INTERNATIONAL COMPETITION FOR MULTINATIONAL INVESTMENT

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Abstract

We examine the economic justification for providing investment subsidies to foreign-owned multinationals. These provide employment opportunities and generate demand for domestic intermediate inputs, produced by domestic workers with increasing returns to scale. Offering subsidies to multinationals may be in the national interest if the investment raises the net value of domestic production. When agglomerative forces are sufficiently strong, a subsidy that attracts the first foreign firm may induce several to enter, establishing a thriving modern sector. With a limited number of foreign enterprises, countries may compete to attract investment. This subsidy competition transfers much of the rents to the multinationals.

Keywords
multinationals, foreign direct investment, location

JEL **Classification Codes**
F12, F23

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1. INTRODUCTION

There is a great deal of political debate as to whether providing subsidies to encourage investment by foreign-owned multinationals is economically justifiable. Critics often argue that these firms generally establish only assembly plants in host nations, retaining management control and research and development activities in their home countries. Consequently, the only benefit to arise for citizens of the host country is increased employment, but this is achieved at high cost to the taxpayer.

The response, by advocates of investment incentives, is that the foreign firm will require other inputs into the production process and that local firms and entrepreneurs will be well-placed to take advantage of this. They further argue that these intermediate inputs into the production process are "high-tech", and can be the springboard for a country's development into an advanced industrial nation. Therefore, the cost of the subsidy necessary to attract the foreign firm will be more than offset by both the immediate increase in employment and the elevated derived demand for locally produced inputs and the earnings that will consequently accrue to the factors employed in their manufacture.

In this paper we examine the incentives to attract foreign direct investment (FDI) by a multinational enterprise (MNE). Our focus is on the consequences for production and employment in the host country and so we ignore questions of trade and consumer choice by assuming that the MNE will produce a fixed quantity of output for the international market and that consumer choices are unaffected by whether or not the firm sets up a plant in the country. We model the MNE as employing labour and inputs of horizontally differentiated intermediate goods produced by indigenous firms that become established in order to meet local demand.

Intermediates are assumed to be produced with increasing-returns-to-scale technology. We further assume that there are knowledge spillovers from one intermediate firm to another, such that the cost of establishing production of a new variety declines with the size of the industry (the number of varieties already in domestic production). Thus the greater the size of the market (the more MNEs there are), the larger number of varieties produced, and thus the lower the costs of production of all intermediate firms. We assume that intermediates are not traded, so that the spillovers are purely domestic.[1]

The domestic government is able to offer financial rewards to foreign-based MNEs in order to induce them to invest in the local economy. We assume that these incentives are non-discriminatory, in that they are available to any (and all) firms that decide to set up final production facilities.[2] Firms that produce intermediate goods are offered no such incentives. Our goal is to establish whether the subsidies paid to induce FDI by MNEs can generate benefits sufficiently large to offset the cost.

Empirically, there is no doubt that the importance of FDI has increased significantly over the past couple of decades (see, for example, Barrell and Pain, 1997). There is also clear evidence of positive spillovers from MNEs to host countries through a number of channels (for a review, see Blomström and Kokko, 1996), but the nature of these spillovers varies between countries and industries. In a theoretical setting similar to ours, Markusen and Venables (1998) study the interaction between MNEs and host country firms through competition and linkages effects. However, while they focus on various channels of interaction in a partial equilibrium setting, the aim of our study is to look at policy issues in a general-equilibrium model. Our model includes complementary between MNEs and local firms (in terms of input-output linkages), and positive externalities between local producers

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[1] A more realistic assumption might be to have intermediates that can be traded, but at a cost. We choose our particular assumptions for the sake of simplicity, given that the results would be qualitatively similar.

of intermediate goods, but with competition between sectors in the factor markets. Given the input-output linkages and the externalities, the model demonstrates agglomeration effects such that, once some MNEs establish production in a host country, it may be more attractive for other MNEs to do the same. This may, however, be counteracted by the increased pressure in the labour market and hence rising labour costs. In this setting, we work out policy options for a single host country, as well as the effects of policy competition between countries competing for the multinational investments.

Our paper may be viewed as part of the general literature on tax competition for FDI. Haufler and Wooton (1998) discuss the case of competition between two countries to attract the investment of a single MNE.[3] In their setting, the countries are of different sizes. The larger country is more attractive to the MNE in providing a bigger market (as exporting incurs trade costs). As a result, the big country always wins the tax/subsidy war. Size is also an issue in our paper. However, it is not final demand that matters (as trade costs are ignored), but the (endogenously determined) quantity of intermediate production taking place a host country. The more MNEs that invest, the larger the number of intermediate firms that become established. Hence the spillovers will be greater and that country will become more attractive for an individual MNE. Fumagalli (1998) also examines tax competition for MNEs with spillovers. In her case, the MNE yields spillovers to firms in the host country. The more backwards the initial technology of the domestic economy, the greater its benefits from the FDI and, consequently, the least advanced country can win the subsidy war.

The plan of the paper is as follows. First of all, in section 2, we spell out the structure of the model and then develop a tractable way of presenting the possible equilibria in section 3. In section 4 we look at welfare effects of MNEs in a single country and discuss

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[2] That is, the government cannot choose a particular MNE to favour, and must give the same subsidies to all firms that become established in the country.

optimal policy for this country, while section 5 deals with policy competition between two potential host countries. Section 6 gives some conclusions.

2. THE MODEL

Our initial focus is on economic activities taking place in the home country. This country has a *traditional sector* which employs labour, exhibiting diminishing returns to that factor (perhaps because of the presence of some non-human factor in inelastic supply). The home country can also have a *modern sector* by being host to production by multinational enterprises (MNEs). These firms are essentially assembly operations, providing employment for domestic workers and using inputs of a variety of domestically produced intermediate goods. The production of intermediates also provides employment for domestic workers.

The MNEs sell their products on world markets and we assume that their sales in the home country are sufficiently small that we can ignore domestic demand for locally produced final goods. MNEs will choose their location in order to maximise profits, taking into account costs of production and whatever financial inducements are offered to them by the national governments. Equilibrium in the production of final goods will be characterised by firms' net domestic production costs equalling those overseas.

2.1 The intermediate goods sector

The market for intermediate goods is monopolistically competitive. In each country firms can freely enter the market, each producing a distinctive variety of intermediate good. The products are sold solely to domestic MNEs for assembly into final goods. Equilibrium is characterised by firms making zero profits, with the number of firms *n* being endogenously determined.

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[3] Haufler and Wooton (1998) provide a discussion of the literature on tax competition for FDI.

All firms are identical in costs and technology. Each firm produces one variety of intermediate good using inputs of labour. There is a necessary input of a workers that the firm views as given and is independent of the quantity produced. To produce each unit of output then requires an additional input of b workers. The cost function of a representative firm is then:

$$c(X) = (a + bX)w \tag{1}$$

where X is the output of the firm and w is the national wage rate.

With Chamberlinean monopolistic competition, we know the price charged will be a fixed mark-up over marginal costs; hence

$$q = \mu w \tag{2}$$

where $\mu \equiv \sigma b / (\sigma - 1)$ and σ is the elasticity of demand for each variety of the intermediate good.

Free entry and exit implies a zero profit condition, which yields:

$$X = \frac{a}{b}(\sigma - 1) \tag{3}$$

There are external economies of scale related to the number of varieties in domestic production. These affect the fixed costs facing intermediate firms. Hence, we have:

$$a = \frac{A}{n^\theta} \tag{4}$$

where $\theta > 0$ such that each firm's fixed cost declines as the number of varieties increases. Substituting this into the zero-profit condition (3) yields:

$$X = \frac{A(\sigma - 1)}{n^\theta b} \tag{5}$$

The total demand for labour in intermediate production L_X depends on the number of firms and their scale of operation:

$$L_X = n(a + bX) \tag{6}$$

Substituting (4) and (5) into (6) yields:

$$L_X = \sigma A n^{1-\theta} \tag{7}$$

2.2 The MNE

There are E MNEs operating in the home country. Each MNE produces a given output, Y, using inputs of labour and varieties of intermediate goods.[4] The MNE's unit cost function is:

$$C = Q^\alpha w^{1-\alpha} \tag{8}$$

where Q is the price index for the intermediate goods:

$$Q = \left[\sum_{i=1}^{n} q_i^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{9}$$

and where q_i is the price of variety i of the intermediate goods. As we assume that all intermediate firms are essentially identical, then q_i is the same for all varieties, in which case we can rewrite (9) as:

$$Q = n^{\frac{1}{1-\sigma}} q \tag{10}$$

The typical MNE's demand for each type of intermediate goods will then be:

$$m = \alpha Q^{\alpha+\sigma-1} w^{1-\alpha} q^{-\sigma} Y$$

which, once we substitute in the expression for the price index (10), becomes:

$$m = \alpha n^{\frac{\alpha+\sigma-1}{1-\sigma}} \left(\frac{w}{q} \right)^{1-\alpha} Y \tag{11}$$

We established the price of intermediates in the previous sub-section. Substituting (2) into (11) and multiplying by the number of MNEs yields the total demand for each variety of intermediate good produced in the country:

$$M = \alpha \mu^{\alpha-1} n^{\frac{\alpha+\sigma-1}{1-\sigma}} EY \tag{12}$$

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[4] We assume that Y has been determined through some optimisation process of the MNE, taking into account production technology and the nature of demand for the particular good that the firm produces.

Similarly we can determine the total demand for labour by all of the MNEs operating domestically:

$$L_Y = (1-\alpha)Q^\alpha w^{-\alpha} EY \tag{13}$$

As before, we substitute the price index and the price of intermediates to yield:

$$L_Y = (1-\alpha)\mu^\alpha n^{\frac{\alpha}{1-\sigma}} EY \tag{14}$$

2.3 The traditional sector

The rest of the economy is modelled as a traditional sector, that uses labour services in the production of an homogeneous good in a competitive market. Let output of this sector be Z and the labour input be L_Z. The production function is characterised by diminishing returns to labour:

$$Z(L_Z) = \frac{L_Z{}^\gamma}{\gamma} \tag{15}$$

where $\gamma < 1$. Assuming that this sector is the numeraire, the wage is equal to the marginal product of labour. Differentiating (15), and re-arranging, yields the demand for labour schedule for the traditional sector:

$$L_Z = w^{-\varepsilon} \tag{16}$$

where $\varepsilon \equiv -1/(\gamma - 1)$ is the elasticity of labour in production of the traditional good.

3. EQUILIBRIUM

In the previous section we specified the optimal choices in each sector. We now consider the equilibrium for the economy. This will arise when three conditions hold: equilibrium in the labour market; equilibrium in the intermediate goods market; and MNEs facing the same costs of production in the domestic market as they would were their production located overseas. We take each of these in turn.

3.1 Labour market equilibrium

There is assumed to be an inelastic supply of labour to production, where the total available is
L. Labour is demanded by each of the three sectors in the economy: intermediate input, MNE, and traditional. Equilibrium is characterised by the aggregate demand for labour exhausting the supply. Summing the elements of equations (7), (14), and (16), we have:

$$L = \sigma A n^{1-\theta} + (1-\alpha)\mu^{\alpha} n^{\frac{\alpha}{1-\sigma}} EY + w^{-\varepsilon} \qquad (17)$$

This is a function of the number of varieties of intermediate goods, the number of MNEs that locate in the domestic economy, and the wage rate.

3.2 Intermediate goods market equilibrium

The total demand for each variety of intermediate good is given by (12), while the firm's supply of each type is given by (5). The equilibrium condition is then:

$$n = \left(\frac{\mu^{\alpha} EY}{\delta} \right)^{\frac{\sigma-1}{\alpha+\beta}} \qquad (18)$$

where $\delta \equiv \sigma A / \alpha$ and $\beta \equiv (\sigma-1)(1-\theta)$. Thus the number of varieties of intermediate products depends positively on the number of MNEs who demand them. Thus, the larger the market for intermediate goods, the greater the number of varieties that can be profitably manufactured.

3.3 MNE's iso-cost condition

It is assumed that the MNE has an alternative country in which it can locate its production and that the cost of producing each unit in that foreign location is C^*. Therefore, in order to be willing to locate in the home country, the firm's costs of production, inclusive of any taxes or subsidies imposed by the government, must be no greater than C^*. Let the per-unit net

subsidy awarded by the government to the firm be s.[5] Thus, in equilibrium, $C - s = C*$.

From the cost function (8), using (10) and (2), we can derive the condition:

$$w = \mu^{-\alpha} n^{\frac{\alpha}{\sigma-1}} (C* + s) \qquad (19)$$

The more varieties of intermediate inputs, the lower the costs of MNE production.[6] Thus, the MNE can remain competitive while paying higher wages if the number of intermediate firms increases.

3.4 Solving the system of equations

From (18), the equilibrium condition for intermediate production, we have an expression for the number of varieties that will be produced as a function of the number of MNEs in the economy. We substitute this expression into the other two equilibrium conditions in order to derive conditions in terms of the wage rate and the number of MNEs that locate in the domestic economy.

Firstly, we consider the iso-cost condition and substitute (18) into (19). After some re-arranging, this yields:

$$w = \left[\delta^{-\alpha} \mu^{\alpha\beta} E^{\alpha} Y^{\alpha} \right]^{\frac{1}{\alpha+\beta}} (C* + s) \qquad (20)$$

Thus the wage that can be paid to workers and yet retain the presence of an MNE is increasing in the number of enterprises that establish in the country. This relationship is shown in Figure 1 as **MM**, a positively sloped schedule that passes through the origin.

Secondly, we substitute (18) into (17) in order to obtain the relationship between the wage rate and the number of MNEs that maintains full employment of the workforce. This yields the expression:

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[5] We assume that the subsidy is financed by a (non-distortionary) lump-sum tax on citizens of the country.

[6] This is a well-known property in "new economic geography" models with input-output linkages. See, for example, Venables (1996).

$$w = \left\{ L - \left[\delta^{\alpha} \mu^{\alpha\beta} (EY)^{\beta} \right]^{\frac{1}{\alpha+\beta}} \right\}^{-\frac{1}{\varepsilon}} \tag{21}$$

This relationship between the number of MNEs and the wage rate is increasing in E. In Figure 1, we plot this condition as line **LL**.

3.5 Plotting the equilibria

Figure 1 shows representative **LL** and **MM** curves.[7] These are shown as intersecting at two points **A** and **B**.[8] There are therefore three equilibrium quantities of MNEs in the domestic economy. Firstly, there can be none ($E = 0$). The wage necessary to draw workers into the modern sector is strictly positive while the willingness to pay (from the iso-profit condition) is nil. This equilibrium is stable, in that a small perturbation, raising E above zero will still have the willingness to pay less than what is necessary, and the MNEs will exit.[9]

Secondly, the two curves intersect at point **A**, the lower value $\underline{E}$ at which the curves intersect. This equilibrium is unstable in that, were E to be increased slightly, the willingness to pay workers in MNEs is greater than the wage necessary to induce them to move (**MM** is above **LL**) and more MNEs will become established, employing an increasing number of workers (both directly and through employment in more intermediate firms). Similarly, all firms will exit were E to be slightly lower that $\underline{E}$. This intersectoral migration will end at point **B**, the higher intersection of the two schedules. This equilibrium $\overline{E}$ is stable, in that further increases in the number of MNEs will not be possible, as the wage that the firms are willing to pay is less than that necessary to induce the workers to leave the traditional sector.

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[7] The figures are drawn using the following parameter values: $\alpha = 0.8$, $\beta = 1.8$, $\delta = 0.75$, $\varepsilon = 2$, $\mu = 1$, $\sigma = 3$, $\theta = 0.1$, $C^* = 0.2$, $E = 10$, $Y = 2$ and, in this instance, $s = 0.07$.

[8] It is possible that the two schedules might not intersect, in which case **LL** would be everywhere above **MM** and there would be no equilibrium in which MNEs would operate in the domestic country.

[9] Here, in our discussion of equilibria and stability, we are treating E as continuous. In our discussion of policies (below) we shall explicitly acknowledge that the number of MNEs must be an integer.

Now consider the range of equilibrium outcomes that might arise for given combinations of parameters of the model. We initially look at those parameters that affect only one of **LL** or **MM**. We then discuss the effects of changing those parameters common to both schedules. Our discussion will focus on stable equilibria and so we are interested in the impact of parameters on $\overline{E}$, the stable equilibrium number of MNEs.

The **MM** curve is affected by the sum $(C^* + s)$, the opportunity cost of producing elsewhere (the firm having to pay C^* for foreign production and forego subsidy s that they would otherwise have been given by the domestic government). Thus, raising either of these terms would make domestic production more attractive at any wage and, consequently, increases in these parameters will shift the **MM** schedule upwards, increasing $\overline{E}$ and lowering $\underline{E}$.

C^* and s do not affect the **LL** schedule, while L and ε affect only the labour-market equilibrium. Increasing the working population of the country lowers the equilibrium wage rate for any number of MNEs. The slope of the schedule also falls as the wage rate does not have to increase as much in response to an expansion of production in the modern sector (MNE and intermediate production). The schedule also flattens out with increases in ε, the elasticity of labour in the traditional sector.

The remaining parameters of the model (A, b, Y, α, σ, and θ) affect both of the schedules, both directly (Y and α) and through their impact on β, δ, and μ (A, b, α, σ, and θ). Increasing Y, the output of each MNE, causes an equi-proportional fall in $\overline{E}$ and $\underline{E}$, because Y always appears multiplied by E. An increase in b, the marginal cost of producing intermediates, causes μ to rise. This results in both schedules becoming steeper, with a consequent fall in $\overline{E}$ at a higher wage. If A (the fixed cost of producing a variety of intermediates) rises or α (the share of intermediates into MNE production) falls, then δ

rises.[10] A rise in δ results in **LL** becoming steeper while **MM** becomes flatter, and consequently $\overline{E}$ falls, as does the wage. If θ, the measure of the spillover externalities, were to increase then β would decline. This makes **LL** become flatter and **MM** become steeper, resulting in a rise in $\overline{E}$. Hence, as one should expect, the more important are the external economies of scale, the larger the modern sector will be once it is actually established. It might, however, be more difficult to establish such a sector in the first place. Finally, changes in σ have the most complicated impact as this elasticity of substitution between intermediate varieties is a component of β, δ, and μ. An increase in σ makes the **LL** schedule steeper and the **MM** schedule flatter, resulting in a fall in $\overline{E}$ at a lower equilibrium wage. A higher σ implies that product differentiation is less important in the intermediate sector, and thus the cost advantage for the MNEs of increasing number of intermediates is reduced.

4. WELFARE

Total output of the domestic economy that can be attributed to domestic factors of production is the output of the traditional sector plus the earnings of workers in the modern sector:[11]

$$D(E) = Z(L_Z) + (L - L_Z)w \tag{22}$$

Repeated substitutions of the various equilibrium conditions that we have already derived allows us to rewrite (22) as:

$$D(E) = \frac{1}{\varepsilon - 1} \left\{ \varepsilon L - \left[\delta^\alpha \mu^{\alpha\beta} (EY)^\beta \right]^{\frac{1}{\alpha+\beta}} \right\} \left\{ L - \left[\delta^\alpha \mu^{\alpha\beta} (EY)^\beta \right]^{\frac{1}{\alpha+\beta}} \right\}^{-\frac{1}{\varepsilon}} \tag{23}$$

As the number of MNEs increases, so too does the value of domestic production. Thus D is increasing in E. We shall look at the relative expansion of D as MNEs are attracted to the

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[10] The overall effect of a change in α is more complicated.
[11] This is not the same as Gross Domestic Product as the MNE may have imported the services of some foreign-owned factors of production, whose earnings are repatriated.

economy. Thus we define $d(E) \equiv D(E) / D(0)$ where $D(0)$ is the level of income received by a country in which all economic activity takes place in the traditional sector.

As we are considering the effects of FDI, the appropriate measure of welfare is gross national product (G) which accounts for the value of all productive activities taking place in the domestic country *less* any payments made to foreign owners of factors. GNP can then be measured by:

$$G(E,s) = D(E) - sEY \qquad (24)$$

Expanding production is achieved at the cost of increased subsidies. Thus the country will only benefit if G increases. Our primary focus will then be on $g(E,s) \equiv G(E,s) / G(0,s)$, the ratio of GNP in the equilibrium induced by the subsidy to the level of GNP that occurs in the equilibrium in which there are no MNEs. This provides a measure of whether the subsidy is worthwhile.

4.1 Optimal policies

The government wishes to encourage domestic production. In order to do this, it offers a production subsidy for each unit produced by the MNE in the domestic economy. This subsidy reduces the private marginal cost of production.[12] It is assumed that the subsidy is non-discriminatory, in that it is available to all MNEs that choose to establish production facilities in the domestic economy. In order to be effective, the subsidy has to lower domestic costs sufficiently to attract the first MNE. We shall call the level of subsidy that would do this, the *threshold subsidy* and identify it as τ.

However, given that this subsidy is non-discriminatory, all of the MNEs will have an incentive to establish a production facility in the home country. The entry of the first firm will change the costs of production for additional entrants. If production costs fall initially

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[12] This form of subsidization differs from investment incentives that lower the fixed costs of production (for example, subidies on the purchase of land, buildings, or capital goods).

(because of the benefits of an expanding intermediates sector), more firms may choose to enter when offered τ. The outcome may be characterised by multiple equilibria: where $\underline{E} = 1$ is an unstable equilibrium and any subsidy that exceeds the threshold level may result in an inflow of FDI from several foreign enterprises, with a cluster of MNEs establishing themselves in the local economy.

Thus we have the possibility of a *low-level production trap* whereby, in the absence of government assistance, no MNEs would invest in the domestic economy; while, if the government offers a sufficiently large inducement, several firms will enter and take advantage of the endogenously derived infrastructure of intermediate firms. Our next task is to find the value of the threshold subsidy and examine the resulting production and welfare levels.

Our two reduced-form equilibrium conditions are the iso-cost condition (20) and labour-market condition (21). Setting these equal to one another and choosing the number of MNEs to be unity ($\underline{E} = 1$), we can derive an expression for the subsidy τ that can achieve this (unstable) equilibrium number of MNEs:

$$\tau = \left[\frac{\delta}{\mu^\beta Y}\right]^{\frac{\alpha}{\alpha+\beta}} \left\{L - \left[\delta^\alpha \mu^{\alpha\beta} Y^\beta\right]^{\frac{1}{\alpha+\beta}}\right\}^{-\frac{1}{\varepsilon}} - C* \tag{25}$$

We can then take this value of subsidy and substitute it into the equilibrium expressions (20) and (21). Substituting one into the other yields a rather unwieldy implicit function of E:

$$L - \left[\delta^\alpha \mu^{\alpha\beta} Y^\beta\right]^{\frac{1}{\alpha+\beta}} = \left\{L - \left[\delta^\alpha \mu^{\alpha\beta} (EY)^\beta\right]^{\frac{1}{\alpha+\beta}}\right\} E^{\frac{\alpha\varepsilon}{\alpha+\beta}} \tag{26}$$

This is not readily solved analytically. Instead we have to resort to numerical simulation.

When the equilibrium expressions are plotted in (E, w) space, they will intersect at $\underline{E} = 1$. They also intersect at a higher value of E, this latter intersection being at $\overline{E}$, the (stable) equilibrium number of MNEs that will be induced to enter given the threshold

subsidy. In Figure 2, we plot these schedules, as well as $d(E)$ and $g(E, \tau)$ the relative impact on national income from inducing the entry of these MNEs (excluding and including the cost of the subsidy, respectively).

In the example shown in the figure, the threshold value $\tau \approx 0.09$. This will yield a stable equilibrium in which $\overline{E} = 7.87$. In this case, the subsidy is worthwhile in that $d(\overline{E}) = 1.284$ and, even when the cost of the subsidy is taken into account the economy benefits because $g(\overline{E}, \tau) = 1.035$. However, should we take into account the fact that $\overline{E}$ must be an integer value, the number of whole MNEs that would be willing to enter is 7. From Figure 2, it is clear that having only this number of foreign firms setting up in the country is welfare reducing, as the cost of the subsidy exceeds the benefit from increased domestic production.

To summarise, we have shown that there are benefits for a country of hosting foreign MNEs. The benefits appear through the direct employment effects as well as through the demand for domestically produced intermediate goods. Both the input-output linkages, between the MNEs and the imperfectly competitive intermediate goods sector, and the external economies of scale in that sector imply that there are self-reinforcing mechanisms in the modern sector (MNEs and intermediate goods). Once one MNE has established production, it is more attractive for the next one to follow. However, the general-equilibrium wage effects of growth in the modern sector work as a counteracting force.

Given the self-reinforcing incentives for MNEs to establish production plants, active policies by the host country government may give net benefits for the country. In our setting with non-discriminatory policies, whether it is worthwhile for the government to subsidize the MNEs depends on the net benefits of having the FDI relative to the cost of giving

favourable conditions to all the foreign firms[13]. It should be noted that the subsidization of MNEs in this model implies a domestic transfer of income from the tax payers (workers and owners of specific factors in the traditional sector) to the workers, since the benefits appear through the increase in the wage rate. As the number of MNEs continues to increase until the net cost of production in this country is again equal to the overseas cost, there is no net transfer of income to the foreign firms.

5. POLICY COMPETITION

The above analysis shows that it may be beneficial for a country to subsidize in order to attract MNEs, since once you get above the threshold level of subsidies to attract the first MNE there will be self-reinforcing mechanisms that make it attractive for more firms to enter. However, it should be quite clear that if this is the case for one country, the same must be true for others, and they could start competing for the MNEs. In this section we extend the analysis somewhat, to address questions having to do with the effects of such policy competition between countries.

We use the same model structure, but allowing for two countries in the region (the home country, *h*, and the foreign country, *f*), both of which consider whether they should try to attract foreign MNEs. We assume that there is a fixed number *E* of MNEs and that all of them will invest and produce in one country or the other.[14] Therefore:

$$E_h + E_f = E \tag{27}$$

The market equilibrium will now be the outcome of a two-stage game, where at the first stage the governments in the two countries simultaneously set subsidy levels that will

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[13] If the government could discriminate between MNEs, the costs for the government could be lower, and the net benefits higher. However, that would require that the government could "pick the winners" and give different conditions to different firms. If we think about the policies as providing for example infrastructure or favourable tax regimes for MNEs rather than direct subsidies, the non-disriminating assumption is more realistic.

[14] Thus there is no outside option of the firms servicing the regional market from other countries.

subsequently apply for all MNEs that choose to locate in that market, and at the second stage all MNEs determine their location of production simultaneously. The solution will be a subgame-perfect Nash equilibrium.

In order for an MNE to be willing to maintain production in a particular location, the net costs of production (that is, inclusive of any production subsidy) can be no greater than those in the other country. An equilibrium allocation of MNEs between the two locations will occur either when costs are equal for firms working in each location or when all firms are located in a single country and no individual firm has an incentive to relocate.

5.1 General-equilibrium outcomes

We consider the situation where the costs of production in the two countries are the same. In order to solve for the equilibrium, we use the **LL** curve for country f (21), the **MM** schedule for the same country (20), the constraint on the number of MNEs in the region (27), and define the unit cost of production in country f to be C_f to obtain:

$$C_f = \frac{\left\{ L_f - \left[\delta^{\alpha} \mu^{\alpha\beta} \left(E - E_h \right)^{\beta} Y^{\beta} \right]^{\frac{1}{\alpha+\beta}} \right\}^{-\frac{1}{\varepsilon}}}{\left[\delta^{-\alpha} \mu^{\alpha\beta} \left(E - E_h \right)^{\alpha} Y^{\alpha} \right]^{\frac{1}{\alpha+\beta}}} \tag{28}$$

Now we substitute this into the home country's **MM** schedule (20), using the fact that the production cost net of any subsidy must be the same in both countries:

$$C_h - s_h = C_f - s_f$$

and this gives:

$$w_h = \left\{ \frac{\left\{ L_f - \left[\delta^{\alpha} \mu^{\alpha\beta} \left(E - E_h \right)^{\beta} Y^{\beta} \right]^{\frac{1}{\alpha+\beta}} \right\}^{-\frac{1}{\varepsilon}}}{\left[\delta^{-\alpha} \mu^{\alpha\beta} \left(E - E_h \right)^{\alpha} Y^{\alpha} \right]^{\frac{1}{\alpha+\beta}}} + s_h - s_f \right\} \left(\delta^{-\alpha} \mu^{\alpha\beta} E_h^{\alpha} Y^{\alpha} \right)^{\frac{1}{\alpha+\beta}} \tag{29}$$

Expression (29) is the new general-equilibrium **MM** schedule for the home country.

Rewriting the **LL** schedule to take into account the country-specific variables yields:

$$w_h = \left\{ L_h - \left[\delta^{\alpha} \mu^{\alpha\beta} (E_h Y)^{\beta} \right]^{\frac{1}{\alpha+\beta}} \right\}^{-\frac{1}{\varepsilon}} \tag{30}$$

These lines are plotted in Figures 3a and 3b where the number of MNEs is 10 and both countries are setting the same level of production subsidy (0.15). The differences in the two figures arise from the sizes of the labour forces in each country. In Figure 3a, $L_h = L_f = 8$, while in Figure 3b both labour forces are fifty percent larger with $L_h = L_f = 12$. As a result of this, the possible equilibrium allocations of MNEs between the two countries differ quite markedly. The reason for this lies in the fact that the general equilibrium effects of a particular level of MNE investment are less for more populous countries, resulting in flatter **LL** curves.

Before we analyse possible equilibria, we have to establish the appropriate welfare measures for the two countries. Rewriting (23) and (24) to account for country-specific variables, yields:

$$D(E_i) = \frac{1}{\varepsilon - 1} \left\{ \varepsilon L_i - \left[\delta^{\alpha} \mu^{\alpha\beta} (E_i Y)^{\beta} \right]^{\frac{1}{\alpha+\beta}} \right\} \left\{ L_i - \left[\delta^{\alpha} \mu^{\alpha\beta} (E_i Y)^{\beta} \right]^{\frac{1}{\alpha+\beta}} \right\}^{-\frac{1}{\varepsilon}} \tag{31}$$

$$G(E_i, s_i) = D(E_i) - s_i E_i Y \tag{32}$$

Note that subsidy levels do not enter directly into (31), but have their effects through E_i the allocation of MNE production.

5.2 Diversified production

Figure 3a displays five equilibria, three of which are stable. Two of these correspond to all of the MNEs concentrating in one country or the other. Suppose, for example, that all of the MNEs were in the home country, that is, $E_h = E$. At this point, the wage that is being offered

by the modern sector is greater than that necessary to induce them to work there. However, also at this point, the "lumpiness" of the MNEs becomes important. In the example illustrated in Figure 3a, there is an unstable equilibrium at point B, where $9 < E_h < 10$. Should any MNE move to the foreign country, the new equilibrium would correspond to the two countries sharing the firms in the region. Thus, any policies that can induce at least one MNE to set up in each country will result in diversified production, that is, both countries having modern and traditional production and employment. In this section we look at policy competition in cases where the stable, diversified equilibrium remains the equilibrium.[15]

In order to find out what equilibrium levels of subsidies will arise, we need to establish the countries' incentives to increase their subsidies. Each country seeks to maximise its level of G (32). Given the symmetry of the model (the countries being identical in all respects), the equilibrium will be characterised by an even division of the MNEs and identical levels of subsidy. If the subsidies are the same, $E_h = E_f$ for any level of subsidy and D will remain constant. Consequently, the two countries will lose from subsidy competition, G falling with increasing levels of production subsidy.

Individual countries have the incentive to raise their subsidy to attract more MNEs. Taking the derivative of (32) with respect to s_i (holding the other country's subsidy constant), yields the benefits to a country of increasing its subsidy:

$$\frac{\partial G(E_i, s_i)}{\partial s_i} = \frac{\partial D(E_i)}{\partial E_i} \frac{\partial E_i}{\partial s_i} - E_i Y - s_i Y \frac{\partial E_i}{\partial s_i} \qquad (33)$$

This is positive in our simulations for $s_h = s_f = 0$ and hence each country has an incentive unilaterally to offer production subsidies. Furthermore, as $\partial D(E_i)/\partial E_i$ and $\partial E_i/\partial s_i$ are constant for $s_i = s_j$, the benefit to a country of increasing its subsidy declines with the initial level of (symmetric) subsidies.

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[15] Concentrated equilibria are dealt with in the next section.

There is, however, a limit to how high subsidies each country will offer; if s_i becomes too high, the country would be better off without any MNE. The maximum subsidy s_i^{max} arises when the cost of the subsidy fully offsets the benefits of having half of the MNEs. That is, $G(E/2, s_i^{max}) = G(0, s_i^{max})$, which from (32) can be written as:

$$D(\frac{E}{2}) - s_i^{max} \frac{EY}{2} = D(0)$$

Solving for the maximum subsidy:

$$s_i^{max} = 2 \frac{D(\frac{E}{2}) - D(0)}{EY} \tag{34}$$

Will policy competition between the two countries always imply that the subsidies are raised to this maximum level? A complete answer to this question would require that we work out the reaction functions for the two countries and study the game between them; as it turns out to be fairly complicated to get general results for the reaction functions we will not follow that route. However, a necessary condition for the subsidy to end up at the maximum level must be that the countries would have had incentives to increase the subsidies further, had not $E_i = 0$ been an option. Hence, if $\partial G(E/2, s_i^{max})/\partial s_i < 0$ we must have an "interior" solution, with both countries subsidizing, but at a rate lower than s_i^{max}. Using (33) and (34), this condition can be written

$$\left[\frac{\partial D}{\partial E_i} - 2 \frac{D\left(\frac{E}{2}\right) - D(0)}{E} \right] \frac{\partial E_i}{\partial s_i} - \frac{EY}{2} < 0$$

all evaluated at $E_i = E/2$. The expression in parentheses is positive as long as the $D(E)$ function is convex, as in figure 2. The overall inequality may still be satisfied, and it is more likely to be satisfied the less sensitive the equilibrium E_i is to unilateral changes in the subsidy rate.

Hence, there must be cases with an interior solution, in the sense that both countries subsidize, but at a rate lower than the maximum one. Neither country has attracted any additional firms, the subsidy competition merely having transferred some of the gains from having MNE investment from the country to the firms themselves. This is a familiar result from public finance, where tax competition for mobile factors can exhaust the rents from their presence.

5.3 Concentrated production

We turn now to the equilibria shown in Figure 3b. In this situation (where the two countries are again symmetric, but the labour forces are larger than in the previous sub-section), the **MM** schedule is steeper than the **LL** schedule when the MNEs are evenly divided between the two countries. Consequently, diversified production is an unstable equilibrium and, instead, one or other of the countries will end up with all of the modern sector.

Each country will have an incentive to attract the modern sector using subsidies. If the home country offers a subsidy greater than that offered by the foreign country, the **MM** schedule will shift up. If the subsidy difference $v \equiv (s_h - s_f)$ is sufficiently great, the home country can guarantee that it will get the MNE investment. In Figure 3b, the sudsidy differential v is equal to v^*, the level which shifts **MM′** such that it intersects **LL** at $E_h = 1$. Suppose that the modern sector is initially in country f. For any subsidy differential less than v^*, no individual MNE would consider moving alone to country h. If, however, $v > v^*$, then the intersection between the **MM** and **LL** lines is at $E_h < 1$, and so a single MNE would be prepared to move from country f and set up production in the home country. This would make relocation more attractive for the remaining firms in the foreign country who would therefore move as well, bringing the modern sector to country h. Thus the potential equilibria are:

(i) $C_h(1) - C_f(E) < v$ concentration in country h

(ii) $C_h(E) - C_f(1) \leq v \leq C_h(1) - C_f(E)$ concentration in *either* country   (35)

(iii) $C_h(E) - C_f(1) > v$ concentration in country f

where $C_i(x)$ is the cost to a representative firm in country i when there are x firms producing in the country. From (35) and given the assumed symmetry of the model, we can determine that:

$$v^* = C_i(1) - C_j(E) \quad \text{for } i \neq j \tag{36}$$

We can now derive the reaction functions for each country. Consider $R_j(s_i)$, which is the subsidy chosen by country j, given country i's subsidy. In order to ensure that it captures and retains the modern sector, country j will have to offer a subsidy such that $s_j = s_i + v^*$.[16] There is, however, an upper limit to the subsidy that the country is willing to offer. The investment is being encouraged in order to raise national income. Therefore the subsidy cannot be so large that, once its costs have been taken into account, the host country is worse off than it would have been without a modern sector. This condition translates to:

$$D(E) - s_j EY \geq D(0) \tag{37}$$

Let s^* be the maximum subsidy offered. (37) can then be rewritten as:

$$s_j \leq s^* \equiv \frac{D(E) - D(0)}{EY} \tag{38}$$

Putting these conditions together yields the reaction function:

$$R_j(s_i) = \begin{cases} s_i + v^* & s_i < s^* - v^* \\ s^* & s_i \geq s^* - v^* \end{cases}$$

The reaction functions of the two countries are illustrated in Figure 4. At points **S** and **T**, countries h and f, respectively, reach their maximum subsidy levels and the reaction functions have kinks. The two reaction functions intersect at point **A**. As both countries are prepared

to offer the same subsidy, neither is guaranteed the modern sector. In addition, as the subsidy is equal to $s*$, the country that captures the modern sector gets no overall benefit from doing so, the MNEs being the major beneficiaries. There will, however, be a distributional impact from attracting the modern sector. Workers will benefit from the increased employment opportunities, being able to move out of the traditional sector and enjoy the resulting higher wages. The losers from attracting the MNE investment then are the owners of the sector-specific resource employed in the traditional sector.

6. CONCLUSIONS

In this paper we have seen how the linkages between multinational firms and domestic intermediate-goods producers may give rise to gains from providing inducements to attract foreign multinational investment. The agglomerating forces imply that the MNEs have incentives to locate together; while pressure from rising wages in the labour market work in the opposite direction. The incentives for countries to use active policies to attract MNEs are particularly strong when the agglomerating forces dominate; such that all of the modern sector ends up in one country. In fact, in our model with two symmetric countries fighting for a given number of MNE plants, the equilibrium in the policy game in the case with strong agglomerating forces, is one where all of the modern sector ends up in one of the countries, but the necessary subsidies are so high that there are no net benefits for that country. The subsidies represent a transfer of income from owners of specific factors in the traditional sector both to domestic workers and to the foreign MNEs.

In certain cases the general-equilibrium effects are strong enough to counteract the complete concentration of the modern sector. In those situations, we get a stable diversified equilibrium with the MNEs evenly spilt between the two symmetric countries. However,

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[16] A higher subsidy would also attract the modern sector but, as the country wishes to maximize its national income, it will choose the lowest subsidy that guarantees getting the modern sector.

there are still incentives for the countries to make an attempt at subsidizing production in order to try to attract a larger share of the MNEs. Whether this policy competition results in subsidies that are so high that all net benefits for the countries are dissipated or not, depends on the exact parameters of the model. As the equilibrium allocation of production is unaffected by the subsidy war, the only effect of the policy competition is to transfer income from the two competing countries to the foreign multinational firms.

In this paper we have limited the analysis to cases with symmetric countries. In future research, the model could be extended to treat policy competition between asymmetric countries. It might also be interesting to extend the analysis by introducing more factors of production such that, for example, the external economies in the modern sector could be linked to learning-by-doing among skilled workers, and where the incentives to become a skilled worker may depend on the relative wages between unskilled and skilled workers. In such a setting the model could give rise to endogenous growth effects following inwards FDI.

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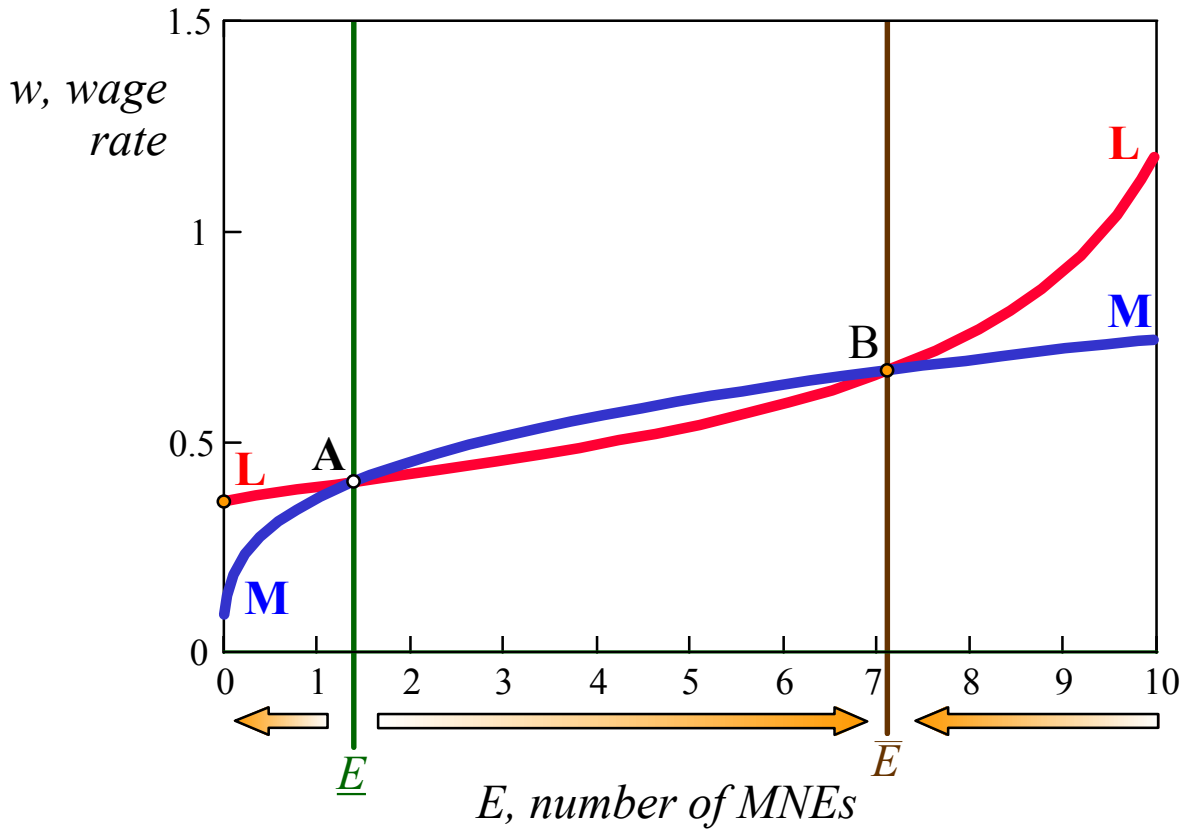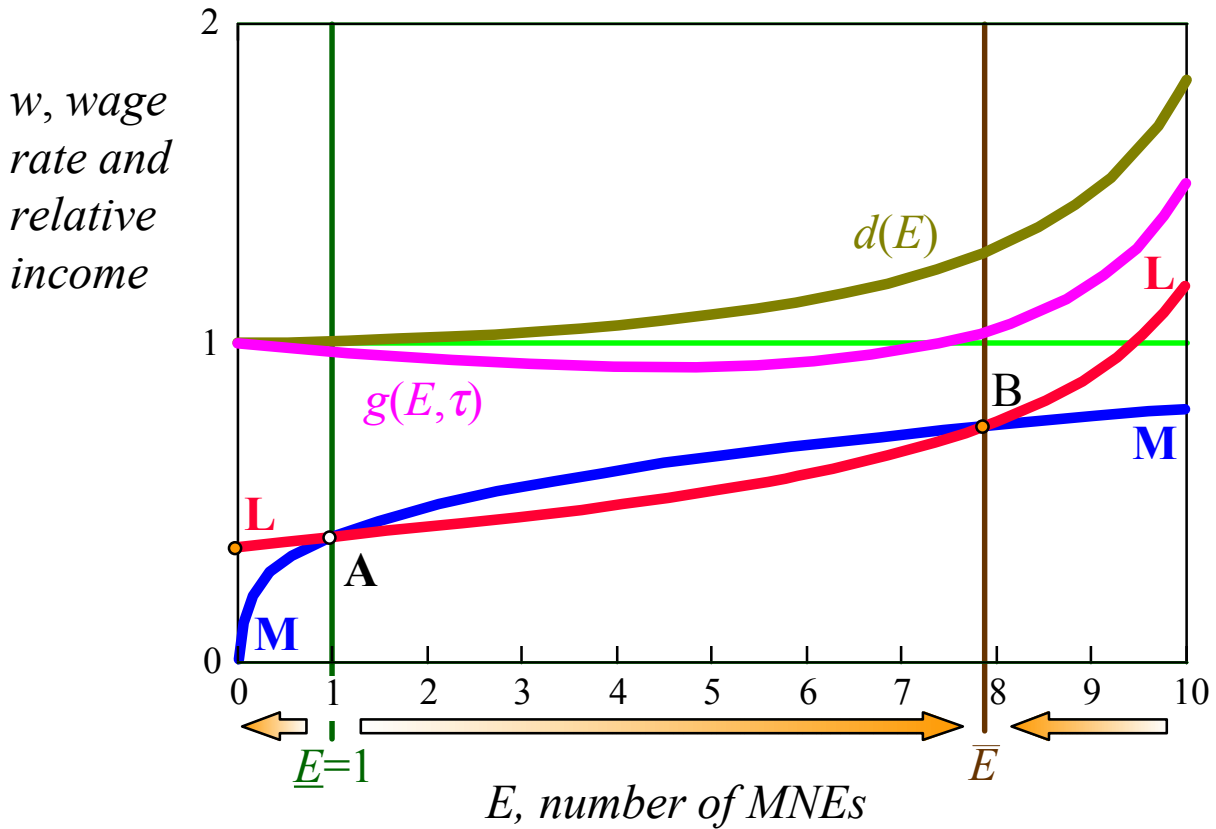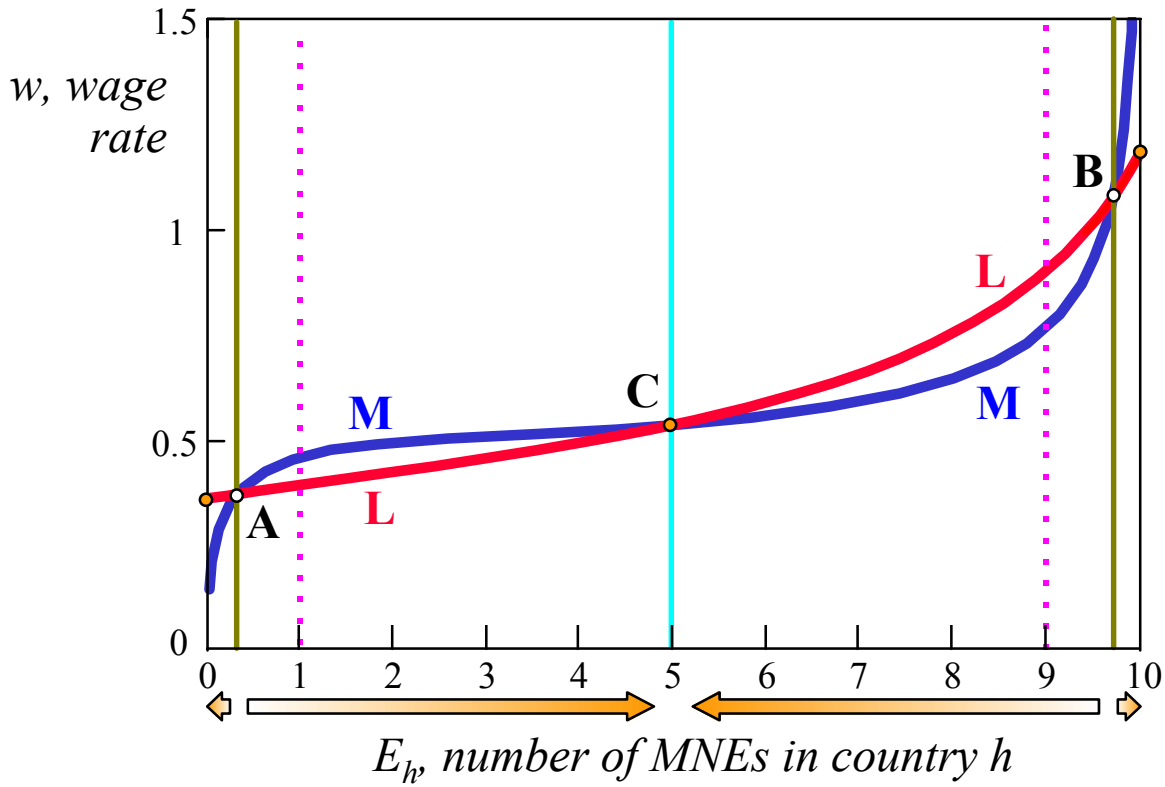
Figure 1. Equilibrium Levels

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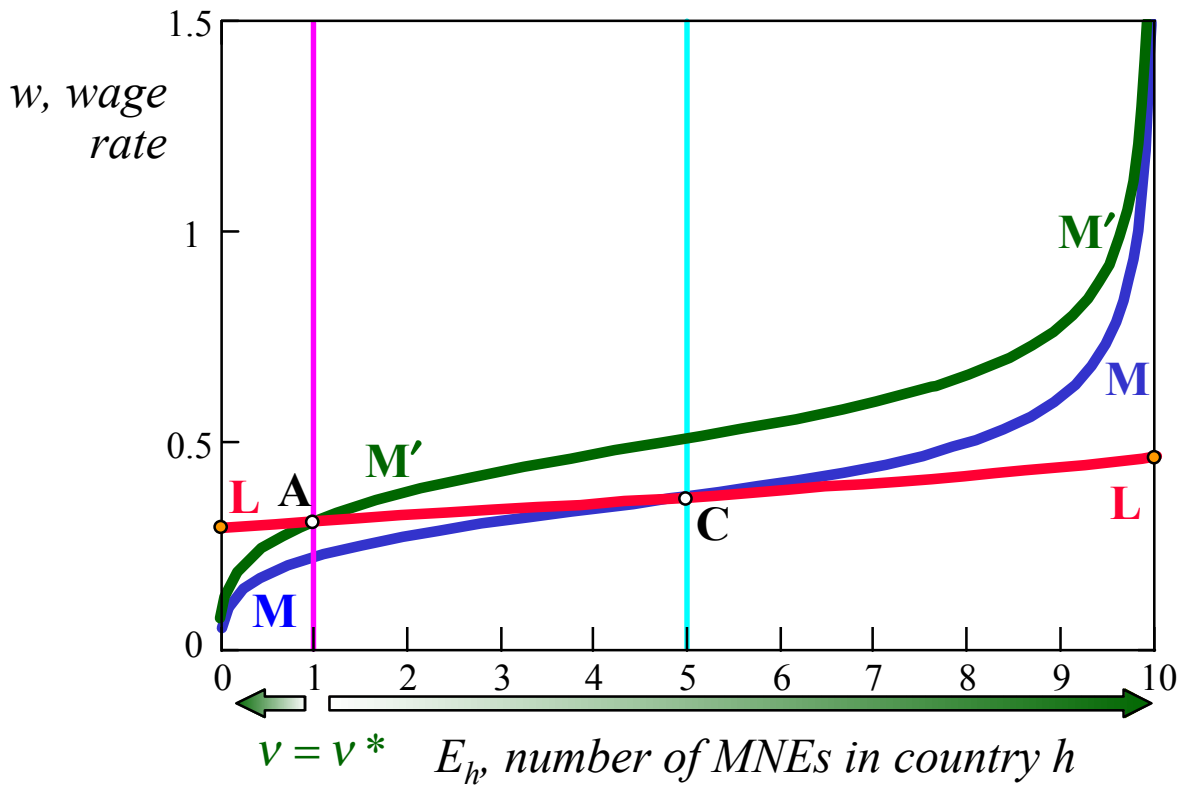
Figure 2. The Threshold Subsidy and Welfare

Figure 2. The Threshold Subsidy and Welfare

Figure 3a. Equilibrium Levels in Country *h*

w, wage rate

E_h, number of MNEs in country h

Figure 3b. Equilibrium Levels in Country *h*

w, wage rate

$v = v*$ *E_h, number of MNEs in country h*

Figure 4. Equilibria with Competition in Subsidies