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MANAGERIAL CONTROL OF INTERNATIONAL FIRMS
AND PATTERNS OF DIRECT INVESTMENT

by

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International firms are among the most apparent links between the economies of different countries. Various claims are made about these links. For instance, it is commonly argued that international firms erode the efficacy of national policies such as macro stabilization measures, tax policies, and workplace safety regulations. The coherence of such arguments is usually hard to assess, since they are almost never supported formally. This paper contributes to the formal investigation of these links. In particular, the paper highlights how certain aspects of the *organizational structure* of international firms may affect the way in which these firms intertwine national economies.

International firms are multifaceted and very complex, and in a rigorous analysis one has to focus on one or a few aspects. The particular aspect focused upon here is the tendency for international firms to be *large*. The size of many existing international firms is indeed striking. For instance, the world's 100 largest international firms in 1982 on average employed 140,000 people.¹ Conversely, not only are many international firms large, international operations are common among large firms; of the total sales of the 792 largest industrial firms in 1982, the share of the sales of overseas subsidiaries and parent exports in total sales was over 40%.²

There is also an important theoretical rationale for why international firms should be large, based on the "OLI" framework. This framework

¹Dunning and Pearce (1985), table 4.1; firm size is here by employment.

²Dunning and Pearce (1985), table 7.6.

summarizes well the commonly accepted view among economists regarding the existence of international firms, seeing foreign direct investment as the consequence of the coincidence of three conditions.³ First, the firm possesses some ownership advantage that can be exploited simultaneously in different countries. Second, locational considerations induce the firm to exploit its advantage by simultaneous operations in several countries, rather than by concentrating production at one location and servicing the others with exports. Finally, it pays to internalize the transactions between the national units instead of conducting them at arm's length. It is an immediate consequence of the choice to internalize a transaction that operations becomes larger than with licensing: the serving of a market through internal production forces the firm to hire employees for the whole production apparatus. Thus, the OLI framework implicitly predicts internationalization to be associated with larger operations. Note that this difference in size is not marginal: if the size of the foreign market is equivalent to that of the home market, it would require approximately a doubling of the amount of productive resources to exploit the foreign market.

What are the more important large - firm aspects? Clearly, large operations yield economies of scope and scale and market power. These are

³The original inspiration is of course Coase (1937). Useful collections of articles and surveys of the theory of direct investment include: Kindleberger (1970), Dunning (1971, 1973, 1977), Hood and Young (1979), Caves (1982), and Kindleberger and Audretsch (1983). Studies expounding and utilizing the OLI framework are legion. The more important contributions include: Hymer (1960), Kindleberger (1969), Caves (1971, 1974), Buckley and Casson (1976), Dunning (1977, 1981), Casson (1979), and Rugman (1981).

concentrated on in the existing formal literature on international firms.⁴

The basic notion of the present paper is that this is only one blade of the scissors. Large international operations are likely also to pose costly problems of *managerial control*, for at least two reasons. First, it seems reasonable to hypothesize that "[t]he larger any organization becomes, the weaker is the control over its actions exercised by those at the top", as summarized by Downs' (1966) "Law of Diminishing Control"; a view deeply rooted in the theory of organization. Second, one should expect problems of control to be even further aggravated in the context of international operations. In addition to overcoming the difficulties posed by the physical distances between their different units, firms must surmount the barriers created by differences among countries in language, culture, industrial relations, legal systems etc. It is necessary not only to acquire sufficient information about a foreign country when undertaking the investment, but also continuously to maintain smooth interaction between the foreign affiliate and the home organization.⁵ This indicates that managerial control aspects of international firms warrant a closer examination. By including these costs one may also make explicit another implicit assumption in the OLI framework, namely that internationalization is inherently costly, and firms do not go international unless there are sufficient rewards from doing so.

The firm in our model utilizes an input with public good features, as

⁴This literature includes Markusen (1984) and Helpman (1984), who model ownership advantages as the possession of public inputs and take internalization as a matter of course, Ethier (1986) who explicitly models the internalization decision and reaches conclusions diametrically at odds with those of Markusen and Helpman, and Bond (1985) who addresses factor mobility issues. Further developments may be found in Helpman (1985), Helpman and Krugman (1985, Part IV), and Horstmann and Markusen (1987).

⁵See ch. 3 of Caves (1982).

in Helpman (1984) and Markusen (1984). This input is a fixed cost to the firm, and hence bounds the size of the firm away from zero. The optimal size and structure of the firm is then the outcome of the tension between the desire to be large, which this public good yields, and the restraining influence which stems from the private good aspect of the firm's managerial control resources. A main message of the paper is the importance of distinguishing between two types of international firms (IFs): the transnational firm (TNF) with different stages of production in different countries, and the multinational firm (MNF) which in addition to having different stages located in different countries also has the same stage simultaneously located in different countries. We will assume that output is proportional to the number of productive workers, and that each firm is a price-taker in the product market as well as in factor markets. These latter assumptions are obviously more or less objectionable on empirical grounds. They are made in order to remove the common sources for limits to the size of the firm, thus enabling us to highlight our main issue -- the importance of the organizational structure of international firms for how they intertwine national economies.

I. MANAGERIAL CONTROL OF THE FIRM

Our starting point is the theory of the limits to firm size advanced by Williamson (1967), which formally describes a (national) firm's organization as a hierarchy. Underlying the theory is the idea that individuals have bounded rationality, in the sense that their information processing capabilities are limited, and that they may be opportunistically promoting their own interest.

The "hierarchy" literature views the firm as an organization with a

variable number of administrative layers, each of which supervises the layer directly below, down to the production workers at the bottom. Each individual can effectively supervise a certain number of lower level workers (the "span of control" of the former), and this determines the relative size of successive layers. As production expands, that is, as the lowest level increases in size, the number of supervisory personnel must increase more rapidly: with a fixed span of control there must be both an equi-proportional increase in the size of each initial layer and an increase in the number of layers. Furthermore, total employment requirements could increase even more if, as assumed in much of this literature, there is a "loss of control", where the instructions of one layer are imperfectly executed by the layer below. Since the distortion is cumulative as instructions are passed down successive layers, an expansion of the firm -- by increasing the number of layers -- increases the average distortion. This must be compensated for by an even larger increase in employment.

The standard methodology in this area has been to hypothesize a relation between a supervisor at one level and his supervisees directly below. Then profit maximization allows an analysis of the equilibrium of the firm. Usually this analysis is concerned with determining the optimum number of layers. The literature takes as given the relative wages of workers in the different layers, the span of control, and the degree of loss of control (if any) between layers.⁶ There is a subliterate concerned with the source of the control loss. One approach, of which

⁶Exceptions are e.g. Rosen (1982) where relative wages are made endogenous, and Keren and Levhari (1979) where the spans of control are likewise derived.

Calvo and Wellisz (1979) is the basic reference, treats cases where managers can only partially monitor subordinates who will shirk when they can. Other papers, like Keren and Levhari (1979), assume the cause to be garbled communication (as when a rumor spreads) or simply the lost time required for one layer to process the information received from another layer and to pass it on.

The formal representations of these models are unfortunately a bit too complicated for our purposes. To keep the analysis manageable we instead employ a simple reduced form representation of the firm, which is based on the insights of this literature. We accordingly assume that any level of production requires a supporting hierarchy of some minimal size, and that this control apparatus must increase more than proportionally to an increase in the employment of (domestic) production workers -- in the following we will refer to this as the "Williamson" effect. We will disregard questions concerning the number of hierarchical layers, and we will consequently assume that all employees are paid the same wage.

This simplified treatment of the hierarchical aspect of the national firm allows us to extend Williamson's notion to firms with international operations, thus introducing the additional difficulties in running operations in locations that are distant geographically, culturally, etc. We denote this latter aspect the "interface effect".

II. THE MODEL OF THE FIRM

A firm employs two factors of production to manufacture an output in one or two countries. There are two components to the process of producing and selling a product, and one of the factors, labor, is involved in both.

Labor supplies, first, the productive effort necessary to produce and sell products. This may be done in either country.

The other component is "headquarter services", which are produced by means of labor and a second factor, called glop. Glop represents intangibles such as entrepreneurship, managerial ability, and R and D -- inputs which are an essential part of a firm's hierarchical apparatus and which are often said to characterize IFs.⁷ Glop is indivisible, so this centralized activity occurs in the country where glop is located. In order to capture the public good aspect of these intangibles we assume that the required amount of glop is independent of the scale of operations. It will hence be a fixed cost, yielding economies of scale. We define units such that the firm hires one unit of glop at a price r . The headquarters also coordinates the services of productive workers and glop. The amount of labor required for this depends upon the size of the firm and is subject to the hierarchical considerations discussed in the previous section.

There are two countries, home and foreign. Consider the technology of a home firm - i.e. a firm with its glop, and therefore its administrative hierarchy, located in the home country. This firm employs E production workers in the home country. In addition, the firm employs its unit of glop along with $H = h(E)$ workers for hierarchical control tasks. The (continuously differentiable) function h hence captures the Williamson effect. In line with the discussion above, it is assumed to have the following properties:

$$(1) \quad h(0) = 0; \quad h'(E) > 0 \quad \text{and} \quad h''(E) > 0 \quad \text{for } E \geq 0.$$

⁷See, for instance, ch. 1 of Caves (1982).

When the firm conducts international operations it must also overcome the barriers created by the interface effect. In order to capture this formally, we assume that when the physical effort is located in another country than its supporting and controlling workers, it has a magnified effect on the required hierarchical activity. Thus, for a home-based MNF, foreign operations of size E^* have the same effect on managerial requirements as would domestic operations of size $z(E^*)$, where the (continuously differentiable) function z fulfills

$$(2) \quad z(0) = 0; \quad z'(E^*) > 1 \quad \text{for } E^* \geq 0.$$

Thus, the hierarchical labor H required for a home MNF with operations E at home and E^* abroad equals $h(E+z(E^*))$.

The output Q of the typical home firm is equi-proportional to the sum of the number of production workers employed in the home and the foreign countries, as long as the firm supplies the required hierarchical effort: $Q = E + E^*$ if $H = h(E+z(E^*))$. This output is a perfect substitute for the outputs of all other firms, all of which are sold on the same perfectly competitive and internationally integrated goods market. Using the price of the final good as numeraire, and letting w and w^* denote the home and foreign wage, respectively, the profit of a typical home firm is:

$$\begin{aligned} \pi &= Q - w(E + H) - w^*E^* - r \\ (3) \quad &= E + E^* - w[E + h(E+z(E^*))] - w^*E^* - r \\ &\equiv \pi(E, E^*; w, w^*, r). \end{aligned}$$

Standard models of international trade assume that firms can substitute between different factors hired domestically. The indivisibility of labor makes such substitution infeasible here, but its public-good nature permits firms instead to substitute between the labor of different countries.

III. FACTOR REWARDS AND THE ORGANIZATIONAL STRUCTURE OF A FIRM

We first examine how firms' profit maximizing employment decisions are influenced by wages at home and abroad. The labor demand of the representative firm is by assumption small relative to the countries' labor endowments, so the firm perceives wages as given. The first-order conditions for a home based firm are then

$$(4) \quad \pi_E(E, E^*) = 1 - w - wh'(E+z(E^*)) \leq 0,$$

$$(5) \quad \pi_{E^*}(E, E^*) = 1 - w^* - wh'(E+z(E^*))z'(E^*) \leq 0.$$

Possible solutions to this optimization problem are conveniently characterized in the w - w^* plane. The four schedules labelled AA' , BB' , CC' , and DD' , illustrated in Fig. 1, have a common intersection point X , and each one is relevant on one side of X only. AX is the graph of $\pi_E(0,0) = 0$, i.e. of $1 - w(1 + h'(0)) = 0$. It shows combination of wages for which a firm with no production at all is just indifferent between commencing production at home or not. To the left of this line, where home wages are lower, the firm can acquire positive earnings by making E positive. To the right of this line E will be kept equal to zero.

The BX line graphs $\pi_{E^*}(0,0) = 0$, that is $1 - wh'(0)z'(0) - w^* = 0$. This shows situations where a firm with no production at all is just indifferent between commencing production abroad or not. Below the line it pays to make E^* positive and above the line it does not.

The CX line is the graph of $1 - (1 - w)z'(0) - w^* = 0$. This latter equation is obtained by substituting $\pi_E(E,0) = 0$ into $\pi_{E^*}(E,0) = 0$. Thus it shows those situations where a firm with no foreign operations but with the optimal level of domestic production is just indifferent between commencing production abroad or not. Below the line it pays to do so while above the line it does not.

Finally, the DX line is the analog of CX, but with the roles of the countries reversed. It depicts wage combinations which make a firm with an optimal level of foreign operations just indifferent between commencing production at home or not. DX is defined by the two equations $\pi_E(0,E) = 0$, and $\pi_{E^*}(0,E^*) = 0$.

Consider now the possible organizational structures of the firm.⁸ The possible outcomes are given in Table 1.⁹

⁸In this section we treat r as a fixed cost which must be paid regardless of output volume.

⁹The values of w at C, D, A', and B, are, respectively, $(z'(0) - 1)/z'(0)$, $(z'(E^*) - 1)/z'(E^*)$, $1/[1 + h'(0)]$, and $1/[h'(0)z'(0)]$. The value of w^* at X is $[1 - h'(0)z'(0)]/[1 + h'(0)]$. The figure is drawn on the assumption that $[1 + h'(0)]/h'(0) > z'(0)$, i.e. that the BX schedule intersects the w -axis at a higher wage than does the AA' schedule. This relation between $h'(0)$ and $z'(0)$ is assumed to hold throughout the paper.

	$\pi_{E^*}(\cdot, 0) < 0$	$\pi_{E^*}(\cdot, E^* > 0) = 0$
$\pi_E(0, \cdot) < 0$	(Z): $E = E^* = 0$	(T): $E = 0, E^* > 0$
$\pi_E(E > 0, \cdot) = 0$	(N): $E > 0, E^* = 0$	(M): $E > 0, E^* > 0$

Table 1

A first possibility is that both wages are high enough to render any home based firm unprofitable; this will be the case for wages in zone (Z).

Another possibility arises when the foreign wage is sufficiently high relative to the home wage, while the latter is not too high in terms of output these wage combinations are found in zone (N). The firm will then choose to become *national*, with all its production in the home country. The firm will employ $E + h(E)$ workers, where E is determined by

$$(6) \quad 1 - w = wh'(E)$$

That is, the firm employs production workers to the point where, at the margin, the revenue net of direct labor cost equals the cost of control. The existence of this optimum hinges on the fact that the costs of controlling the firm increase more than proportionally to the value of output $Q = E$. The Williamson effect hence limits the size of the firm. Clearly, the more pronounced the effect (the larger h' for given E) or the higher the home wage, the lower is E , and hence the lower the output level.

Consider next the opposite extreme case, the *transnational* firm, which employs all its E^* production workers abroad. This organizational structure is optimal for wages in zone (T). The first-order condition for the optimal size of the foreign operations E^* is the solution to

$$(7) \quad 1 - w^* = wh'(z(E^*))z'(E^*).$$

The TNF thus equates, at the margin, the contribution of its production net of direct labor costs, all undertaken abroad, with the cost of controlling these operations from the home base.

The second-order condition for an internal maximum is that $(z')^2h'' + h'z''$ be positive. The first term is, of course, positive by the of the Williamson effect. The sign of z'' reflects the nature of the administrative burdens behind the interface effect, and it is less obvious whether z'' would be positive or negative. If the firm continues to encounter new burdens as its foreign operations expand, these burdens will have a cumulative effect on the organization and it is natural to assume z'' positive; we will refer to this as the case of an *increasing* interface effect. If, on the other hand, these problems can be dealt with by setting up an office of "experts", the interface is more like a fixed cost and we should assume z'' to be negative. The literature contains apparent examples of both.¹⁰ No doubt the actual situation varies from case to case, depending upon the countries and industries involved. Thus we see no compelling reason to make one assumption rather than the other. But, since

¹⁰See ch. 3 of Caves (1982).

$z'' > 0$ will allow analysis of both interior and boundary cases, whereas $z'' < 0$ will restrict us to the latter, it will prove expositionally more convenient to examine the case of an increasing interface effect. We thus assume $z'' > 0$.

The size of the transnationals' foreign operations, and thus also of output $Q = E^*$, falls in both the home and the foreign wage. In this case either the Williamson effect or an increasing interface effect suffices to limit the size of the firm. In the presence of the former the interface effect has a mainly quantitative impact.

The interface effect may, however, also have important qualitative implications for the firm's structure. This becomes apparent in zone (M). For wages in this zone both (4) and (5) will be fulfilled with equality for positive output volumes in both home and the foreign countries; the firm will hence find it optimal to be *multinational*. This requires an *increasing* interface effect. Consider for a moment the case of a "constant" interface effect: $z(E^*) = kE^*$ for all E^* , where k is some constant. The first-order conditions will now be:

$$(8) \quad \pi_E(E, E^*) = 1 - w - wh'(E + kE^*) \leq 0,$$

$$(9) \quad \pi_{E^*}(E, E^*) = 1 - w^* - wkh'(E + kE^*) \leq 0.$$

We see that only in the special case $k(1 - w) = 1 - w^*$ will both (8) and (9) be fulfilled with equality. Hence, only then would the firm not profit from becoming either national or transnational.

However, an increasing interface effect may induce the firm to become multinational. Like the TNF, the MNF exploits lower foreign wages, hiring

foreign labor to the extent that its contribution to profits net of direct labor costs, at the margin, equals the cost of control, as magnified by the interface effect:

$$(10) \quad 1 - w^* = wh'(E+z(E^*))z'(E^*).$$

Like the national firm, the MNF employs production workers at home to the point where, at the margin, control costs equate revenue net of direct labor costs: $wh'(E+z(E^*)) = 1 - w$. But, as opposed to both the national firm and the TNF, the MNF has to take into account in these hiring decisions that home and foreign operations are interrelated because they simultaneously contribute to the loss of control in the firm. The different units are thus not only utilizing the same public input, they are also "competing" for another service provided by the headquarters, a service with strong "non-public good" features: intra-firm control. Defining the Williamson effect $h(\cdot)$ over both home *and* foreign employment of labor (rather than over each group separately) captures the fact that the MNF is *one* entity rather than two independent producers.

To verify that it may indeed be optimal to be multinational, we must check second-order conditions:

$$\begin{aligned} \pi_{EE} &= -wh'' < 0; \quad \pi_{E^*E^*} = -wh''(z')^2 - wh'z'' < 0; \\ \pi_{EE}\pi_{E^*E^*} - \pi_{EE^*}^2 &= w^2h'h''z'' > 0. \end{aligned}$$

These conditions are clearly fulfilled for $z'' > 0$. But if $z'' < 0$ the interior extremum is not an optimum and the firm will maximize profit with a boundary solution, that is, by concentrating all effort either at home or

abroad. Thus, in this case the firm must be either national or transnational.¹¹

To summerize:

Proposition 1. The interplay between the Williamson effect and an increasing interface effect may make multinational operations profit maximizing.

Let us finally, before turning to general equilibrium considerations, examine how the MNF's employment decisions are influenced by the two wages. Using the first-order conditions it is easily shown that the MNF's employment of home and foreign labor and decreases in own wage and increases in the other wage:

$$(11) \quad dE/dw = - [(1 + h'')z'' + z'h'']/wh''z'' < 0,$$

$$(12) \quad dE^*/dw^* = - 1/wh'z'' < 0,$$

$$(13) \quad dE/dw^* = dE^*/dw = z'/wh'z'' > 0.$$

These expressions imply that the optimal output volume is inversely related to the home wage:

$$(14) \quad dQ/dw = - [(1 + h')z'' + (1 - 1/h')z'h'']/wh''z'' < 0.$$

¹¹Of course, either of these cases might emerge even if $z'' > 0$, since an interior optimum need not exist.

More surprisingly, the optimal output volume is *positively* related to the foreign wage:

$$(15) \quad dQ/dw^* = (z' - 1)/wh'z'' > 0.$$

As is clear from (15) this stems from the increasing interface effect. Consider, say, an increase in the foreign wage. This will induce the firm to reduce the size of its foreign operations. Due to the interface effect, this reduction releases control resources that can be used to supervise a larger number of home country production workers than was released abroad. This will increase the optimal total output, even though it will reduce equilibrium profits.

IV. FACTOR ENDOWMENTS AND INTERNATIONAL FIRMS' ORGANIZATIONAL STRUCTURE

We now characterize how factor endowments influence wages and hence international investment patterns. Countries are assumed to share the same technology, i.e. the same h and z functions. Let F^* and F denote the employment of production workers in the foreign and the home country, respectively, of the representative foreign firm. Its output is $Q^* = F^* + F$, and symmetrically to the home firm, its profit is:

$$\begin{aligned} \pi^* &= Q^* - w^*(F^* + H^*) - wF - r^*, \\ (16) \quad &= F^* + F - w^*[F^* + h(F^* + z(F))] - wF - r^* \\ &\equiv \pi^*(F^*, F; w^*, w, r^*). \end{aligned}$$

where r^* is the foreign price of glob. First-order conditions for profit maximization by a foreign firm are then:

$$(17) \pi_F^* = 1 - w^* - w^* h'(F^* + z(F)) \leq 0,$$

$$(18) \pi_{F^*}^* = 1 - w - w^* h'(F^* + z(F)) z'(F) \leq 0.$$

Fig. 1 therefore applies to the foreign country as well, but with the roles of w and w^* reversed. The home and foreign versions are superimposed in Figure 2, where A^*X^* depicts the foreign analog of the AX schedule, etc. The eight labelled zones in Fig. 2 correspond to the patterns of international direct investment indicated in Table 2.

(TN*):	$E = 0, E^* > 0;$	$F = 0, F^* > 0$	(home TNFs; foreign nationals)
(MN*):	$E, E^* > 0;$	$F = 0, F^* > 0$	(home MNFs; foreign nationals)
(NN*):	$E > 0, E^* = 0;$	$F = 0, F^* > 0$	(home and foreign nationals)
(NM*):	$E > 0, E^* = 0;$	$F, F^* > 0$	(home nationals; foreign MNFs)
(NT*):	$E > 0, E^* = 0;$	$F > 0, F^* = 0$	(home nationals; foreign TNFs)
(NZ*):	$E > 0, E^* = 0;$	$F = F^* = 0$	(home nationals; no foreign firms)
(ZZ*):	$E = E^* = 0;$	$F = F^* = 0$	(no home firms; no foreign firms)
(ZN*):	$E = E^* = 0;$	$F = 0, F^* > 0$	(no home firms; foreign nationals)

Table 2

Wages have so far been treated as exogenous. Our next task is to establish the factor endowments that support these wages in equilibrium. We assume that countries may differ in their factor endowments, as in a Heckscher-Ohlin world. Factors are internationally immobile physically, so we allow international direct investment but not international real investment.

Each economy's output is produced by firms of the type analyzed above. These firms hence employ the total stocks of labor and glop, denoted respectively L and G for the home country, and L^* and G^* for the foreign country. Since each firm uses one unit of glop, the equilibrium number of firms are G and G^* in the home and foreign country, respectively. With free entry into the product market, (that is, an internal glop market in each country), r and r^* must adjust to ensure zero equilibrium profit.

In equilibrium w and w^* will be such as to clear the respective labor markets. We can therefore conclude immediately that wages in zones (ZZ^*) , (NZ^*) , and (ZN^*) are not sustainable in equilibrium, as they each involve unemployed labor in some country. Since zone (NT^*) is identical to zone (TN^*) , with the roles of the countries reversed, and similarly for zones (NM^*) and (MN^*) , we subsequently restrict our attention to zones (NN^*) , (MN^*) , and (TN^*) .

Figure 3 depicts graphically what is shown formally in the appendix. The figure is drawn in the plane of the relative labor abundance of the two countries, i.e. $\ell \equiv L/G$ and $\ell^* \equiv L^*/G^*$. The positive quadrant is divided into five non-overlapping and exhaustive regions: $\circ(TN^*)$, $\circ(MN^*)$, $\circ(NN^*)$, $\circ(NM^*)$, and $\circ(NT^*)$. These zones correspond, respectively, to zones (TN^*) , (MN^*) , etc, in figure 2. The boundaries between zones $\circ(TN^*)$ and $\circ(MN^*)$, and between $\circ(NM^*)$ and $\circ(NT^*)$, are drawn for a given value of $g \equiv G/G^*$. (g is hence a measure of the relative size of the two economies, for constant ℓ and ℓ^*). If the two countries' endowments are in zone $\circ(NN^*)$ there will be national firms in both countries, if they are in $\circ(MN^*)$ there will be home MNFs and foreign nationals (with reversed roles in $\circ(NM^*)$), and if they are in $\circ(TN^*)$ there will be home TNFs and foreign nationals (with reversed roles in $\circ(NT^*)$).

Note, first, that when the relative factor abundances of the two countries are sufficiently similar there will only be national firms. Second, as the difference in the relative factor abundance becomes more and more pronounced, IFs appear, first as MNFs and then, with sufficiently diverse relative abundances, as TNFs. The source country of the direct investment will then always be the globally abundant country. Note, finally, that there is a critical level for the countries' relative abundances (in the figure denoted $\bar{\ell}_n$ for the home country) above which *no* difference in relative factor abundances, however large, is sufficient to cause MNFs or TNFs to arise. This is a consequence of the interface effect.

V. IMPLICATIONS OF THE ORGANIZATIONAL STRUCTURE OF INTERNATIONAL FIRMS

We now examine some comparative statics to highlight how the organizational structure of IFs influences the way in which they tie national economies together. This will in turn allow us to determine how changes in countries' relative factor endowments, affect real wages.

All Firms are National

We start with the simplest case where all firms are national. The two national economies are then essentially independent entities, so consider just the home country. It is described by the condition for profit maximization (4), the factor market clearing condition

$$(19) \quad E + h(E) = \ell,$$

and the zero profit constraint

$$(20) \quad r = E - w(E + h(E)).$$

Hence, as the economy becomes increasingly labor abundant, firms must expand their activities in order for the labor market to clear. This requires the wage to fall, and will cause the rent of glop to increase.

These are standard features. What is novel is that the proportion of the labor force engaged in managerial control increases as the economy becomes relatively more labor abundant. The limited availability of glop restricts the number of firms. Instead the firms expand, becoming increasingly inefficient as measured by the ratio of the managerial control input to the output of goods.

Home Firms are Transnational and Foreign Firms are National

The international equilibrium where home firms are transnational, and foreign firms are local, is described by the home and foreign factor market equilibrium conditions

$$(21) \quad h(z(E^*)) = \ell,$$

$$(22) \quad F^* + h(F^*) + gE^* = \ell^*,$$

and the conditions for profit maximization (5) and (17) for the home and foreign firms, respectively.

Let the home country's relative labor abundance ℓ fall. As long as the economy remains in zone (TN*), home firms must reduce their control

activities. They will consequently reduce their operations abroad, and since foreign factor endowments are assumed unchanged, more foreign labor is left for foreign firms. For these adjustments to be consistent with profit maximization, foreign firms must face a lower wage. But since home firms then also face a lower wage in the foreign labor market, the latter will be induced to reduce their foreign operations only if the control activities undertaken at home become sufficiently more expensive. The home wage must thus increase.

An increase in the foreign relative labor abundance ℓ^* , or a fall in the relative size of the home country g , produces qualitatively similar results, with the exception that the home firms' employment of foreign labor remains unchanged. Foreign firms again increase the size of their operations, the foreign wage falls, and the home wage rises.

Home Firms are Multinational and Foreign Firms are National

The equilibrium with home multinationals and foreign nationals is slightly more complicated than the two considered above, but is easily analyzed diagrammatically. In Fig. 4, the first and second quadrants show, respectively, the clearing condition for the foreign factor markets (22), and the condition for profit maximization for foreign firms (17). The fourth quadrant contains two schedules. One, denoted WE, summarizes the equilibrium conditions for the foreign country depicted in quadrants one and two (it is obtained by solving (17) for F^* and substituting this into (22)). The HH schedule is a reduced form of the home country factor markets clearing condition

$$(23) \quad E + h(E+z(E^*)) = \ell,$$

and the first-order conditions for the home firms' profit maximization (4) and (5).

Consider first a fall in the home country's relative labor abundance ℓ . The availability of less home labor relative to glop requires home firms to reduce their total demand for home labor. At an unchanged foreign wage, the conditions for profit maximization for home firms in conjunction with the clearing condition for factor markets, requires an increase in the home wage and a reduction of domestic production E coupled with an increase in foreign operations E^* . Diagrammatically, the home equilibrium schedule HH shifts outward, as indicated by the broken line in Fig. 4. This puts upward pressure on the foreign wage w^* , and induces foreign firms to reduce their operations F^* . Consequently, glop rents in both countries fall.

Now let the foreign country's relative labor abundance ℓ^* increase. For any given demand by MNFs for foreign labor, the foreign wage must fall to make foreign firms hire more labor: the WE -schedule shifts upward in Fig. 4. A lower foreign wage w^* will induce home MNFs to increase their foreign operations E^* . At an unchanged home wage w the total control apparatus of the typical home firm will remain constant, so home firms will reduce their demand for productive home labor E . As a consequence, the home wage must fall to clear the labor market, and, with both wages falling, the rents r and r^* must increase.

The Qualitative Impact of International Firms' Organizational Structure

The above results are summarized in Table 3, which displays the direction in which a fall in ℓ , and an increase in ℓ^* (which corresponds qualitatively to a fall in g) affect equilibrium employment levels and factor rewards. Two types of international equilibria are compared: one

with home TNFs and foreign locals, and one with home MNFs and foreign locals.

	dE	dE*	dF*	dw	dw*	dr	dr*
TNFs: $d\ell < 0 \Rightarrow$		-	+	+	-	?	+
TNFs: $d\ell^* > 0 \Rightarrow$		0	+	+	-	?	+
MNFs: $d\ell < 0 \Rightarrow$	-	+	-	+	+	-	-
MNFs: $d\ell^* > 0 \Rightarrow$	-	+	+	-	-	+	+

Table 3

Comparing the TNF and the MNF equilibria, one notices immediately the striking difference in impacts on the world economy of a change in home relative labor abundance. Excluding E, at least four of the remaining seven variables actually move in opposite directions in the two equilibria! When the home relative labor abundance changes, employment abroad changes in the same direction in the TNF case. In contrast, with MNFs the employment of *home* production workers moves in the same direction as the relative home labor abundance, while its employment of foreign labor instead moves in the opposite direction: an increase in home relative labor abundance reduces the home wage and induces MNFs to shift production from the foreign to the home country. Hence, the link between the home and the foreign country -- i.e. home MNFs' employment of foreign labor -- will transmit signals to the foreign labor market in *opposing* directions in the two equilibria. Thus the foreign country variables F^* , w^* , and r^* , must adjust in different directions with MNFs and with TNFs.

The organizational structure of international firms crucially affects the way in which the national economies are interrelated. With MNFs, labor forces in the two countries are *substitutes* in the sense that an increase in the home country labor force, by reducing the home wage, induces MNFs to shift their operations from the foreign to the home country, hence causing the foreign wage to fall. In contrast, in the presence of TNFs the expansion of the home labor force must be absorbed by increased control activities. The foreign operations of the TNFs hence expand, putting an upward pressure on the foreign wage. It is the *complementary* aspect of the home and the foreign operations which is dominant in the case of TNFs.

The qualitative difference between economies with MNFs and TNFs has several interesting implications. Suppose, for instance, the foreign labor force grows at a higher rate than the common growth rate of the other factors. Let the initial relative abundances be described by point a in Fig. 3; all firms are national firms at the outset. The location of the endowment point hence starts to move vertically upwards in the figure. Now consider what happens to wages. The foreign wage will, of course, fall steadily. But the domestic wage will go through three stages. First, as long as relative wages are not too diverse, domestic firms maintain all operations in the home country, due to the interface effect. The domestic wage is unaffected by the growth in the foreign labor force.

But with sufficiently diverse relative endowments, and hence wages, home firms become multinational. As the foreign labor force grows, domestic workers suffer from *declining* wages: the lower the foreign wage, the larger the share of the MNFs' production that is undertaken abroad and the less the demand pressure on the domestic wage. But firms eventually

become transnational. Now a further increase in the foreign labor force *increases* domestic wages! All domestic workers are engaged in control activities, are now complementary to foreign workers, and benefit from lower foreign wages and the increased profitability of domestic TNFs.

To summarize:

Proposition 2. As links between national economies, international firms function qualitatively differently, depending on their organizational structure. With MNFs workers in different countries are substitutes and their wages are positively related, but with TNFs they are complements and their wages are negatively related.

Not only relative factor endowments but also *absolute* country size matter for real wages. Consider a proportional increase in foreign factor endowments. This will leave both countries' relative endowments ℓ and ℓ^* unaffected and will reduce the relative size g of the home country. These results are easily derived since a change in g , at constant relative endowments ℓ and ℓ^* , qualitatively corresponds to a change of ℓ^* in the opposite direction, at constant g and ℓ .

Workers in the host country of the international firms are worse off the *larger* the host country is relative to the source country regardless of firms' organizational structure: the smaller is the source country relative to the host country, the lower is the international firms' aggregate demand for host country labor relative to the host country labor endowment, and the lower is the host country wage.

For home workers the situation is different. With TNFs, source

country workers are better off the smaller the source country is relative to the host country. A fall in g at constant ℓ and ℓ^* , implies that L falls relative to L^* . Since with TNFs the two labor forces are complements, the increased relative scarcity of one of these factors - home labor - will increase its reward. In contrast, the substitutability between the two work forces with MNFs implies that their wages are positively correlated. A larger host country will feature a lower wage, inducing MNFs to locate less production in the source country, hence exerting a downward pressure on the source country wage. So with MNFs source country workers get lower wages the smaller the country relative to the host country.

Proposition 3 summarizes these results:

Proposition 3. In the presence of international firms absolute country size affects the equilibrium allocation of factors and their rewards. Host country workers are better off the smaller the country is relative to the source country. Source country workers are also better off the smaller their own country is relative to the other, when firms are transnational. But when economies are linked by multinational firms source country real wages are higher the larger the country is.

The Impact of Direct Investment on Real Wages

It is an immediate consequence of the above results that a profit maximizing organizational structure need not be to the advantage of

workers. To see this, treat the home country equilibrium as determined by the home factor endowment and the foreign wage. Let these variables assume values such that an equilibrium with home MNFs would arise in the absence of any outside interference with firms' choices of organizational structure. Compare the home wage in this case with that which would result if home firms were forced to be purely national. In both situations the wage would be determined by (4) expressed with equality:

$$(24) \quad \bar{w} = 1/[1 + h'(\cdot)],$$

where the argument of h' is E_n in the equilibrium with national firms, and $E_m + z(E_m^*)$ in the case of multinationals, and where E_n and E_m are determined by (19) and (23), respectively. A comparison of these expressions yields $E_n > E_m$, and hence $E_n < E_m + z(E_m^*)$, since $h(E_n) = \ell - E_n < \ell - E_m = h(E_m + z(E_m^*))$. By (24) we conclude that $w_n > w_m$: home workers' real incomes are lower when home firms are multinational than when they are forced to remain national.

The lower the foreign wage the more home firms expand their production abroad, and the more they contract home production. Eventually, when the foreign wage attains some value $\bar{w}^*$, all home production has ceased. The MNFs have now become TNFs, and for foreign wages lower than $\bar{w}^*$, the home wage will be determined by

$$(25) \quad w_t = (1 - w^*)/[h'(z(E_t^*))z'(E_t^*)],$$

where E_t^* is determined by (21). Hence, as noted above, from this point

onwards the home wage will increase as the foreign wage falls, Note, however, that for w^* sufficiently close to $\bar{w}^*$, $w_t < w_n$: home wages would be higher if the TNFs were forced to become purely national. Will home workers *always* prefer purely national firms? No, it is possible that when the foreign wage is sufficiently low, the wage with TNFs would be high enough so that workers are better off letting firms undertake all production abroad and all managerial control at home.

It is clear that foreign real wages are always higher with home direct investment, since at any given wage demand has increased. Formally, from (22) we have that F^* is smaller with IFs than with only national firms. Then, from (17) expressed with equality,

$$(25) \quad w^* = 1/[1 + h'(F^*)],$$

we have that foreign workers benefit from the investment.

We have hence established the following:

Proposition 4. Source country real wages are higher if firms that would otherwise be multinational are constrained to national operations. Source country real wages may or may not be higher with such a restriction if firms would be transnational if unrestricted. Real incomes of host country workers are higher with international direct investment, regardless of the investing firms' organizational structure.

VI. CONCLUDING REMARKS

This paper has extended the hierarchical theory of internal

organization to firms that can operate across national borders. Our approach embeds a reduced form version of the theory in a general equilibrium context to examine the role of the inherent cost of multinational activity. In contrast to earlier general equilibrium analyses of IFs, the size of the firm is limited by cost side factors.

A public input that can support any level of output at any number of locations generates increasing returns to scale. These are balanced against the administrative costs of large organizations (the Williamson effect), so the size of the firm is limited. Firms may shift production abroad in search of lower wages, but this incurs costs of its own due to the difficulty of administering an organization across national frontiers (the interface effect).

The key determinants of firms' organizational structure in this model are the nature of the interface effect and the pattern of factor endowments. The critical feature of the interface effect is whether it is increasing or decreasing in additional foreign activity. A decreasing interface effect implies that firms will always be either purely national or transnational. An increasing interface effect also permits an interior solution in which MNFs emerge. The role of factor endowments is somewhat more subtle. Similar relative endowments imply that both countries have purely national firms. If relative endowments are sufficiently diverse, the labor abundant country will supply purely national firms and the other country international firms. But the form of the latter depends upon an interaction of relative endowment differences and absolute differences. Greater differences in relative endowments render it more likely that the international firms will be transnational rather than multinational, but a larger relative size of the country supplying international firms makes it

more likely that those firms will be multinational rather than transnational.

The central message that emerges from the analysis is that *the role played by international firms in intertwining national economies may depend crucially on the organizational structure of these firms*. MNFs tend to make labor forces of different countries substitutes, in contrast to TNFs, which tend to promote complementarity between labor forces. Our results therefore imply a critical importance for the determinants of international firms' organizational structure. But, much more remains to be done before any firmer conclusions can be drawn.

APPENDIX

We now partition the ℓ - ℓ^* space into five distinct zones corresponding to different patterns of direct investment by deriving the boundaries mt and mn between zones oNN^* and oMN^* , and zones oMN^* and oTN^* , in Fig. 3. The remaining boundaries are by symmetry mirror images in the line $\ell = \ell^*$. Our method is to establish, for an arbitrary value of ℓ^* , the value ℓ_n required for the international equilibrium to have home firms just indifferent between national and multinational operations. We then compare ℓ_n with ℓ_t , which is the ℓ that would, for the same ℓ^* , support an international equilibrium where home firms are just indifferent between multinational and transnational operations. (Variables pertaining to the two cases will be denoted by, respectively, subscripts n and t .)

The first type of equilibrium is given by

$$(A1) \quad 1 - w_n[1 + h'(E_n)] = 0,$$

$$(A2) \quad 1 - w_n^* - w_n h'(E_n) z'(0) = 0,$$

$$(A3) \quad 1 - w_n^*[1 + h'(F_n^*)] = 0,$$

$$(A4) \quad \ell_n = E_n + h(E_n),$$

$$(A5) \quad \ell^* = F_n^* + h(F_n^*),$$

and the second kind of equilibrium is defined by

$$(A6) \quad 1 - w_t[1 + h'(z(E_t^*))] = 0,$$

$$(A7) \quad 1 - w_t^* - w_t h'(z(E_t^*)) z'(E_t^*) = 0,$$

$$(A8) \quad 1 - w_t^*[1 + h'(F_t^*)] = 0,$$

$$(A9) \quad \ell_t = h(z(E_t^*)),$$

$$(A10) \quad \ell^* = F_t^* + h(F_t^*) + gE_t^*.$$

(A5) and (A10) imply $F_t^* < F_n^*$. Hence, by (A3) and (A8),

$$(A11) \quad w_t^* > w_n^*.$$

Substitution of (A1) into (A2) yields

$$(A12) \quad 1 - w_n^* - h'(E_n) z'(0) / [1 + h'(E_n)] = 0,$$

and by (A6) and (A7)

$$(A13) \quad 1 - w_t^* - h'(z(E_t^*)) z'(E_t^*) / [1 + h'(E_t^*)] = 0.$$

Substituting (A12) and (A13) into (A11) one obtains

$$(A14) \quad h'(E_n) z'(0) / [1 + h'(E_n)] > h'(z(E_t^*)) z'(E_t^*) / [1 + h'(z(E_t^*))].$$

By the assumption of an increasing interface effect $z'(0) \leq z'(E_t^*)$. (There will be equality only in the case where home firms cease producing entirely.) Hence, by (A14), $E_n > z(E_t^*)$, and utilizing (A4) and (A8), we can therefore establish

$$(A15) \quad \ell_t = h(z(E_t^*)) < h(E_n) \leq E_n + h(E_n) = \ell_n.$$

Let us finally determine the location of the mn and mt schedules. As E_n and E_t^* approach zero, F_n^* and F_t^* converge to the same strictly positive value. The above inequalities then tend to equalities, and both ℓ_t and ℓ_n approach zero. This requires ℓ^* to approach what is obtained if (A1), (A2), (A3) and (A5) are solved for ℓ^* (and w , w^* , and F^*), with $E_n = 0$. This is the lower limit of ℓ^* for the boundaries mn and mt.

We know already the relative position of the two schedules from (A15). It remains to establish that they converge to finite values $\bar{\ell}_t < \bar{\ell}_n$ as ℓ^* grows indefinitely large. Consider first schedule nm. The larger is ℓ^* the smaller is w_t^* and the larger is E_t^* . The maximum value of E_t^* , $\bar{E}_t^*$, is attained at the minimum value of w_t^* , $\bar{w}_t^*$. But even if $\bar{w}_t^*$ were 0, $\bar{E}_t^*$ would remain finite, as can be seen from (A13). Consequently, $\bar{\ell}_t$ is finite.

Now turn to the mt schedule. As ℓ^* goes to infinity, w_n^* will fall to its lowest attainable value $\bar{w}_n^*$. E_n then reaches its maximum $\bar{E}_n$. The interface effect implies that $\bar{E}_n$ is finite, and $\bar{\ell}_n$ is therefore also finite. But, by (A3), (A5), (A8), and (A10), $\bar{w}_n^* = \bar{w}_t^*$. Hence, by the reasoning above $\bar{E}_n > z(\bar{E}_t^*)$, implying that $\bar{\ell}_n > \bar{\ell}_t$, and that the difference is non-marginal.

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