representative firm, and $r^* > r$.

<u>Case 2</u>. Suppose that Y is produced with a Lentief technology in which the input-output coefficients a_{LY} and a_{KY} are fixed and X is

produced only with labor according to the following production function:

$$x = \begin{cases} 0 & \text{for } \ell_X < \overline{\gamma}_X \\ (\ell_X - \overline{\gamma}_X)/\gamma_X & \text{for } \ell_X \geq \overline{\gamma}_X \end{cases} \qquad \overline{\gamma}_X, \gamma_X > 0$$

In this case the equilibrium conditions (5), (6) and (11) can be written as follows:

(5b) $$a_{LY}Y + (\overline{\gamma}_X + \gamma_X x)N = L$$

(6b) $$a_{KY}Y = K + \Delta$$

(11b) $$R(N) = 1 + \overline{\gamma}_X/(\gamma_X x)$$

It is straightforward to see that in this case $dN/d\Delta < 0$ and $dx/d\Delta < 0$, provided $R(\cdot)$ is declining in N, which happens when the elasticity of $h(\delta)$ is increasing in δ at $\delta = 1/N$.

Our examples show that indeed the social productivity of a factor of production can be understated or overstated by its market reward and that an expansion in the quantity of a factor of production may increase or reduce the number of varieties available to consumers. With a suitable reinterpretation of the equilibrium conditions, taking $\rho \equiv 0$, the last example can be used to produce $r^* < 0$ which shows that in a closed economy with differentiated products capital accumulation may be welfare reducing -- an immiserizing growth result. Finally, the reader should not be left with the impression that changes in the capital stock always affect N and x in the same direction; this is a special feature of our examples in which X-goods are produced with a homothetic production function. In Helpman and Razin (1980) there is an example with a nonhomothetic production function in which they can be affected in opposite directions.

5. CONCLUDING REMARKS

We have shown in this paper that in economies with sectors which produce differentiated products under increasing returns to scale, foreign investment may flow in the wrong directions thereby harming the recipient as well as the investing country. This was demonstrated by identifying two channels of influence which are special to such economies and which are not taken into account by private capital owners; the contribution of capital flows to GDP through its inducement of changes in the scale of operation of individual firms and its contribution to welfare through an inducement of changes in the number of varieties supplied to consumers. This finding has a clear policy implication -- it calls for an intervention to prevent harmful capital flows by bringing the private return on foreign investment in line with the social return, with the social return being the one derived in our cost-benefit analysis.

Although this paper deals with capital movements, the issue that is raised in it is much broader; the issue is really that in economies with increasing returns and a monopolistic market structure -- even if it is perfect competition according to Lancaster's (1979) terminology -- private valuations of productive resources do not coincide with social valuations. We have, for example, already indicated in the main text that in such economies the contribution of a factor of production to GDP may be negative and that capital accumulation may bring about a decline in welfare. However, given the market structure, one can use our techniques to compute appropriate shadow prices for policy evaluation purposes.

FOOTNOTES

* This paper is related to our Seminar Paper No.155, Institute for International Economic Studies, University of Stockholm, but it is not merely a revision of that paper.

1. This function is implicitly defined by $F(xL_X/X, xK_X/X) = x$, where $F(\cdot)$ is the single firm's production function and (L_X, K_X) are employment levels in industry X.

2. This can be easily verified by logarithmic differentiation of (3')-(6').

REFERENCES

Hanoch, G., 1975, "The elasticity of scale and the shape of average costs," <u>American Economic Review</u> 65, 492-497.

Helpman, E., 1981, "International trade in the presence of product differentiation, economies of scale and monopolistic competition: A Chamberlin-Heckscher-Ohlin approach," <u>Journal of International Economies</u> 11, 305-340.

Helpman, E., 1982, "Increasing returns, imperfect markets and trade theory," Chapter 7 in R.W.Jones and P.B.Kenen (eds.), <u>Handbook of International Economics</u> (North-Holland Publishing Company), (forthcoming).

Helpman, E. and A.Razin, 1980, "Monopolistic competition and factor movements," Seminar Paper No.155, Institute for International Economic Studies, University of Stockholm.

Jones, R.W., 1965, "The structure of simple general equilibrium models," <u>Journal of Political Economy</u> 73, 557-572.

Jones, R.W., 1967, "International capital movements and the theory of tariffs and trade," <u>Quarterly Journal of Economics</u> 81, 1-38.

Lancaster, K., 1979, <u>Variety, Equity and Efficiency</u> (Columbia University Press, New York).

Lancaster, K., 1980, "Intra-industry trade under perfect monopolistic competition," <u>Journal of International Economics</u> 10, 151-175.

Varian, H.R., 1978, <u>Microeconomic Analysis</u> (Norton, New York).