

## **On the Coexistence of National Companies and Multinational Enterprises**

### Abstract

National and multinational companies coexist in many sectors of all developed countries. However, economic models struggle to resemble this fact because of the assumption of symmetry between companies. To show that the symmetry assumption is the reason for this struggle, a two-country general equilibrium model is set up where multinational enterprises emerge endogenously in reaction to exogenously induced market integration. In a model version with symmetric companies, stable mixed equilibria with national and multinational companies do not exist, because all companies decide to internationalize production at the same conditions. In contrast, if companies are allowed to differ, there exist a wide range of economic conditions where national and multinational companies coexist.

JEL: F12 F23 L22

Keyword: Globalization, Multinational Enterprises, Exports, Market Structure

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# **On the Coexistence of National Companies and Multinational Enterprises**

## **1. Introduction**

There is no doubt that national and multinational companies coexist in many sectors and many economies. Although the number of multinational enterprises (MNEs) has increased significantly in recent years, there are no signs of exporting national companies (NCs) dying out. Almost all industries are characterized by a stable structure consisting of both, NCs and MNEs. Moreover, NCs coexist in many industries with two groups of MNEs: with MNEs based in the same country and with affiliates of MNEs based in foreign countries.

Models of MNEs can, generally, not reflect this coexistence. This is troubling because the analysis of market structures is thus restricted to corner solutions which reflect observed market structure in many industries not very well. Brainard (1993) discusses coexistence for a knife-edge solution of her model. Markusen and Venables (1998) claim that both types of companies coexist in their model, because under particular conditions there might be NCs or MNEs in equilibrium. However, the market structure is not explicitly given, and the existence of a particular type of company might depend on the prevailing market structure. Moreover, companies do not compare profits from exporting and from producing abroad, the two possible strategies for foreign market supply. There is, therefore, no check in the model whether it would be profitable for a company to switch the strategy. Whether the coexistence result prevails if such a comparison is made was unclear.

The symmetry assumption of all companies yields the difficulty for theoretical models to generate stable mixed equilibria. Identical companies face the choice between acting as an NC or as an MNE that depends on exogenous parameters. Since all companies are symmetric, they all internationalize production at the same exogenous parameter constellation. To show this, a two-country general equilibrium model with symmetric companies is set up. Companies can choose between exports and production abroad to serve the foreign market. Their decision is dependent on their production technology, demand characteristics, and the degree of separation of the two economies, i.e. the level of distance costs. Hence, the decision is effected by exogenous parameters. The effect of an exogenous change in distance costs on the internationalization decision is particularly important in this framework, because falling distance costs drive the endogenous emergence of MNEs in this model. With such a setting the model resembles the globalization process.

Exogenously falling distance costs, which result in changing conditions of competition, are the source of economic integration of the two countries in this model. Economic integration changes incentives of companies to internationalize their production. In the initial situation, distance costs are assumed to be high. The distance costs can be thought of as border effects (McCallum 1995). They separate the two markets in this two-country model but do not apply

to domestic transactions. Border effects have fallen over the last two decades (Nitsch 2000). By assumption, distance costs here occur only in the manufacturing sector but not in the agricultural sector.

With falling distance costs, an economy with symmetric companies switches from hosting only NCs to hosting only MNEs when distance costs have fallen below a particular threshold. An equilibrium with NCs and MNEs (mixed equilibrium) is a knife-edge solution. It is restricted to the adjustment process between the pure NC equilibrium and the pure MNE equilibrium at one particular level of distance costs. Hence, the model cannot resemble stable mixed equilibria.

However, we observe mixed equilibria. I argue that lacking differences between companies hinder the model to resemble this empirical fact. To show this, the model structure is changed to incorporate differences between companies. Then, the manufacturing sector consists of one industry which hosts several groups of different companies. These are symmetric within their group but two companies from different groups have at least one different characteristic. A consumer chooses his/her most preferred version of the differentiated good in a two-stage process. First, the consumer chooses one of the different groups depending on the price indexes of the groups. Second, he/she selects the most preferred version from the chosen group. Companies which differ in their technology or in the demand characteristics for their products change their optimal supply strategy of the foreign market at a different distance cost level. Mixed equilibria result. In contrast to the symmetric company model, these mixed equilibria are stable.

## **2. Related Literature and Model Structure**

Helpman et al. (2002) presented a model of companies facing the choice between three alternatives: not serving the foreign market, serving it by exports or by production abroad. After market entry, companies draw their productivity level from a known distribution. Depending on the productivity, one of three strategies dominates the other two (except for the indifference points, which have a probability of zero). In equilibrium, the most productive companies choose to produce at home and abroad, i.e. they become MNEs, the least productive companies serve only the home market and companies in between export to serve the foreign market. Hence, MNEs and NCs coexist. Companies' asymmetry is the key to this mixed market structure. Coexistence of MNEs and NCs in the model I present here depends also on asymmetry among the companies. However, companies do not differ in their productivity but in characteristics such as fixed costs, product differentiation and the complexity of their production process.

The model stands in the tradition of Brainard (1993). It has two sectors, agriculture and manufacturing, two countries, home and foreign, and one factor, labor. The perfect competitive agricultural sector produces a homogenous good. In the manufacturing sector, two groups of companies are active: final goods producers and intermediate goods producers. Final good producers produce a bundle of differentiated goods, which consists of many varieties. Final good producers engage in monopolistic competition within their group. It is profitable to produce a single variety of the bundle of differentiated goods in only one company because the final good producers in the manufacturing sector use fixed input factors in production. They produce in a multi-stage process, which include fixed inputs at the corporate level (R&D, marketing, financing) and at the plant level (equipment). Furthermore, final good producers use a specific intermediate good, which is also produced in the manufacturing sector. Final goods producer choose between exports and production abroad to serve the foreign market. Exporting saves on additional fixed costs at the plant level, while production abroad saves on distance costs. All goods in both economies are produced by using labor, the only production factor.

The model goes beyond Brainard (1993) in modeling the usage of the specific intermediate good in the production process of the final good. Recent empirical work (Feenstra 1998, Campa and Goldberg 1997) has called attention to the increasing use of imported intermediate goods in various developed economies and has related this to rising activities of MNEs (Hummels et al. 1998). Intermediate goods companies in the model presented here are assumed to produce a homogenous good in a single stage without using fixed input factors. Their market is perfectly competitive. The intermediate good is specific either to the final goods or to the production processes, or to both. Final goods producers use, therefore, the intermediate good exclusively from their home country, even if they produce abroad. Intermediate good producers and final good producers of the same country compose a network. A good example is a car producer's production in a foreign country which relies on the same component inputs as at home. These inputs must be imported by the foreign affiliate. Non-specific intermediate goods could be modeled as labor. There would be an additional production factor which is taken from the country where production takes place. For simplicity, non-specific intermediate goods are excluded here. Non-specific intermediate goods do not add new insight to the analysis, while specific intermediate goods do. Table 1 gives a short summary of the model structure.

Table 1: Model Structure

	Agricultural good	Intermediate good	Final good
Product characteristic	homogeneous	homogeneous	differentiated many varieties
Competition	perfect competition	perfect competition	monopolistic competition
Input factors	labor	labor	labor, intermediate goods
Production stages	one stage	one stage	headquarter service and production stage using fixed costs at plant level
Foreign market service	trade without incurring distance costs	exports to foreign affiliates of home-based MNE, incurring distance costs	exports with incurring distance costs or foreign production
Number of companies	–	–	endogenous

Exogenous falling distance costs change the optimal consumption bundle, prices, optimal output levels, the number of companies in equilibrium and the preferred strategy for supplying the foreign market. Hence, market structure changes with the level of distance costs. For very high and very low distance costs, equilibria with only NCs prevail. For high distance costs, variable profits of the foreign affiliate are not high enough to cover the additional fixed cost at the plant level. For small distance cost levels, savings of distance cost are not large enough to make up for the additional fixed cost at the plant level. Companies then always prefer exports to production abroad. For intermediate distance cost levels, however, profits of foreign affiliates might be sufficient to cover the additional fixed costs at the plant level.

There is, therefore, only a limited range of (intermediate) distance costs where MNEs may exist. Hence, there is only a limited range of distance costs, where coexistence is possible. The analysis concentrates on this range studying necessary conditions for the emergence of mixed equilibria with NCs and MNEs. In models with symmetric companies, mixed equilibria are an instable knife-edge solution. In the model with different groups of companies varying in their characteristics, however, stable mixed equilibria may exist over a wide range of distance costs.

### 3. The Basic Model

There are two symmetric countries, home  $H$  and foreign  $F$ , each with two sectors of production. The output of the agricultural sector is denoted  $Q_A$ . Companies in agriculture

produce a homogenous product with constant returns to scale under perfect competition. Companies in the manufacturing sector produce a variety of final goods under monopolistic competition and a homogeneous intermediate good under perfect competition. The aggregate output of the final goods in the manufacturing sector is  $Q_M$ . An individual final good producer's output is denoted  $q_i$ . The final goods producer, which can serve the foreign market through exports or production abroad, uses the intermediate good. The output of the intermediate good is  $Z$ .  $Z$  is used as input exclusively by the final goods producer headquartered in the same country. The assumption is, therefore, that the intermediate good is tradable. Foreign affiliates of the MNEs import it from the home country. But the intermediate good is not used by foreign companies. Because of the symmetry of the two countries, it is sufficient to describe the economy of the home country  $H$ . All definitions, conditions and derivations apply to the foreign country  $F$  in the same way.

It is assumed that every individual in  $H$  is endowed with one unit of labor,  $L$ . The individual is free to choose any job in his/her country. There is no cross-border mobility of labor. The labor market equilibrium gives wage level,  $w_H$ , in country  $H$ . Full employment is assumed.

### 3.1 Consumption

$L_H$  inhabitants live in  $H$ . They have identical preferences. Their utility function is increasing in the agricultural product and the aggregate manufacturing product.

$$U_H = Q_{A,H}^{1-\mu} Q_{M,H}^{\mu} \quad \mu \in (0,1) \quad (1)$$

$\mu$  gives the income share spent on manufacturing goods. The aggregate  $Q_M$  is a CES-function consisting of  $\lambda$  different products

$$Q_{M,H} = \left[ \sum_{i=1}^{\lambda} q_{i,H}^{\rho} \right]^{1/\rho} \quad \rho \in (0,1) \quad (2)$$

where  $\rho$  defines the degree of differentiation among the manufacturing goods. The products are poor substitutes for each other if  $\rho$  is small, leaving the companies with more market power. The CES-function (2) implies that consumers love variety. It yields a constant elasticity of substitution  $\sigma$ , with  $\sigma=1/(1-\rho)$ , between any two varieties of the final goods in the manufacturing sector.

Individuals maximize their utility (1) subject to budget constraints

$$Y_H = P_{A,H} Q_{A,H} + \sum_{i=1}^{\lambda} q_{i,H} p_{i,H} \quad (3)$$

to obtain the optimum quantities of agricultural and manufacturing goods

$$Q_{A,H} = (1 - \mu)Y_H / P_{A,H}, \quad (4)$$

$$Q_{M,H} = \mu Y_H / P_{M,H}. \quad (5)$$

$P_{A,H}$  is the price of agricultural goods,  $P_{M,H}$  is the price index of the varieties of manufacturing goods. This price index depends on the prices,  $p_{i,H}$ , of each individual product  $i$ .

Since agriculture is the perfectly competitive sector in the economy and since the agricultural good can be traded without incurring costs, the price of the agricultural product is the same in both economies. It is set one ( $p_A=1$ ). The agricultural good is, therefore, used as a numeraire throughout the paper.

## 3.2 Production

### 3.2.1 *The Agricultural Good Producer*

Companies in the agricultural sector produce under constant returns to scale. Because agriculture is a perfectly competitive sector, the wage,  $w_H$ , is paid according to the marginal products of the production factor labor.

$$\frac{\partial Q_{A,H}}{\partial L_{A,H}} = w_H \quad (6)$$

Perfect mobility of workers across sectors assures identical wages in all sectors of the economy. Production costs in agriculture,  $C_{A,H}$ , are given by

$$C_{A,H} = w_H Q_{A,H}. \quad (7)$$

### 3.2.2 *The Manufacturing Goods Producer*

Final good producers in the manufacturing sector engage in monopolistic competition. Consumers view the differentiated products as imperfect substitutes for one another. Each company produces a single variety. Hence, the number of differentiated goods equals the number of firms producing the final good in the two countries.

There are two groups of companies in the manufacturing sector, intermediate goods producers and final goods producers. Each final goods producer uses the intermediate good as input in final good's production. Since the intermediate good is specific to a production process or a final good, the production of the final good in the foreign country depends on the supply of intermediate goods from the home country. For the sake of simplicity, it is assumed

that MNEs exclusively use intermediate goods produced in their home country, irrespective of whether production of the final good occurs in the home or in the foreign country.

### *Intermediate Good Producers*

The intermediate good is a homogenous good. It is used by all final good producing companies in the manufacturing sector for their production.

Costs of production of the intermediate good,  $C_H^Z$ , are given in (8) by

$$C_H^Z = z_H w_H. \quad (8)$$

Production of the intermediate good requires only labor. Costs of production are proportional to output. The marginal costs equal the wage rate,  $w_H$ , in country  $H$ . Since the intermediate good is a homogenous good produced under perfect competition its price equals marginal costs,  $w_H$ .

$$pz_H = w_H \quad (9)$$

Equation (9) gives the price of the intermediate good at home, i.e. without distance costs. The price,  $pz_H^M$ , perceived by affiliates in the foreign country, however, must take distance costs,  $\tau$ , into account. Foreign affiliates of  $H$ -bases MNEs have to pay c.i.f. prices (which include distance costs) for the intermediate goods they use. The price of the intermediate good increases to

$$pz_H^M = w_H e^\tau. \quad (10)$$

Distance costs are modeled in Samuelson's 'iceberg' form: a part of the value of every product must be paid for transportation. To buy one unit of the imported intermediate good, the affiliate of the final good producer in the foreign country must pay  $e^\tau$  ( $>1$ ) units,  $e^\tau - 1$  units being distance costs. For very high distance costs,  $\tau$ , the price of the intermediate good used as input in the foreign country,  $pz_H^M$ , goes to infinity. For very small distance costs, it approaches  $pz_H$ .

### *Final Good Producer*

There are two possible types of final goods' producers in every country: (i) the NC, producing in their home market and serving the foreign country through exports and (ii) the MNE, producing domestically and abroad. Given the symmetry of both countries in this model, exports of MNEs' affiliates to the home country cannot be profitable.

Final good producers produce in a multi-stage process. In the first stage, each company produces headquarter services. These headquarter services, like R&D or marketing, can be used non-rivalry within the company. In the second stage, production takes place at the plant



level. Headquarter services and intermediate goods are used as inputs. The cost function of an NC is given by

$$C_{i,H}^N = w_H r_H + w_H f_H + \left( \frac{w_H}{\theta} \right)^\theta \left( \frac{p z_H}{1-\theta} \right)^{1-\theta} q_{i,H}^N \quad \theta \in (0,1) \quad (11)$$

The first term represents fixed costs at the company level, the second term the fixed costs at the plant level. Fixed costs increase in wages,  $w_H$ , and in  $r_H$  and  $f_H$ .  $r_H$  and  $f_H$  are the levels of headquarter-services produced and the amount of fixed input necessary at the plant, respectively.  $r_H$  and  $f_H$  are technology parameters and exogenous to the company.

Variable costs, the third term in equation (11), increase in the factor price of labor at home,  $w_H$ , the price of the intermediate goods,  $p z_H$ , and the output level  $q_{i,H}^N$ . Marginal costs,  $(w_H/\theta)^\theta (p z_H(1-\theta))^{1-\theta}$ , are denoted by  $c_H^N$ .

Costs of an MNE's producing in its home-country are denoted  $C_{i,H,H}^M$ . They are given by

$$C_{i,H,H}^M = w_H r_H + w_H f_H + \left( \frac{w_H}{\theta} \right)^\theta \left( \frac{p z_H}{1-\theta} \right)^{1-\theta} q_{i,H,H}^M \quad \theta \in (0,1). \quad (12)$$

The first subscript stands for the company, the second for the home country of the MNE, and the third for the location of the production plant. An MNE's production costs differ from production costs of an NC only in the third term, the variable costs. Factor prices and technologies used are the same but the MNE produces at its home country plant only to meet demand in the home market and not for export. The quantities produced in country  $H$  by an  $H$ -based NC and an  $H$ -based MNE differ ( $q_{i,H}^N \neq q_{i,H,H}^M$ ). Marginal costs are the same ( $c_H^N = c_H^M$ ), but variable costs differ because the quantities differ.

The two plants of an MNE have different variable costs because the prices of the intermediate good ( $p z_H^M \neq p z_H$ ) differ in both countries. In the foreign country, the affiliate pays the c.i.f. price. An affiliate's costs in the foreign country  $F$ ,  $C_{i,H,F}^M$ , are given by

$$C_{i,H,F}^M = w_F f_F + \left( \frac{w_F}{\theta} \right)^\theta \left( \frac{p z_H^M}{1-\theta} \right)^{1-\theta} q_{i,H,F}^M \quad \theta \in (0,1). \quad (13)$$

Costs of production in the foreign country do not include costs at the corporate level. The MNE produces the headquarter services at home and uses them non-rivalry in both plants. Production costs of the foreign affiliate depend on the wage rate,  $w_F$ , in  $F$ , the amount of fixed inputs used in production,  $f_F$ , the elasticity of production,  $\theta$ , and on the price of the intermediate good,  $p z_H^M$ , (including distance costs). Production costs of the foreign affiliate increase in distance costs, because the price of the intermediate good increases in distance

costs. For very high distance costs, affiliate's production costs in the foreign country approach infinity.

Output,  $q_{i,H}^k$ , ( $k=N, M$ ) differs between NCs and MNEs based in the same country as well as between the MNE's home country plant and its affiliate in the foreign country. In equilibrium, companies produce the amount of goods they can sell at an optimal price. Given the utility function (1) and the composition of the aggregated final manufacturing good (2), equation (14) gives the demand for a single product,  $q_{i,H}^N$ , of an NC, which serves the foreign market through exports.

$$q_{i,H} = \frac{p_{i,H}^{-(1+\gamma)}}{P_{M,H}^{-\gamma}} \mu Y_H + \frac{p_{i,H}^{-(1+\gamma)} e^{-(1+\gamma)\tau}}{P_{M,F}^{-\gamma}} \mu Y_F \quad \gamma = \rho / (1 - \rho) \quad (14)$$

The optimal quantity of good  $i$  produced in  $H$  depends on: its price,  $p_{i,H}$ , the price-indexes,  $P_{M,H}$ ,  $P_{M,F}$ , in both markets, the size of the markets,  $\mu Y$ , and the distance costs,  $\tau$ . The lower the price of good  $i$  is relative to the price index in both countries, the higher is the optimal output of this good. High distance costs decrease the optimal output by increasing the good's price in the foreign market. Consumers in the importing country  $F$  must pay the distance costs and, therefore, react by partially substituting imported goods by goods produced in their country  $F$ . For very high distance costs, exports approach zero.

An MNE headquartered in  $H$  produces in both countries. The optimal output from the domestic plant,

$$q_{i,H,H}^M = \frac{p_{i,H,H}^{M, -(1+\gamma)}}{P_{M,H}^{-\gamma}} \mu Y_H, \quad (15)$$

equals the demand in the home country (no re-exports). The output of the foreign affiliate,

$$q_{i,H,F}^M = \frac{p_{i,H,F}^{M, -(1+\gamma)}}{P_{M,F}^{-\gamma}} \mu Y_F, \quad (16)$$

is lower, since the price of a good of an MNE from country  $H$  in the foreign market  $F$  is higher than at home because of the more expensive intermediate good. However, the affiliates' output,  $q_{i,H,F}^M$ , is larger than export volumes of an exporting NC, because the affiliate's price is lower than the price for an imported good. Consumers do not have to pay distance costs for the affiliate's good.

The quantity of the intermediate good used by a single final goods producer can be calculated from the cost functions (14–16) by taking the partial derivatives with respect to the

price of the intermediate good,  $pz_H$  (Shephards lemma). Quantities used by an NC,  $z_H^N$ , and by an MNE,  $z_H^M$ , differ.

$$z_H^N = \frac{\partial C_{i,H}}{\partial pz_H} = \left( \frac{w_H}{\theta} \right)^\theta \left( \frac{1-\theta}{pz_H} \right)^\theta q_{i,H}^N \quad (17)$$

$$\begin{aligned} z_H^M &= \frac{\partial C_{i,H,H}^M}{\partial pz_H} + \frac{\partial C_{P,i,H,F}^M}{\partial pz_H^M} = z_{H,H}^M + z_{H,F}^M \\ &= \left( \frac{w_H}{\theta} \right)^\theta \left( \frac{1-\theta}{pz_H} \right)^\theta q_{i,H,H}^M + \left( \frac{w_F}{\theta} \right)^\theta \left( \frac{1-\theta}{pz_H^M} \right)^\theta q_{i,H,F}^M \end{aligned} \quad (18)$$

In equilibrium, aggregate demand for intermediate goods equals aggregate supply,  $Z_H$ . The amount spent on intermediate goods,  $I_H$ , equals total costs of the intermediate good producers.

Every final good producer sets his/her price to maximize profits. The solution to this maximization problem is a fixed mark-up factor over marginal costs,  $c_{PV,i,H}^k$   $\{k=N,M\}$ .

$$p_{i,H}^k = c_{i,H}^k / \rho \quad k=N, M \quad (19)$$

The price of a single final good depends only on the good's marginal costs,  $c_{i,H}^k$  and on  $\rho$ , the parameters of differentiation. Marginal costs can be obtained from variable costs in (11–13). Marginal costs differ only if the factor prices differ. But factor prices cannot differ within one country, because of inter-sectoral mobility. Hence, the prices of the different varieties  $i$  produced in the same country are the same ( $p_{H,H} = p_{i,H,H}$ ).

In each country  $H$ , there are four different potential suppliers of final manufacturing goods: (i) country  $H$ 's NCs producing for their home country, (ii) foreign NCs serving country  $H$  through exports, (iii) MNEs, with headquarters in country  $H$  producing at their plant in  $H$ , and (iv) MNEs with headquarters in country  $F$  producing at their affiliate in country  $H$ .

F.o.b. prices (net of distance costs) set by companies located in  $H$  and  $F$  do not differ. By assumption, the economies are symmetric. Thus, companies do not differ in their ability to use economies of scale, they all operate at the same scale in their home market. However, prices set by NCs and MNEs from the same country differ in their foreign market but not at home. There are, therefore, up to three different prices,  $p_{j,H}^k$ , ( $j=H,F$  and  $k=N,M$ ) for different varieties of the final good in each market  $H$  depending on the strategy by which the market is served: the price of goods produced by  $H$ -based firms (NCs and MNEs), the price of imported goods and that of goods produced by an  $F$ -based MNE affiliate's plant in  $H$ . The price of an NC's good in the foreign market,  $p_{H,F}^N$ , equals the home-market price multiplied by distance costs,  $p_{H,F}^N = p_{H,H}^N e^\tau$ .

From equations (1) and (2), the price index,  $P_{M,H}$ , for each market  $H$  can be calculated:

$$P_{M,H} = \frac{\mu Y_H}{Q_{M,H}} = \left[ \sum_{i=1}^{\lambda} p_i^{-\gamma} \right]^{-\frac{1}{\gamma}}. \quad (20)$$

Using the different product prices, equation (20) changes to

$$P_{M,H} = \frac{\mu Y_H}{Q_{M,H}} = \left[ \sum_{i=1}^{n_H} (p_{H,H}^N)^{-\gamma} + \sum_{i=1}^{n_F} (p_{F,H}^N)^{-\gamma} + \sum_{i=1}^{m_H} (p_{H,H}^M)^{-\gamma} + \sum_{i=1}^{m_F} (p_{F,H}^M)^{-\gamma} \right]^{-\frac{1}{\gamma}} \quad (21)$$

$n_H$  is the number of NCs located in  $H$ ,  $n_F$  the number of NCs located in  $F$ , and  $m_H$  and  $m_F$  are the numbers of MNEs headquartered in  $H$  and  $F$ , respectively.  $n_H$ ,  $n_F$ ,  $m_H$ , and  $m_F$ , add up to equal  $\lambda$ . The price index,  $P_{M,H}$ , increases in the prices of each kind of company and therefore in distance costs.

Since there is free market entry and exit, the zero-profit condition holds in equilibrium for both, NCs and MNEs:

$$\Pi_H^N = (1 - \rho) p_H^N q_H^N - w_H (r_H + f_H) = 0 \quad (22)$$

$$\Pi_H^M = (1 - \rho) (p_{H,H}^M q_{H,H}^M + p_{H,F}^M q_{H,F}^M) - w_H (r_H + f_H) + w_F f_F = 0 \quad (23)$$

The zero-profit-conditions (22) and (23) are sufficient to determine the number of NCs,  $n_H$ , and the number of MNEs,  $m_H$ , in country  $H$  in equilibrium. The numbers depend on the market share of the total market  $\mu(Y_H + Y_F)$  each group holds, which is endogenous.

### 3.3 Distance Costs and Factor Demand

From the iceberg-form assumption of distance costs follows, a loss of the fraction  $t_H$  of the final goods when an NC exports its good.  $tz_H$  is the loss of the intermediate good due to distance costs when the intermediate good is shipped.

$$t_H = (e^\tau - 1) \frac{(p_H e^\tau)^{-(1+\gamma)}}{P_{M,F}^{-\gamma}} \mu Y_F \quad (24)$$

$$tz_H = (e^\tau - 1) m_H z_{H,F}^M p z_H^M \quad (25)$$

Labor demand is derived by using Shepard's Lemma. The cost functions (7), (8), and (11) through (13) are differentiated with respect to the factor price  $w$ . Note that the goods that melting away when exported ( $t_H$  and  $tz_H$  from 24 and 25) are also produced using labor input.

### 3.4 Market Equilibrium

I assume full employment of all resources in both economies. For a given endowment of labor in  $H$ ,  $L_H$ , equation (26) gives the labor market clearing condition.

$$L_H = L_{A,H} + n_H (r_H + f_H + L_H^N + L_{t,H}^N) + (z_H + L_{tz,H}) + m_H (r_H + f_H + L_{H,H}^M) + m_F (f_H + L_{F,H}^M) \quad \text{with} \quad (26)$$

$$L_H^N = (\theta/(1-\theta))^{1-\theta} (pz_H/w_H)^{1-\theta} q_H^N, \quad L_{t,H}^N = (\theta/(1-\theta))^{1-\theta} (pz_H/w_H)^{1-\theta} t_H, \quad L_{tz,H} = (\theta/(1-\theta))^{1-\theta} (pz_H/w_H)^{1-\theta} t_{z,H}, \quad L_{H,H}^M = (\theta/(1-\theta))^{1-\theta} (pz_H/w_H)^{1-\theta} q_{H,H}^M, \quad \text{and} \quad L_{F,H}^M = (\theta/(1-\theta))^{1-\theta} (pz_F^M/w_H)^{1-\theta} q_{F,H}^M.$$

The labor market clears if fixed labor supply in country  $H$ ,  $L_H$ , equals the sum of labor demand of the agricultural sector,  $L_A$ , of all stages of production of  $H$ 's NCs and MNEs producing final goods, of the intermediate good producers in  $H$ , of the affiliates in  $H$  of MNEs' headquartered in  $F$ , and of the transport of final and intermediate goods.

Wages are set in order to clear factor markets. The wage level determines the size of the agricultural sector. In both countries, the price of agricultural goods equals marginal costs.

$$P_{A,H} = c_{A,H} = w_H \quad (27)$$

Income  $Y_H$  in each country is given by the sum of the incomes of all individuals.

$$Y_H = w_H L_H \quad (28)$$

The demand functions (4) and (5), the income equation (28) and the budget constraint (3) ensure that goods markets clear. Equation (26) ensures clearance of the factor market. The marginal product of labor (6) determines the wage in each economy. The pricing rule (19) and equations (14) to (16), (22) and (23) determine the output of NCs and MNEs and their number in each country. The demand equations for the intermediate good [(17) and (18)] determine its production level. The price of the intermediate good equals marginal costs which are set to one. The pricing rule (27) determines the agricultural goods output in each economy and, therefore, together with demand equation (4), the level of inter-industry trade. Free of cost one-way trade of the homogeneous agricultural good,  $Ex_H^A$ , leads to its price equality in both economies. Because of the assumed symmetry between the two countries, there is only intra-industry trade;  $Ex_H^A$  is zero in any equilibrium. If the countries are symmetric, there is no trade in the agricultural good. Each country satisfies its own demand for this good.

There is always intra-industry trade of final manufacturing products,  $Ex_H^{MF}$ , in this model because final goods are not perfect substitutes for each other. Trade in services depends on the existence of MNEs, since trade in services in this model is trade in headquarter services. It rises with the number of MNEs, the wage rate, and the level of headquarter services, which is

necessary for production. Trade in intermediate goods is also bound to MNEs. In total, trade must always be balanced.

#### 4. The Strategic Decision: Trade or Production Abroad in the Model with Symmetric Companies

All final goods producers decide whether to serve the foreign market through exports or to become an MNE and produce abroad. If there are no restrictions to production abroad, a company internationalizes its production if it is profitable to do so. Whether the internationalization of production is profitable depends on technological parameters which enter the production function (fixed costs on plant and company level,  $f$  and  $r$ , and the share of the intermediate good used in production,  $1-\theta$ ), on the degree of differentiation,  $\rho$ , on the degree of competition,  $\Gamma$ , which is affected by the type of companies in equilibrium (and defined below) and on the distance cost level,  $\tau$ , which separate the two markets.

The price of a good in the foreign market depends on the strategy of its supply. An exporting company's good is more expensive abroad than a good produced in a foreign affiliate, because consumers in the foreign country pay distance costs on an imported good but not on an affiliate's good. A foreign affiliate's good, in turn, is more expensive than a good produced by a foreign company (in its home market), because the affiliate's good is more costly. The higher costs result from the higher (c.i.f.) prices which must be paid for the intermediate good the affiliate uses in production. The quantity of a final good produced by a foreign affiliate is therefore larger than its export volumes would be. Hence, variable profits of an MNE are larger than those of an exporting NC. An NC decides to produce abroad if the gains in variable profits are at least as high as the additional fixed costs at the plant level. Then it pays to become an MNE.

$$w_F f_F \leq (1-\rho) \left( p_{H,H}^M q_{H,H}^M + p_{H,F}^M q_{H,F}^M - p_H^N q_H^N \right) \quad (29)$$

Condition (29) is essential for the resulting equilibrium. It shows whether it is more profitable for a company to serve the foreign market by exports or by production abroad. Condition (29) depends on the level of distance costs. Hence, it changes in the globalization process. It is easy to see, that the lower are the fixed costs at the plant level,  $w_F f_F$ , the more likely is it that an NC decides to build a plant abroad. Furthermore, the internationalization decision depends only on the profits earned in the foreign market since prices, quantities and mark ups, and therefore profits, of NCs and MNEs at home are the same. But foreign profits differ. Rewriting (29) yields

$$\Phi = (p^M - c^M) D(p^M) - (p^N - c^N) D(p^N e^\tau) - w_F f_F \text{ or}$$

$$\Phi = \left[ \frac{1-\rho}{\rho} c^M \frac{(c^M/\rho)^{\frac{1}{1-\rho}}}{\Gamma} - \frac{1-\rho}{\rho} c^N \frac{(c^N e^\tau/\rho)^{\frac{1}{1-\rho}}}{\Gamma} \right] \mu Y_F - w_F f_F \quad (30)$$

For convenience, let  $p^N, p^M, c^N$  and  $c^M$  stand for  $p_{H,F}^N, p_{H,F}^M, c_{H,F}^N$ , and  $c_{H,F}^M$ , respectively. For any given distance cost level,  $\tau$ , profitability of exports or production abroad depends on the market structure which affects the degree of competition  $\Gamma$ .  $\Gamma$  stands for the weighted price index in the manufacturing sector which can be interpreted as a measure for the degree of competition.  $\Gamma$  is defined as  $\Gamma = n(c^N/\rho)^{\frac{\rho}{1-\rho}} + n(e^\tau c^N/\rho)^{\frac{\rho}{1-\rho}} + m(c^N/\rho)^{\frac{\rho}{1-\rho}} + m(c^M/\rho)^{\frac{\rho}{1-\rho}}$ .

The trigger function (30) gives the incentive of an NC to become an MNE. If  $\Phi$  is negative it is profitable to be an exporting NC, given the exogenous parameters and the market structure. An MNE can increase its profits by switching to exports for the supply of the foreign market. Trigger function (30) shows that companies refrain from establishment of a foreign affiliate if distance costs are very high. Then, the term in brackets becomes very small, although it always remains positive, because  $(c^M/\rho)^{\frac{1}{1-\rho}} > (c^N e^\tau/\rho)^{\frac{1}{1-\rho}}$  and  $c^M > c^N$  for any  $\tau > 0$ . For very high distance costs, demand for home country's goods in the foreign market is too small to generate enough variable profits to make up for the additional fixed costs at the plant level,  $w_F f_F$ . For very low distance costs, foreign production is not a profitable alternative either, since the term in brackets approaches zero and  $\Phi$  is negative. Thus, the trigger curve is heavily affected by changes in distance costs. This can be seen in equation (31) which shows the derivative of  $\Phi$  with respect to distance costs,  $\tau$ .

$$\frac{\partial \Phi}{\partial \tau} = \frac{c^M \left( \frac{c^M}{\rho} \right)^{\frac{1}{1-\rho}} n \left( \frac{c^N}{\rho} \right)^{\frac{\rho}{1-\rho}} \left[ e^{\tau \left( \frac{\rho}{1-\rho} \right)} - (1-\theta) \left( 1 + e^{\tau \left( \frac{\rho}{1-\rho} \right)} \right) \right]}{\Gamma^2} \mu Y - \underbrace{\frac{c^N \left( \frac{c^N e^\tau}{\rho} \right)^{\frac{1}{1-\rho}} n \left( \frac{c^N}{\rho} \right)^{\frac{\rho}{1-\rho}} \left[ e^{\tau \left( \frac{\rho}{1-\rho} \right)} - \frac{1}{\rho} \left( 1 + e^{\tau \left( \frac{\rho}{1-\rho} \right)} \right) \right]}{\Gamma^2}}_{>0} \mu Y \quad (31)$$

The first line of (31) shows the effect of changing distance costs on the (variable) profits of production in the foreign country, the second line shows the effect on variable profits of exports. For convenience, the first line is denoted  $\Phi_M'$  (for MNE), the second  $\Phi_N'$  (for NC, defined without the minus sign).  $\Phi_M'$  is negative for all distance costs levels,  $\tau$ , which are not too low, given that the share of intermediate good input in production of the final good,  $1-\theta$ , is not too low either. Then, falling distance costs result in larger profits of foreign production. For very high distance costs, the term in brackets approaches  $-(1-\theta)$ . For a production function which does not require the use of the intermediate good, ( $1-\theta=0$ ), the first line turns positive.

At any distance cost levels, *decreasing* distance costs are then related to *decreasing* profits of production abroad.

The second line of (31) is always positive, since the minus sign in front of the term changes the negative sign of  $\Phi_N'$ . Variable export profits rise with falling distance costs. To see this note that the term in brackets is always negative because  $\rho$  is defined as  $0 < \rho < 1$ . The total effect of falling distance costs on the strategic decision is determined by the difference of the two effects ( $\Phi_M' - \Phi_N'$ ). For most parameter constellation (distance cost levels not too low, intermediate good share not too low), both,  $\Phi_M'$  and  $\Phi_N'$ , have the same sign, they are negative. Hence, the sign of the difference depends on the size of the effects which falling distance costs have on variable profits of production abroad,  $\Phi_M'$  and exports,  $\Phi_N'$ . For very low distance cost levels and intermediate good's shares, however, the total effect must be positive, because  $\Phi_M'$  is positive:  $\Phi$  increases with rising distance costs and decreases with falling. For an intermediate good share of zero, this results for all distance cost levels. The model converges to the Brainard (1993) model. For intermediate goods shares which are higher than zero, the total effect is not easily calculated since it depends on various exogenous parameters in a non-linear manner. Table A in the Appendix gives the level and curvature of the trigger function.

The emergence of an MNE is parameter dependent. For a range of realistic parameter constellations, MNEs may emerge in a globalization process such as the one modeled here, where falling distance costs drive international integration. In this process, companies rely on exports to serve the foreign market until distance costs have fallen below a certain threshold. Then, internationalization of production becomes profitable. However, the parameters are industry or even company specific. This may explain the observed pattern of internationalization of production with strong concentration on some industries and some industries preceding others in this process.

In addition to the exogenous parameters, the decision about the optimal internationalization strategy depends on the market structure in the final good segment. This structure is represented by  $\Gamma$ . It can be seen from (30) that  $\partial\Phi/\partial\Gamma = -(1/\Gamma)[.] \mu Y_F < 0$ . This derivative is smaller zero, since the term in brackets is always positive.

Competition yields different equilibrium outcomes for a  $\Gamma$  that includes MNEs than for a  $\Gamma$  which does not. As long as deviating is not profitable, the composition of  $\Gamma$  does not change (although prices and numbers of companies change). However, with the emergence of the first MNE, composition and level of  $\Gamma$  change. For a given number of companies,  $\lambda$ , in equilibrium,  $\Gamma$  increases in the number of MNEs,  $m$ . This can be seen by differentiating  $\Gamma$  with respect to  $m$  for a given number of companies  $\lambda = 2m + 2n$  (with  $m = m_H = m_F$  and  $n = n_H = n_F$ ).



$$\frac{\partial \Gamma}{\partial m} = -\left(\frac{c^N}{\rho}\right)^{-\frac{\rho}{1-\rho}} \left(1 + e^{-\tau \rho / (1-\rho)}\right) + \left(\frac{c^M}{\rho}\right)^{-\frac{\rho}{1-\rho}} + \left(\frac{c^N}{\rho}\right)^{-\frac{\rho}{1-\rho}} = \left(\frac{c^M}{\rho}\right)^{-\frac{\rho}{1-\rho}} - \left(\frac{c^N}{\rho} e^{\tau}\right)^{-\frac{\rho}{1-\rho}}$$

Plugging in  $c^M = c^N e^{\tau(1-\theta)}$  yields

$$\frac{\partial \Gamma}{\partial m} = \left(e^{-\tau(1-\theta)\rho/(1-\rho)} - e^{-\tau\rho/(1-\rho)}\right) \left(\frac{c^N}{\rho}\right)^{-\frac{\rho}{1-\rho}} > 0. \quad (32)$$

An increase of the number of MNEs in an economy affects the weighted price index positively. That results from the fact that although the price of an affiliate's product is lower than the import price of the same good would be, demand of the good is expanded so that its weight in the consumption bundle increases. Sales of this good increase in the foreign country, consumers substitute this good partly for all other goods. Sales of the other goods fall. That holds for domestic as well as foreign (imported or affiliate's product) companies' goods in this market. All companies incur losses. Some must drop out, since the zero profit condition holds in the long run. The new equilibrium with one more MNE and an endogenous number of NCs settles if no (negative) profits are made.

In total, home sales fall relative to foreign companies' sales. However, home sales generate more variable profits per unit sales, because the part of the sales in the foreign market which covers distance costs is not profit-relevant (Kleinert 2002). Hence, total variable profits fall with the establishment of the foreign affiliate. In equilibrium with free entry and exit, variable profits equal the sum of fixed costs of the companies. This sum increases in the number of MNEs in an equilibrium with a fixed number of companies,  $\lambda$ , since MNEs have higher fixed costs than NCs because they run two plants. Given the lower variable profits and the higher fixed costs in equilibrium, the number of companies must fall when foreign affiliates are established.

The degree of competition,  $\Gamma$ , increases in the number of companies. Comparison of  $\Gamma$  with the price index in (21) gives  $\Gamma = P_{M,j}^{-\gamma}$ . Since  $P_{M,j}$  falls in  $\lambda$ , as can be seen by solving the partial derivative of (21) with respect to  $\lambda$ ,  $\Gamma$  must rise. There are, therefore, two opposing effects from the increase in the number of MNEs on the degree of competition,  $\Gamma$ , which push in opposite directions in symmetric free entry and exit equilibria.

$$\frac{\partial \Gamma}{\partial m} = \frac{\partial \Gamma}{\partial m} \Big|_{2(m+n)=\lambda} + \frac{\partial \Gamma}{\partial \lambda}$$

The first term is known from equation (32). It shows the increase in the degree of competition which results from the decision of one NC to internationalize production (holding constant the number of companies). With free entry and exit however the resulting market structure is not stable, since companies incur losses. Some companies drop out. The reduction

in the number of companies lowers competition, which is seen in the second term on the right hand side. The term is negative, since  $\Gamma$  falls with a falling number of companies in equilibrium,  $\lambda$ . In total,  $\Gamma$  stays constant in the internationalization of production, since the two opposite effects cancel each other out in this symmetric model.

To see this, recall that the zero-profit condition (22) implies that the reduction in the degree of competition through market exit of companies must be large enough to ensure that  $(c^N/\rho)^{-(\rho/(1-\rho))}/\Gamma$  is as high after the adjustment as before the internationalization decision of the competitor. Total income spend on final goods,  $\mu(Y_H+Y_F)$ , does not change, fixed costs of a single company,  $w_H f_H$ ,  $w_F f_F$ ,  $w_H r_H$ ,  $w_F r_F$ , and the mark-up,  $1/\rho$ , remain unchanged. Thus, adjustment must come through the degree of competition,  $\Gamma$ . The ratio of company sales over the degree of competition,  $(c^N/\rho)^{-(\rho/(1-\rho))}/\Gamma$ , must be the same before and after the competitor internationalized its production. Since the marginal costs,  $c^N$ , and the degree of differentiation,  $1/\rho$ , are unchanged,  $\Gamma$  must also remain unchanged.

The trigger curve is therefore not affected by the internationalization decision of other companies in the long run, because  $\Gamma$  is unchanged in the long run if the zero-profit condition holds. That lets the ‘last NC’ with the same incentive to internationalize production as the first. Thus, all companies internationalize production at the same distance cost level. A mixed equilibrium of NCs and MNEs is therefore not stable in this symmetric setting. Both economies jump from an equilibrium with only NCs to an equilibrium with only MNEs. This result does certainly not reflect the empirical pattern of the process of internationalization of production. It stems from the strong simplification that was made by assuming all companies to be symmetric.

## 5. Coexistence in Equilibria with Different Groups of Companies

Real-world companies differ in characteristics such as fixed costs,  $f$  and  $r$ , the degree of the differentiation of their products,  $1/\rho$  or the complexity of their production process, here characterized by the importance of the intermediate good,  $1-\theta$ . Therefore, I give up the symmetry assumption in this section. Asymmetry in company characteristics leads thereby to asymmetry in the internationalization decision. Companies that differ in at least one of the characteristics internationalize their production at different levels of distance costs,  $\tau$ . At some  $\tau$ , there might exist equilibria in which NCs and MNEs coexists. While it is profitable for some companies to internationalize production, it is not profitable for others. For some exporting NCs, it might never become profitable to internationalize production or only ‘later’, i.e. at a lower level of distance costs. Thus, the mixed equilibrium is stable. At given conditions, there is no incentive for any company to change its strategy to serve the foreign market.

To show this, the model structure from section 3 is change slightly to reflect differences of companies within an industry. I use a model with different groups of companies belonging to the same industry to analyze competition within this industry. Companies within a group are symmetric but companies belonging to different groups differ in at least one characteristic. The final goods segment of the manufacturing sector consists, therefore, of a single industry hosting several groups of companies. To give consumers a chance to choose among the different groups, I use a utility function which allows for the possibility of substitution among products of companies from different groups. Individuals choose their most preferred version of the differentiated final good in a two-stage process. First, one of the different groups is chosen depending on the price indexes. Second, the most preferred version from the chosen group is selected. The CD-CES structure utility function in (1) and (2) changes to a CD-nested CES structure in (33) and (34)

$$U_j = Q_{A,j}^\mu Q_{M,j}^{1-\mu} \quad \text{with } \mu \in (0,1); j=H,F \quad (33)$$

$$Q_{M,j} = \left[ \sum_{h=1}^{\lambda} Q_{M_h,j}^\zeta \right]^{1/\zeta} \quad \text{with} \quad Q_{M_h,j} = \left[ \sum_{i=1}^{\lambda_h} q_{i,j}^{h \rho_h} \right]^{1/\rho_h} \quad (34)$$

where  $\zeta, \rho_h \in (0,1); j=H,F$ .

Individuals choose a group  $h$  of products from the whole set of different groups of differentiated final goods. Groups of products are formed by similar companies, which stand in tougher competition among each other than final goods from two different groups. The idea is, that within an industry like the automobile industry, for instance, there are different groups, like compact cars, sports cars, pick-ups, which compete for customers. Although there certainly is competition between a producer of a pick-up and a producer of a sports car<sup>3</sup>, the competition between two sports car producers is tougher. That requires the degree of differentiation  $1/\rho_h$  between different members of a group  $h$  to be lower than the degree of differentiation  $1/\zeta$  between different groups. After having chosen their preferred group, individuals choose the most preferred variety among the group members in the second stage.

Given the change in the utility function, demand of the representative consumer changes. She/he chooses among goods of the different groups depending on their prices. The income share spent on each group  $h$  varies with prices. It increases in the price index of manufacturing goods (the weighted sum of the price indexes of all groups of differentiated final goods),  $P_{M,j}$ , with the share of income spend on manufacturing goods  $\mu$  and with total

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<sup>3</sup> It is hard to maintain the single product company approach in this example, but for simplicity, I continue to base the argument on a single product company.

income  $Y_j$ , and decreases in its own price index,  $P_{M_h,j}$ . Equation (35) gives the demand for each group of final goods,  $Q_{M_h}$ . Equation (36) gives the price index of manufacturing goods,  $P_{M,j}$ , which can be calculated from (34).

$$Q_{M_h,j} = \frac{P_{M_h,j}^{-(1+\chi)}}{P_{M,j}^{-\chi}} \mu Y_j \quad \text{with } \chi = \zeta / (1 - \zeta); j = H, F; h = 1 \dots \kappa \quad (35)$$

$$P_{M,j} = \left[ \sum_{h=1}^{\kappa} P_{M_h,j}^{-\chi} \right]^{-\frac{1}{\chi}} \quad \text{with } \chi = \zeta / (1 - \zeta); j = H, F; h = 1 \dots \kappa \quad (36)$$

$P_{M,j}$  increases in the price indexes,  $P_{M_h,j}$ , of the different groups and decreases in their number,  $\kappa$ . Each group consists itself of different (symmetric) companies which produce imperfectly substitutable final goods. The price indexes of these groups increase in the (within-group identical) prices of the final goods and decrease in the number of goods in each group,  $\lambda_h$ . Prices of goods in different groups may differ. Within each group, prices are identical because companies are symmetric. The price index,  $P_{M_h,j}$ , of group  $h$  in the industry is shown in (37).

$$P_{M_h,j} = \left[ \sum_{i=1}^{\lambda_h} P_{i,h,j}^{-\gamma_h} \right]^{-\frac{1}{\gamma_h}} \quad j, l = H, F; j \neq l; h = 1, 2, \dots, \kappa; \gamma_h = \rho_h / (1 - \rho_h) \quad (37)$$

Demand for a single variant of the differentiated good depends on the variable market size,  $\Omega_{h,j}$  ( $\Omega_{h,j} = P_{M_h,j} Q_{M_h,j}$ ), of each group of goods. Demand for a single variant  $i$  of the differentiated final good in group  $h$  increases in the market size for its group's goods,  $\Omega_{h,j}$ , and in the group's price index and decreases in its own price. Demand may differ for companies from different groups. Within a group, demand differs for NCs and MNEs in the foreign market because they are differently affected by distance costs. At home, NCs and MNEs face the same demand. Output of an individual company, which equals demand in equilibrium, is given in (38–40). The output of an NC (38) includes the supply of home and foreign demand, since the foreign market is served through exports. Production takes place exclusively at home. An MNE produces in both countries to satisfy the local demand at home (39) and abroad (40). I omit the subscript  $i$  for the individual company because all companies within a group are symmetric. The first subscript stands for the group the company is in, the second for its home country, the third for the country of production. The third subscript applies only to MNEs.

$$q_{h,j} = \frac{P_{h,j}^{-(1+\gamma_h)}}{P_{M_h,j}^{-\gamma_h}} \Omega_{h,j} + \frac{P_{h,j}^{-(1+\gamma_h)} e^{-(1+\gamma_h)\tau_M}}{P_{M_h,l}^{-\gamma_h}} \Omega_{h,l} \quad j, l = H, F; l \neq j; \gamma_h = \rho_h / (1 - \rho_h) \quad (38)$$

where  $\Omega_{h,j} = P_{M_h,j} Q_{M_h,j}$

$$q_{h,j,j}^M = \frac{P_{h,j,j}^M}{P_{M_h,j}^{-\gamma_h}} \Omega_{h,j} \quad j=H,F; \gamma_h = \rho_h / (1 - \rho_h) \quad (39)$$

$$q_{h,j,l}^M = \frac{P_{h,j,l}^M}{P_{M_h,l}^{-\gamma_h}} \Omega_{h,l} \quad j,l=H,F; l \neq j; \gamma_h = \rho_h / (1 - \rho_h) \quad (40)$$

Output of an NC,  $q_{h,j}$ , is larger than output of the home plant or the foreign plant of an MNE. Output of an MNE's home plant,  $q_{h,j,j}^M$ , is larger than output in the foreign plant, because its price abroad,  $p_{h,j,l}^M$ , is higher than its price at home,  $p_{h,j,j}^M$ , because of the higher costs for the intermediate good abroad. Final goods produced by an MNE at home sell at the same price as goods of a domestic NC,  $p_{h,j,j}^M = p_{h,j}$ .

Changes in the price index of the group affect the number of companies in each group in this multi-group model version. Market shares of the groups are variable. The size of the market for each group's goods is important for the number of companies entering each group. In equilibrium, the zero profit condition determines the number of final goods producers in each group. For a special cases (zero distance costs, symmetry between the two countries), the number of companies in group  $h$  can be calculated as the product of the market share,  $\Omega_{h,j}$ , and the share of variable profits in total revenue of a company,  $1 - \rho_h$ , divided by the sum of the fixed costs,  $w_j(f_j + r_j)$  or  $w_j(f_j + r_j) + w_l f_l$ . The number of companies changes with the variable market share. The number of NCs and MNEs in a group  $h$  are given, respectively, by

$$n_{h,j} = \frac{(1 - \rho_h) \Omega_{h,j}}{w_j r_{h,j} + w_j f_{h,j}} \quad j=H,F; h=1 \dots \kappa$$

$$m_{h,j} = \frac{(1 - \rho_h) \Omega_{h,j}}{w_j r_{h,j} + w_j f_{h,j} + w_l f_{h,l}} \quad j,l=H,F; j \neq l; h=1 \dots \kappa$$

The model with different groups of companies has the advantage to allow for more general substitution patterns across alternatives than the basic model in section 3. The main drawback of using a nested CES structure is that the results are quite sensitive to the grouping and it is not always clear how the industry should be partitioned. That poses a problem mainly to empirical analyses but not to the analysis presented here.

I focus on mixed market structures. Coexistence of NCs and MNEs emerges within the industry, because not all companies but only those belonging to the same group internationalize production at the same time. To see this, look at the trigger curve,  $\Phi$ , which shows the profitability of exports relative to the profitability of production abroad for a company  $i$  in group  $h$ .

$$\Phi_{h,j} = (1 - \rho_h) \left( p_{h,j,j}^M q_{h,j,j}^M + p_{h,j,l}^M q_{h,j,l}^M - p_{h,j}^N q_{h,j}^N \right) - w_l f_{h,l} \quad j,l=H,F; j \neq l. \quad (41)$$

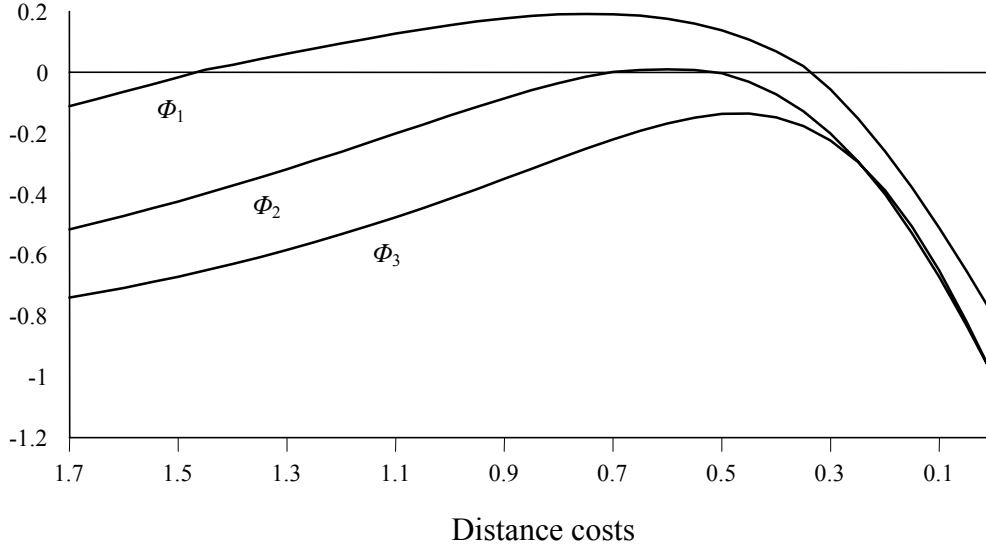
The trigger curves are group specific. It is easy to see that differences in the level of fixed costs on the plant level between two groups leads to different trigger curves. Lower plant level fixed costs favor production abroad. The trigger curve shifts upward. Production abroad becomes profitable at a higher level of distance costs,  $\tau$ . Fixed costs on the company level enter not so obviously. They affect the output of the companies via the degree of competition,  $\Gamma$ . Higher fixed costs on the company level lead to fewer companies in equilibrium. That decreases  $\Gamma$ , and hence, increases  $\Phi_h$  as known from section 4. Hence, higher fixed costs on the plant level also lead to an upward shift in  $\Phi_h$ .

The degree of differentiation within a group,  $1/\rho_h$ , also affects the trigger curve.  $\rho_h$  enters the decision between exports and production abroad in several ways. First, it defines the share of (variable) profits in sales. Second, it enters the price of both, the exported good and the good of the foreign affiliate, as fixed mark-up over costs. Third, it enters the demand (and therefore the output) of the good under both strategies of supplying the foreign market in a highly non-linear way. In total, a higher degree of differentiation increases the freedom to strategic choices such as the internationalization of production. Companies internationalize production at a wider range of distance cost levels.

Finally, the complexity of production (characterized by the share of variable costs which is spend on the intermediate good) affects the trigger curve. The larger this share is the higher are the variable costs of production abroad. Savings on distance costs by production abroad are smaller. Exports are relatively more profitable. Very complex production processes, which rely heavily on intermediate goods, are therefore more likely to be kept in the home country. Companies engaged in complex production processes serve the foreign market through exports.

All this taken together reveals a higher likelihood to produce abroad if fixed costs at the company level are large but those at the plant level are small, if the degree of differentiation is high and if the complexity of production not too high. Figure 1 shows the trigger curve of three groups of companies with different characteristics. Group 1 includes companies with the highest level of fixed costs at the company level and the lowest at the plant level. Companies from this group produce goods which show the highest degree of differentiation. They are, therefore, likely to produce abroad at the widest range of distance cost parameters. Group 2 and 3 differ in the degree of differentiation of their goods and in their level of fixed costs at the company level. Both are higher for group 2 companies which are, therefore, more likely to produce abroad.

Figure 1: Trigger Curves for Companies from Different Groups



$$\begin{aligned} \mu=0.6, \zeta=0.6, \rho_1=0.7, \rho_2=0.75, \rho_3=0.8, \theta_1=\theta_2=\theta_3=0.7, \\ L_1=1000, L_2=1000, r_{1,1}=r_{1,2}=1.5, r_{2,1}=r_{2,2}=1.25, r_{3,1}=r_{3,2}=1, \\ f_{1,1}=f_{1,2}=0.8, f_{2,1}=f_{2,2}=f_{3,1}=f_{3,2}=1 \end{aligned}$$

There is a wide range of distance cost levels where NCs and MNEs coexist. Companies from group 1 prefer production abroad over exports between  $\tau=1.47$  and  $\tau=0.33$ . In this range of distance costs, NCs and MNEs coexist, because group 3 companies always prefer to serve the foreign market through exports. In equilibrium, there are, therefore, MNEs from group 1 and NCs from group 3. Whether group 2 companies decide to export or to produce abroad depends on the distance cost level. Between  $\tau=0.71$  and  $\tau=0.51$  they produce abroad. At lower or higher distance costs levels, they export.

The trigger curves are not independent from each other. The groups affect each other through changes in the price indexes of the groups. Price index changes lead to changes in the market share a group holds. The degree of differentiation between the groups,  $1/\zeta$ , determines how strong substitution between different groups is. If  $1/\zeta$  is low, goods from different groups are good substitutes. Note, however, that the degree of differentiation within a group,  $1/\rho_h$ , is always smaller than the degree of differentiation between different groups  $1/\zeta$ . That results in a larger elasticity of substitution within the group than between the groups.

The trigger curves in Figure 1 are calculated using the price index of the prevailing market structure. All adjustment processes are therefore included. Although one industry's internationalization affects the other industries, this cannot be seen in the trigger curves as long as free market entry and exit is assured. The numbers of companies adjusts in reaction to changing market shares of an industry. The trigger curves remain unchanged.

## 6. Conclusions

Market structure in many sectors is characterized by coexistence of NCs and MNEs. In this mixed market structure competition takes place between many companies which differ with regards to many characteristics, such as size, the degree of differentiation of their products, their cost structure and their engagements in foreign markets. These differences among companies are a necessary condition for the emergence of mixed market structures with NCs and MNEs.

To show this, a two-country general equilibrium framework is set up which models the endogenous emergence of MNEs in reaction to exogenously falling distance costs. I introduce and compare two versions of the model. Whereas in a model with symmetric companies stable mixed equilibria cannot emerge, such a market structure arises in a model with groups of different companies for a wide range of economic condition. Companies which differ in characteristics such as product differentiation and cost structure decide at different economic states of condition to internationalize their production.

The analysis of mixed market structures with NCs and MNEs is important, because such market structures exist in many sectors. Analyses of equilibria with only NCs or of equilibria with only MNEs concern only border cases. For assessments of welfare effects or of the relationship of exports and production abroad, market structure where NCs and MNEs coexist are probably more relevant.



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## Appendix

The second derivatives give the curvature of  $\Phi_M'$  and  $\Phi_N'$ . They are shown in (A1) and (A2).

$$\frac{\partial \Phi_M'}{\partial \tau} = \frac{\frac{\rho}{1-\rho} \left(\frac{c^M}{\rho}\right)^{\frac{1}{1-\rho}} c^M n \left(\frac{c^N}{\rho}\right)^{\frac{\rho}{1-\rho}} \left[ e^{\tau \left(\frac{-\rho}{1-\rho}\right)} - (1-\theta)^2 \left(1 + e^{\tau \left(\frac{-\rho}{1-\rho}\right)}\right) \right] \Gamma^2}{\Gamma^4} \mu Y \quad (A1)$$

$$- \frac{c^M \left(\frac{c^M}{\rho}\right)^{\frac{1}{1-\rho}} n \left(\frac{c^N}{\rho}\right)^{\frac{\rho}{1-\rho}} \left[ \theta e^{\tau \left(\frac{-\rho}{1-\rho}\right)} - (1-\theta) \right] 2\Gamma}{\Gamma^4} \mu Y$$

The second derivative of the variable profits of affiliates' products with respect to  $\tau$ ,  $\Phi_M''$ , is negative for low levels of  $\tau$  and positive for high levels of  $\tau$ .  $\Phi_N''$  is always positive.

$$\frac{\partial \Phi_N'}{\partial \tau} = \frac{-\frac{1}{1-\rho} c^N \left(\frac{c^N}{\rho} e^\tau\right)^{\frac{1}{1-\rho}} n \left(\frac{c^N}{\rho}\right)^{\frac{\rho}{1-\rho}} \left[ e^{\tau \left(\frac{-\rho}{1-\rho}\right)} \left(\rho - \frac{1}{\rho}\right) - \frac{1}{\rho} \right] \Gamma^2}{\Gamma^4} \mu Y \quad (A2)$$

$$- \frac{c^N \left(\frac{c^N}{\rho} e^\tau\right)^{\frac{1}{1-\rho}} n \left(\frac{c^N}{\rho}\right)^{\frac{\rho}{1-\rho}} \left[ -\frac{1-\rho}{\rho} e^{\tau \left(\frac{-\rho}{1-\rho}\right)} - \frac{1}{\rho} \right] 2\Gamma}{\Gamma^4} \mu Y$$

Table A: Level and Curvature of the Profitability Functions

Distance cost level	Foreign production $\Phi_M$ (net of fixed costs)	Exports $\Phi_N$	Total $\Phi$ (including fixed costs)
$\tau=0$	$\Phi_M=\Phi_N$ , $\Phi_M'>0$ , $\Phi_M''<0$	$\Phi_N=\Phi_M$ , $\Phi_N'<0$ , $\Phi_N''>0$	$\Phi=-w_{FF}$ , $\Phi'>0$ , $\Phi''<0$
$0 < \tau < 1-\theta/\theta > e^{\tau \left(\frac{-\rho}{1-\rho}\right)}$	$\Phi_M$ high, $\Phi_M'>0$ , $\Phi_M''<0$	$\Phi_N$ medium $\Phi_N'<0$ , $\Phi_N''>0$	$\Phi'>0$ , $\Phi''<0$
$1-\theta/\theta > e^{\tau \left(\frac{-\rho}{1-\rho}\right)}$ $< \tau < \tau^*$	$\Phi_M$ medium, $\Phi_M'<0$ , $\Phi_M''<0$	$\Phi_N$ low $\Phi_N'<0$ , $\Phi_N''>0$	
$\tau^* < \tau$	$\Phi_M$ low, $\Phi_M'<0$ , $\Phi_M''>0$	$\Phi_N$ very low $\Phi_N'<0$ , $\Phi_N''>0$	
$\tau \rightarrow \infty$	$\Phi_M \rightarrow 0$ , positive $\Phi_M'<0$ , $\Phi_M''>0$	$\Phi_N \rightarrow 0$ , positive $\Phi_N'<0$ , $\Phi_N''>0$	$\Phi \rightarrow -w_{FF}$ $\Phi'<0$ , $\Phi''>0$

$\tau^*$  denotes distance cost level, when the function  $\Phi_M$  changes from being concave to being convex at  $\Phi_M''=0$ .