MULTINATIONAL FIRMS, TRADE AND GROWTH

MICHAEL PFAFFERMAYR

90/1997

MULTINATIONAL FIRMS, TRADE AND GROWTH

A Simple Model with a Trade-off between Proximity to the Market and Plant Set-up Costs under International Trade in Assets

MICHAEL PFAFFERMAYR

WIFO Working Papers No. 90
March 1997

MULTINATIONAL FIRMS, TRADE AND GROWTH:

A simple model with a trade-off between proximity to the market and plant set-up costs under international trade in assets

Michael Pfaffermayr

March 1997

Abstract:

This paper extends previous work on multinational firms using an endogenous growth model. In the steady state firms develop new brands at a constant rate and, in economising on transportation costs, existing firms invest in production facilities abroad at the same rate, even with factor prices equalised. The growing number of both multinationals engaging in intrafirm trade and exporting firms engaging in goods trade rationalises the widely observed two-way pattern of trade and multinational activity between equally endowed trading partners. However, trade and multinational activity may also have an endowment basis. The welfare analysis reveals the importance of know-how transfer by multinationals and, opposed to potential dynamic welfare losses depending on the opportunity costs of multinational activity, a static welfare gain from economising on transportation costs.

Austrian Institute of Economic Research
P.O. Box 91
A-1103 Vienna
Austria
email: pfafferm@wsr.ac.at

MULTINATIONAL FIRMS, TRADE AND GROWTH:

A simple model with a trade-off between proximity to the market and plant set-up costs under international trade in assets

Michael Pfaffermayr

I. Introduction

In the last two decades foreign direct investment has grown considerably faster than trade among developed countries and multinationals increasingly dominate international business. Furthermore, in correspondence to the dominating pattern of trade among developed countries, foreign direct investment likewise exhibits an overwhelmingly two-way pattern between equally developed countries (Markusen, 1995). Both stylised facts are rarely accounted for by traditional economic models of trade and investment and as well not by modern theories of geography and trade which, based on an industrial organisation approach, introduced product differentiation, scale economics and imperfect competition to explain trade between similar countries. The dominating assumption made in these theories is still the national single plant firm. The endogenous horizontal and vertical investment decisions of firms to build additional plants in foreign markets are usually not considered.

Starting point of the attempt to model the interrelationship between trade and the emergence of multinational firms has been the work of Helpman (1984, 1985) and Helpman, Krugman (1985) who demonstrated that multinationals may come into existence if trading partners possess very different factor endowments which render the equalisation of factor prices impossible without multinationals. Their model is based on the new theory of trade and assumes that production can be separated between countries. Multinationals concentrate activities requiring skilled labour, especially headquarter services and intermediate products, in the parent country that is well endowed with skilled labour whereas production intensive in unskilled labour is undertaken in subsidiaries set up in countries well endowed with unskilled labour. They furthermore show that this division of labour within the multinational firm across countries substitutes for interindustry trade but generates interindustry trade and intrafirm trade. The implied pattern of multinational activity, however, is still the North-South pattern as in the traditional trade models with perfect competition. Another route has been taken by Horstmann, Markusen (1992), Brainard (1993) and Markusen, Venables (1995) who additionally introduce transportation costs and as well carefully distinguish between fixed plant set-up costs and firm level scale economies as key elements. Based on the trade-off between transportation cost (interpreted in a wide sense to include trade barriers or simply costs of staying far away from the market) and plant set-up costs these models can explain a wide range of trade patterns. Especially, they are able account for two-way trade *and* two-way investment between equally endowed trading partners, the most important stylised fact. A further important step has been the integration of modern theories of endogenous growth and trade (eg. Grossman, Helpman, 1989, 1991, Dinopoulos, Oehmke, Segerstrom, 1993) to study the common determinants of endogenous growth, the evolution of trade patterns and multinational activity.

The present paper uses a highly simplified model of two countries facing endogenous growth. It is based on the love of variety approach (Dixit, Stiglitz, 1977) with monopolistic competition and incorporates multinationals as emerging from a trade-off between transportation costs and plant set-up costs. It takes the analysis a step further, however, by adding a time dimension to the decision of firms to become multinational. At any point in time in each country new firms invest in R&D, develop a new brand and set up a first plant. Existing firms can decide to become multinational by comparing the fixed cost of setting up a second plant abroad with the stream of additional future profits arising from avoided transportation costs. In the presence of international trade in assets it is shown that factor prices equalise despite transportation costs[1] allowing to set up a quasi-integrated equilibrium along the line of Dixit, Norman (1980). It is shown that a steady state exists with both new brands and multinational firms coming into existence at the same rate of growth and with a constant share of brands produced by multinationals. Furthermore, the

---

1) The model follows Krugman (1980) in this respect. But as Helpman, Krugman (1985) pointed out, closed solutions for trade models with transportation costs require quite restrictive assumptions about the demand and cost conditions. A highly simplified model may nevertheless be useful to highlight the underlying principles especially the role of market size for increasing return industries.

model implies that trade in goods and intrafirm trade grow complementarily at the same rate. So there is two-way-trade and two-way investment between equally endowed countries in the steady state. If in contrast countries have different endowments, that country well endowed with skilled labour headquarters more multinational firms and has developed more brands at any point in time. This adds an endowment basis to trade and investment as the country well endowed with unskilled labour concentrates on the production of brands. It tends to be a net-exporter of brands whereas the country well endowed with skilled labour becomes a net-exporter of skilled labour intensive intermediates and headquarter services.

The impact of multinationals on trade and welfare is usually handicapped as the alternative scenario cannot readily be specified. Following Markusen, Venables (1995) the model presented here allows to restrict multinational activity exogenously. This exercise shows that there may exist two counteracting welfare effects. As multinationals use resources (skilled labour) for setting up plants abroad which could otherwise employed in the research lab, the growth rate tends to be lower in the presence of multinationals. On the other hand, this negative growth effect may be compensated, however, if multinationals play an important role in transferring know-how between the countries. Additionally, there are static welfare gains as multinational firms economise on transportation costs.

The paper is organised as follows. The next section sets up the model, discusses the main assumptions and derives the steady state of the quasi-integrated equilibrium. Section III analyses the structure of trade and multinational activity and Section IV investigates into the welfare effects of multinational firms. The last section provides the conclusions and shortly summarises the results.

II. The assumptions and the model

To keep the model as simple as possible a series assumptions are made, which on the one hand guarantee tractability, but on the other hand allows to capture the main stylised facts described above. Consumers in two countries, called home and foreign, are assumed to be identical and are modelled by a representative household loving diversity (Dixit, Stiglitz, 1977). They consume one horizontally differentiated good where each brand may stem from one of three different sources. In the home country, for example, they consume n varieties produced by domestic firms, M varieties produced by multinational firms headquartered in the foreign country and N-M varieties are imported from the foreign country. For the foreign consumers the same holds true. Instantaneous utility has usual CES-form, for example in the home country, (in the sequel variables in lower letters refer to the home country, those corresponding to the foreign country use capitals and variables referring to the quasi integrated solution have a "~") reads:

$$(1) \qquad u(s_1,\ldots,s_{n+N}) = \left(\sum_{i=1}^{n} s_i^{\beta} + \sum_{j=1}^{M} s_j^{\beta} + \sum_{k=1}^{N-M} s_k^{\beta} \right)^{\frac{1}{\beta}}$$

Denoting the discount rate by ρ, consumers intertemporal utility function is defined as

$$(2.1) \qquad v_t = \int_t^{\infty} e^{-\rho(\tau-t)} \log(u) d\tau$$

Consumers maximise (2.1) subject to the usual intertemporal budget constraint (2.2) under the assumption of free lending and borrowing on the world capital market at interest rate r.

$$(2.2) \qquad \int_t^{\infty} e^{-r(\tau-t)} e(\tau)\, d\tau = \int_t^{\infty} e^{-r(\tau-t)} i(\tau)\, d\tau + a(t)$$

$e(\tau)$ denotes the expenditures at time τ, $i(\tau)$ the factor income and $a(t)$ with $a(0)=0$ accumulated assets which can be traded internationally. The intertemporal budget constraint requires the present value of expenditures on consumption to be equal to the present value of total factor income plus the value of assets at any point in time. Therefore, trade only needs to be balanced in present value as a trade deficit can be financed by trading assets (see also Dinopoulos, Oehmke, Segerstrom, 1993). Maximisation of (2.1) with respect to (2.2) leads to the well known Euler-equation which determines the expenditure path. The home country's expenditure path, for example, is given by

$$(3) \qquad \frac{\dot{e}}{e} = r - \rho$$

(3) holds for the home country, the foreign country as well as for the quasi-integrated case defined blow. Instantaneously (1) is maximised subject to the instantaneous budget

constraint, for example $\sum_{i=1}^{n} s_i p_i + \sum_{j=1}^{M} s_j p_j + \sum_{k=1}^{N-M} s_k p_k = e$ for consumers in the home-country, yielding demand equations for each brand:

$$(4) \qquad p_l = \frac{e s_l^{\beta-1}}{u'} \quad l = i, j, k \text{ and } u' = \sum_{i=1}^{n} s_i^{\beta} + \sum_{i=j}^{M} s_j^{\beta} + \sum_{k=1}^{N-M} s_k^{\beta}$$

The imported brands are subject to transportation costs. For simplicity it is assumed that these amount to a share ϑ of marginal production costs. This is equivalent to transportation costs of the "iceberg" type with the exported good shrinking by an amount of $100*(1+\vartheta)^{-1}$% during shipment. As in the Helpman, Krugman (1985), in the product market monopolistic competition with a large number of firms each producing a single brand is assumed so that a single firm does not consider its influence on the decisions of all the other firms in maximising profits[2]. In the presence of factor price equalisation, which is shown to hold below, and with identical production technologies, which is assumed throughout, the first order conditions for profit maximisation for the firms in both countries can be written as follows:

(5.1) $\beta p_i = \beta p_j = \beta p = c$ i.e. if the brand is not imported

(5.2) $\beta p_k = c(1+\vartheta) \Rightarrow p_k = p(1+\vartheta)$ i.e. if the brand is imported

(4), (5.1) and (5.2) imply that the quantities consumed from domestic or multinational firms as well as those imported from abroad are equal for all firms delivering brands to the consumers of a country in the respective way. Inserting (5) in (4) gives:

$$(6) \qquad p_i = \frac{e s_i^{\beta-1}}{u'} = p_k(1+\vartheta)^{-1} = \frac{e(1+\vartheta)^{-1} s_k^{\beta-1}}{u'} \Rightarrow s_k = (1+\vartheta)^{\frac{1}{\beta-1}} s_i \equiv \varphi^{-1} s_i$$

Variant *i* as well as *j* is produced and consumed in the home country, whereas variant *k* is imported. For the foreign country the equivalent relationship holds. With these

---

2) More precisely, the competition in this market may be described by a three stage game. In the first stage new firms choose to enter or not, in the second they decide to export or to become multinational and in the third stage there is Bertrand competition. To keeps things simple, it is assumed that the number of firms is large enough, so that the equilibrium in the third stage is well approximated by the simplifying assumption that a single firm does not influence the sales of the other firms in the sense that its perceived elasticity of demand is constant (Helpman, Krugman, 1985, p.119).

assumptions, the profits of domestic and foreign firms specialised in producing one particular brand and exporting it, are given by.

(7.1) $\pi^{EX} = (p_i - c)s_i + (p_k - c(1+\vartheta))S_k = (1-\beta)p\left[s_i + \varphi^{-\beta} S_i\right]$

(7.2) $\Pi^{EX} = (p_i - c)S_i + (p_k - c(1+\vartheta))s_k = (1-\beta)p\left[S_i + \varphi^{-\beta} s_i\right]$

The development of new brands is modelled as an investment decision as in Grossman, Helpman (1989, 1991). At each point in time a new firm can invest a fixed amount of human capital, $\frac{a_{HR}}{K_n}$, to develop a new brand inducing monopoly for this brand forever and thereby a stream of future profits worth π^{EX}/r resp. Π^{EX}/r with certainty. For simplicity, it is assumed that the set-up costs for the first plant are included in these costs. With free entry of innovative firms into product development the present value of future profits is driven down to the costs of product development.

Growth is driven by the expanding stock of knowledge, K_n, costlessly available to all firms in the world, which represents the cumulative experiences in product development from the past. Following Grossman, Helpman (1991) it is assumed that the stock of knowledge is embodied in the number of product variants currently produced in the world. As time goes on more and more brands are invented and developed to a new product and in this way the stock of knowledge is enhanced and thereby productivity in the research labs. However, knowledge spillovers are assumed to be imperfect and, more important, it is assumed that there is also a role for multinationals in promoting knowledge-spillovers. Formally, the stock of knowledge available to all firms is represented by $K_n = \tilde{n}\tilde{\kappa}^{\alpha}$, $\tilde{\kappa} = \frac{\tilde{m}}{\tilde{n}}$, i.e. the productivity in the research labs depends additionally on share of multinationals in the world. Multinationals operate closer to the market and may thus provide an additional channel for transferring know-how from one country to the other. In this way they enhance the stock of knowledge available in each country. In the absence of multinationals the stock of knowledge world-wide available would be smaller because of the incomplete knowledge spillovers as measured by the parameter α.

The assumption of world-wide availability of knowledge is rather restrictive as it assumes perfect instantaneous knowledge spillovers between countries in the presence of multinational firms. But as the work of Grossman, Helpman (1991) shows it is a prerequisite to establish the existence of a steady state trade equilibrium which is determined by differences in endowment. If knowledge spillovers are absent and the stock of knowledge is country specific, countries size matters and history as well as expectation may also determine long run growth. Countries, furthermore, will tend to specialise implying the impossibility of factor price equalisation in the long run. The analysis presented here has thus to be viewed as a benchmark case.

The R&D costs of developing a new brand amount to $c_n = \frac{w_H a_{HR}}{K_n}$ and are normalised to 1. Together with free entry to product development activities and equalised interest rates due to international trade in assets it gives identical non-arbitrage conditions in the two countries:

(8.1) $\pi^{EX} = r$

(8.2) $\Pi^{EX} = r$

They imply that profits of home and foreign firms, (8.1) and (8.2), also have to be equalised at each point in time. Given factor price equalisation, which indeed holds in the steady state if the countries are not too different, marginal costs and thus prices are equal in both countries and, therefore, the quantities produced by each firm for the respective market, too: $s_i = S_i = s$.

At every point in time each existing firm has the option to become multinational and to set up a second plant abroad instead of exporting. The model presented here follows Brainard (1993) and Markusen, Venables (1995) which in contrast to the Helpman-model (Helpman, 1984, 1985, Grossman, Helpman, 1989,1991) assume that firms have to trade-off plant specific fixed costs of setting up a plant abroad against higher marginal costs of serving foreign markets arising from transportation costs. Their analysis is pursued a step further, however, by adding a time dimension to this trade-off. Setting up a plant abroad is an investment decision whose returns are higher profits in the future due to proximity to the market and the absence of transportation costs. This investment will be attractive, if the set-up costs are lower than difference between the present value of the profits stream firms can achieve in the two forms of penetrating the foreign market. It is assumed that establishing a plant abroad requires $\frac{a_{HM}}{K_m}$ units of skilled labour in the parent country. Setting up a plant similar to an already established one at home, principally, can draw on the existing stock of knowledge. So the amount of skilled labour required to establish a plant abroad is likewise assumed to decrease as the number of available brands grows[3], $K_m = \tilde{n}$.

(9) $$c_m = \frac{w_H a_{HM}}{K_m} = \frac{a_{HM}}{a_{HR}} \tilde{\kappa}^{\alpha}$$

According to (8) and (9) firms become multinational (i.e. the number of brands produced in multinational firms $m, M, \tilde{m}$ increases) and consumers of both countries are eager to finance the internationalisation of firms as long as

(10) $$\left(\pi^{MUL} - \pi^{EX}\right)\frac{1}{r} = \left[(1-\beta)2ps - (1-\beta)ps\left(1+\varphi^{-\beta}\right)\right]\frac{1}{r} = (1-\beta)ps\left(1-\varphi^{-\beta}\right)\frac{1}{r} \geq c_m$$

holds. In equilibrium the returns of both developing new brands and becoming multinational have to equalise leading to the FDI-condition which defines the equilibrium share of multinationals:

(10') $$\frac{\left(1-\varphi^{-\beta}\right)}{\left(1+\varphi^{-\beta}\right)} = \frac{w_H a_{HM}}{K_m} = \frac{a_{HM}}{a_{HR}} \tilde{\kappa}^{\alpha} \Rightarrow \tilde{\kappa} = \left[\frac{\left(1-\varphi^{-\beta}\right)}{\left(1+\varphi^{-\beta}\right)} \frac{a_{HR}}{a_{HM}}\right]^{\frac{1}{\alpha}}$$

Usually this trade-off results either in a pure export or a pure multinational equilibrium. With multinationals transferring know-how form one country to the other external diseconomies of investing abroad are introduced. For a given number of brands the stock knowledge increases with the share of multinational firms, and thereby the wage rate of skilled labour, whereas stock of "internationalisation know-how" remains constant implying the existence of a share which equalises (10) and renders firms indifferent between exporting and investing abroad. This is one possible way of rationalising the observation that equilibria with all firms exporting or all firms multinational are never found empirically[4]. The formulation of the FDI-condition implies, that a pure exporting

---

3) Another equivalent assumption generating a mixed equilibrium is that $c_m = w_H a_{HM} \tilde{\kappa}^{\alpha}, K_n = K_m = \tilde{n}$, i.e. the plant set-up costs are increasing in $\tilde{\kappa} = \frac{m}{\tilde{n}}$, the share of firms in the world which are multinationals, and that knowledge is internationally available even in the absence of multinationals. This assumption implies that for a given stock of knowledge (i.e. a given number of brands) setting-up a plant becomes more costly the higher the share of multinational firms. This may be caused by delimiting factors, for example costs for communication networks may increase with the number of multinationals or there are limitations in proper space for establishments. Note that these diminishing returns are external to the firms.

4) Note that a mixed configuration can be sustained as Nash-equilibrium if firms view set-up costs as constant but are aware that they could decide strategically on setting up a plant abroad (Brainard, 1993).

equilibrium does not exist in the steady state as long as α greater than zero and finite. If multinationals play no role in generating knowledge spillovers the usual corner solutions are obtained: All firms want to become multinational if (10) holds and all firms are exporters in the steady state if (10) does not hold. The equilibrium configuration defined by (10′) is determined by the requirements of skilled labour for setting up a plant abroad as compared to those of developing a new brand for a given stock of knowledge. Higher transportation costs increase the returns of becoming multinational. Note that there are additional restrictions on the parameters forcing the share of multinationals in the [0,1] interval[5].

On the production side it is assumed that firms use unskilled labour, $\tilde{l}$, and skilled labour, $\tilde{h}$, to produce the horizontally differentiated goods. New firms come into existence to develop new brands or existing firms become multinational which both requires skilled labour. For simplicity input coefficients are assumed constant. Principally, they could depend on factor prices, the analysis and especially notation, however, is considerably simplified without changing the results essential (Grossman, Helpman, 1989, 1991). In addition, it is postulated that production is internationally separable in the sense that the production of a brand requires an intermediate input, which is produced in the headquarter of the multinational firm using skilled labour only and which can be traded costlessly within the firm across borders. So in stead of exporting the final product, multinationals may export the intermediate product without transportation costs and employ foreign unskilled labour to finish the product abroad. The multinational firms are thus both vertically and horizontally integrated across borders and they engage in intrafirm trade in blue prints and intermediates (Helpman, Krugman, 1985). The resource constraint for the home country reads:

(11.1) $a_{Ls}s(n+M)+a_{Ls}(1+\vartheta)s(n-m)\varphi^{-1}=a_{Ls}s(n+M)+a_{Ls}s(n-m)\varphi^{-\beta}=l$

Apart from the zero profit condition, in the Nash-equilibrium it holds for the marginal firm (e.g. of the home country):

$\pi^{EX}(\tilde{m})\geq\pi^{MUL}(\tilde{m}+1)$, $\pi^{MUL}(\tilde{m})\geq\pi^{EX}(\tilde{m}-1)$. Using the zero-profit condition of exporting firms, it can easily be shown that these inequalities hold if $\tilde{n}\tilde{\phi}\geq 1+\varphi^{-\beta}$. Thus, if the number of brands is large enough, any mixed equilibrium can be sustained (see Brainard, 1993 for a similar condition).

5) $\tilde{\kappa}\leq 1\Leftrightarrow\frac{\left(1-\varphi^{-\beta}\right)}{\left(1+\varphi^{-\beta}\right)}\leq\frac{a_{HM}}{a_{HR}}$

(11.2) $a_{Hs}s(n+m)+a_{Hs}s(n-m)\varphi^{-\beta}+a_{HR}\frac{n}{\tilde{n}}\tilde{\kappa}^{-\alpha}g_n+a_{HM}\frac{m}{\tilde{n}}g_m=h$

The resource constraint of the foreign country is given by

(12.1) $a_{Ls}s(N+m)+a_{Ls}s(N-M)\varphi^{-\beta}=L$

(12.2) $a_{Hs}s(N+M)+a_{Hs}s(N-M)\varphi^{-\beta}+a_{HR}\frac{N}{\tilde{n}}\tilde{\kappa}^{-\alpha}{}_N+a_{HM}\frac{M}{\tilde{n}}g_M=H$

If both countries face the same rate of product development, $g_n=g_N=g_{\tilde{n}}$, and as well the same growth rate of multinationals, $g_m=g_M=g_{\tilde{m}}$ then (11) and (12) can be easily aggregated to the world resource constraint being used for the analysis of the quasi-integrated equilibrium which would occur with mobile inputs but the same number of MNE's (see Dixit, Norman, 1980, for this approach to establish trade equilibria). The aggregate model is called quasi-integrated as transportation costs are still present and divide the world into two countries. The aggregate resource constraint defining the quasi-integrated equilibrium is used to determine the growth rate, the wage rates and product prices. It is split up afterwards to reproduce the trade equilibrium and to derive the structure of trade and multinational production. Adding (11.1) to (12.2) and as well (11.2) and (13.2) gives

(13.1) $a_{Ls}s\left[(\tilde{n}+\tilde{m})+(\tilde{n}-\tilde{m})\varphi^{-\beta}\right]=a_{Ls}s\tilde{n}\tilde{\phi}=\tilde{l}$

(13.2) $a_{Hs}s\tilde{n}\tilde{\phi}+a_{HR}\tilde{\kappa}^{-\alpha}g_{\tilde{n}}+a_{HM}\tilde{\kappa}g_{\tilde{m}}=\tilde{h}$

with $\tilde{\phi}=\left(1+\varphi^{-\beta}\right)+\tilde{\kappa}\left(1-\varphi^{-\beta}\right)$. The equality of growth rates between the two countries is a necessary condition to sustain a steady state trade equilibrium. Furthermore, the growth rate of product development and that of multinationals have to be equal in the steady state: $g_{\tilde{n}}=g_{\tilde{m}}=g$. Substituting (13.1) in (13.2) and using the FDI-condition (10) gives:

(14) $$g=\frac{\tilde{l}}{a_{HR}\tilde{\kappa}^{-\alpha}+a_{HM}\tilde{\kappa}}\left[\frac{\tilde{h}}{\tilde{l}}-\frac{a_{Hs}}{a_{Ls}}\right]=\frac{\left(1+\varphi^{-\beta}\right)\tilde{\kappa}^{\alpha}}{a_{HR}\tilde{\phi}}\bar{\tilde{h}},\ \bar{\tilde{h}}=\tilde{l}\left[\frac{\tilde{h}}{\tilde{l}}-\frac{a_{Hs}}{a_{Ls}}\right]$$

In order to sustain the long-run growth rate in (14) as the positive equilibrium growth rate skilled labour beyond that employed in the production of brands has to be available. This is the case if the home and the foreign country taken together are relatively well endowed with skilled labour so that $\tilde{h}/\tilde{l}\geq a_{Hs}/a_{Ls}$ holds. Furthermore, the Euler-equation defining the expenditure path (3), the non-arbitrage conditions (8) and as well the FDI condition (10) have to be fulfilled at any point in time. In this case, consumers are willing to finance

R&D and as well plants abroad and firms find it profitable to develop new brands or to invest in plants abroad at the prevailing interest rate. To see that this indeed holds true in the steady state, multiply (13.1) and (13.2) by the respective wage rates, add and substitute (8) using (3), (7) and (10'):

$$(15)\qquad \left(w_L a_{Ls} + w_L a_{Ls}\right) s\tilde{n}\tilde{\phi} + \tilde{n}g + \tilde{n}\frac{1-\varphi^{-\beta}}{1+\varphi^{-\beta}}\tilde{\kappa}g = \beta p s\tilde{n}\tilde{\phi} + \frac{g\tilde{n}\tilde{\phi}}{1+\varphi^{-\beta}} = w_L\tilde{l} + w_H\tilde{h} \Rightarrow$$

$$\beta\tilde{e} + \frac{g\tilde{n}\tilde{\phi}}{1+\varphi^{-\beta}} = \frac{\beta(g+\rho)\tilde{n}\tilde{\phi}}{(1-\beta)\left(1+\varphi^{-\beta}\right)} + \frac{g\tilde{n}\tilde{\phi}}{1+\varphi^{-\beta}} = w_L\tilde{l} + w_H\tilde{h} \Rightarrow g = \frac{1}{\tilde{n}\tilde{\phi}}(1-\beta)\left(1-\varphi^{-\beta}\right)\left(w_L\tilde{l} + w_H\tilde{h}\right) - \beta\rho$$

Since $w_H = \frac{\tilde{n}\tilde{\kappa}^{\alpha}}{a_{HR}}$, $w_L = \frac{\beta p}{a_{Ls}} - \frac{w_H a_{Hs}}{a_{Ls}} = \frac{\beta\tilde{e}}{\tilde{l}} - \frac{\tilde{n}\tilde{\kappa}^{\alpha} a_{Hs}}{a_{HF} a_{Ls}}$, we have $w_L\tilde{l} + w_H\tilde{h} =$
$\beta\tilde{e} - \frac{\tilde{n}\tilde{\kappa}^{\alpha} a_{Hs}}{a_{HR} a_{Ls}}\tilde{l} + \frac{\tilde{n}\tilde{\kappa}^{\alpha}}{a_{HR}}\tilde{h} = \frac{\beta(g+\rho)\tilde{n}\tilde{\phi}}{(1-\beta)\left(1+\varphi^{-\beta}\right)} + \frac{\tilde{n}\tilde{\kappa}^{\alpha}\tilde{l}}{a_{HR}}\left[\frac{\tilde{h}}{\tilde{l}} - \frac{a_{Hs}}{a_{Ls}}\right]$. Thus, $\frac{g\tilde{n}\tilde{\phi}}{\left(1+\varphi^{-\beta}\right)} = \frac{\tilde{n}\tilde{\kappa}^{\alpha}\tilde{l}}{a_{HR}}\left[\frac{\tilde{h}}{\tilde{l}} - \frac{a_{Hs}}{a_{Ls}}\right]$.

As in traditional models of endogenous growth, the growth rate is positively related to the endowments with skilled labour and to the productivity in the research labs. However, for the latter determinant now a direct and an indirect effects can be identified. The indirect one is determined by the impact of multinationals on growth and it can be derived by differentiation of (14) with respect to $\tilde{\kappa}$:

$$(16)\qquad \frac{\partial g}{\partial\tilde{\kappa}} = \frac{\left(1+\varphi^{-\beta}\right)\tilde{\kappa}^{\alpha}}{a_{HR}\tilde{\phi}^2}\left[\alpha\tilde{\kappa}^{-1}\left(1+\varphi^{-\beta}\right) - (1-\alpha)\left(1-\varphi^{-\beta}\right)\right]\tilde{h} \geq 0 \Leftrightarrow \tilde{\kappa} \leq \frac{\alpha\left(1+\varphi^{-\beta}\right)}{(1-\alpha)\left(1-\varphi^{-\beta}\right)}$$

The existence of multinationals may or may not promote growth depending on the amount of knowledge spillovers they induce and on the resources they use to set up plants abroad which could otherwise be employed in the research labs. If the latter effect outweighs the former (16) is negative and growth is lower the higher the share of multinationals. If in this case the requirements for skilled labour in the research lab cp. increase, the indirect effect is caused by the reduction in the wage rate for skilled labour (as its productivity falls). This extends the number of firms becoming multinational and reallocates skilled labour from the research labs to setting up plants abroad. To give another example, a decrease in transportation costs induces less firms to set up plants abroad, this reduces the demand for skilled labour and in this way expands the resources available for product development. Via this mechanism, a further deepening of economic integration due to a reduction in transportation costs and trade barriers generates, in addition to the static gains, growth effects. Note that this conclusion rests on a negative relationship between the growth rate and the share of multinational firms arising from the assumption that both R&D and investing abroad draw on the same pool of resources. The negative relationship between economic growth and multinational activity is less pronounced, however, the larger the knowledge spillovers generated by multinational firms and it may well turn into a positive one as can be seen by (16).

Figure 1

The disequilibrium dynamics of the model are quite simple. Figure 1 illustrates the non-arbitrage conditions as well as the resource constraint. According to (14) the resource constraint does not slope downwards in expenditures per normalised brand (normalised by transportation costs and the share of multinationals, $\tilde{n}, \tilde{\phi}$) since for a given number of brands production of goods is limited by the amount of unskilled labour available. The growth rate is constant and independent from expenditures per normalised brand. In the steady state both activities, becoming multinationals and product development, yield the same returns and both conditions are represented by the identical upward-sloping line. If the quasi-integrated economy starts with a too low share of multinationals, the FDI-condition shows that the returns form substituting exports by local production are higher than those from product development. Thus investors are only willing to finance multinationalisation. If the returns are decreasing with the number of multinationals ($\alpha > 0$) the FDI-line rotates downwards until the steady state is reached and the share of multinationals stays constant. If, on the other hand, the number of multinationals is too large at the starting point, product development is more profitable and no firm additionally becomes multinational. As in the simple endogenous growth model with brand proliferation (Grossman, Helpman, 1991) the economy immediately jumps to a constant rate of product development. If, for example, initial expectations about subsequent profits are too pessimistic and consumers want to consume more per normalised brand than the equilibrium quantity, they drive up the prices and wage rates as for a given number of brands the quantity of each brand produced has to adjust to clear the labour market. In this way the profits per normalised brand immediately jump to their equilibrium value. Over time the share of multinationals falls towards the steady state value and if it is reached the growth rate falls discretely since now investors finance both the development of new brands and the stet-up of plants abroad.

III. Trade, multinationals and product development in the long run

The steady trade and investment pattern can be derived by splitting up the resource constraints of the quasi-integrated economy into those of the two countries, which is possible if the two countries' endowments are sufficiently similar. Using

(17.1') $n + M + (N - M)\varphi^{-\beta} = n\phi - \Delta m - (\Delta n - \Delta m)\varphi^{-\beta}$
(17.2') $N + m + (n - m)\varphi^{-\beta} = N\Phi + \Delta m + (\Delta n - \Delta m)\varphi^{-\beta}$

aggregate expenditures on consumption goods in each country can be written as

(18.1) $e = ps\left[n + M + (N - M)\varphi^{-\beta}\right] = ps\left[n\phi - \Delta m - (\Delta n - \Delta m)\varphi^{-\beta}\right]$

(18.2) $E = ps\left[N + m + (n - m)\varphi^{-\beta}\right] = ps\left[N\Phi + \Delta m + (\Delta n - \Delta m)\varphi^{-\beta}\right]$

Trade need not be balanced at any point in time of the steady state but imports of brands and intrafirm imports of each country have to be covered by exports and net asset trade (Dinopoulos, Oehmke, Segerstrom, 1993). Net trade in assets is defined as the share of brands in the total number of brands available in the world which are developed and produced in the foreign country (in the home country if it is negative) but financed and thus owed by shareholders of the home country (foreign country if negative). It is denoted by η. Formally, the stock of assets held by shareholders in each country is defined by non-arbitrage conditions[6] (remind that R&D costs are normalised to *1*):

(19) $\tilde{a} = \frac{\tilde{n}\tilde{\phi}}{1+\varphi^{-\beta}}, a = \frac{n\phi + \eta\tilde{n}\tilde{\phi}}{1+\varphi^{-\beta}}, A = \frac{N\Phi - \eta\tilde{n}\tilde{\phi}}{1+\varphi^{-\beta}}$

If η is positive the home country is a net exporter of capital (net-importer of assets) and it is negative if the foreign country is. The balance of payments can easily be derived from the income identity, for example for home it is given by

---

6) Integrating the steady the budget constraint (2.2) at time *t* and using $g = r + \rho$, which is constant in the steady state, gives $e = i + \rho a$. The assets are claims on the profits of newly developed brands, they consist of profits arising from brands developed in the past corrected by net stock of assets sold to the foreign country so that (19) holds.

(20) $$i = w_L l + w_H h = \beta ps(n\phi - \theta_L \Delta m) + \left(\frac{n\phi}{\tilde{n}\tilde{\phi}} + \eta\right)\left[(1-\beta)ps\tilde{n}\tilde{\phi} - \frac{\rho\tilde{n}\tilde{\phi}}{1+\varphi^{-\beta}}\right] =$$

$$= psn\phi - \beta ps\theta_L \Delta m + \eta(1-\beta)ps\tilde{n}\tilde{\phi} - \frac{(n\phi + \eta\tilde{n}\tilde{\phi})\rho}{1+\varphi^{-\beta}}$$

$$e = w_L l + w_H h + \frac{(n\phi + \eta\tilde{n}\tilde{\phi})\rho}{1+\varphi^{-\beta}} = psn\phi - \beta ps\theta_L \Delta m + \eta(1-\beta)ps\tilde{n}\tilde{\phi}$$

where θ_L denotes the share of unskilled labour in average variable costs. Subtracting the expenditures for those brands produced and consumed in the same country gives the balance of payments. Measured in terms of $\tilde{n}\tilde{\phi}$, for the home country it reads:

(21) $$\frac{ps}{\tilde{n}\tilde{\phi}}(n-m)\varphi^{-\beta} + \frac{ps}{\tilde{n}\tilde{\phi}}(1-\beta\theta_L)m - \eta(1-\beta)ps = \frac{ps}{\tilde{n}\tilde{\phi}}(N-M)\varphi^{-\beta} + \frac{ps}{\tilde{n}\tilde{\phi}}(1-\beta\theta_L)M$$

Trade in final products and intrafirm trade of each country grow at the steady state growth rate g. For example, assuming the home country is an net-exporter of goods its growth rate of exports (excluding trade in assets) is

(22) $$\hat{ex}_H = \frac{1}{ex_H}\left[(\dot{ps})\left(n\varphi^{-\beta} + \left(1-\beta\theta_L - \varphi^{-\beta}\right)m\right) + ps\left(\dot{n}\varphi^{-\beta} + \left(1-\beta\theta_L - \varphi^{-\beta}\right)\dot{m}\right)\right] =$$

$$= \frac{ps}{ex_H} g\left(n\varphi^{-\beta} + \left(1-\beta\theta_L - \varphi^{-\beta}\right)m\right) = g\,.$$

Since from (6) $\hat{e} = \hat{p} + \hat{s} + \hat{\tilde{n}}\hat{\tilde{\phi}} = g$, it follows that $(\dot{ps}) = 0$. Furthermore, unskilled labour's share in variable average costs as well as transportation costs remain constant over time.

For the foreign country the same holds true so that according to (21) net trade in assets grows also at rate g implying that the share of assets held by each country stays constant over time as $\tilde{n}\tilde{\phi}$ grows at rate g. Thus, in the steady state exports of each country grow complementarily with the number of their multinational firms. On the one the hand exports of final products increase along with the number of brands developed in a country, but consumed in both countries. On the other hand the number of multinational firms grows with the same rate substituting part of the trade in final products but generating intrafirm trade in intermediate products and blue prints, which partly compensates for the substitution of exports in final products. Taking the log time derivative of the respective shares shows that these indeed remain constant over time in the steady state.

$$(23.1)\quad \frac{d}{dt} \log \frac{ps(n-m)\varphi^{-\beta}}{ex_H} = g\frac{ps(n-m)\varphi^{-\beta}}{ps(n-m)\varphi^{-\beta}} - g = 0$$

$$(23.2)\quad \frac{d}{dt} \log \frac{ps(1-\beta\theta_L)m}{ex_H} = g - g = 0$$

To get a clearer picture of the structure of trade it is useful to decompose (21) in a net-trade component and an "intra"-components as do the traditional models of intraindustry trade (Helpman, Krugman, 1985). Interindustry trade is by definition excluded. However, it is nonetheless helpful to decompose asset adjusted trade into components based on different factor endowments (S_N) and into those which would also be present in the absence of comparative advantage (S_I). For this task assume that the home country is a net-exporter of brands and a net importer of intrafirm services and intermediates (i.e. $\Delta n - \Delta m \geq 0, \Delta m \leq 0$):

$$(24.1)\quad S_N = \frac{(\Delta n - \Delta m)\varphi^{-\beta} - (1-\beta\theta_L)\Delta m}{(\tilde{n}-\tilde{m})\varphi^{-\beta} + (1-\beta\theta_L)\tilde{m}} = \frac{2(n-m)\varphi^{-\beta} + 2(1-\beta\theta_L)M}{(\tilde{n}-\tilde{m})\varphi^{-\beta} + (1-\beta\theta_L)\tilde{m}} - 1$$

$$(24.2)\quad S_I = 1 - S_N = 2 - \frac{2(n-m)\varphi^{-\beta} + 2(1-\beta\theta_L)M}{(\tilde{n}+\tilde{m})\varphi^{-\beta} + (1-\beta\theta_L)\tilde{m}} = 2 - 2\frac{\frac{n}{\tilde{n}}(1-\kappa)\varphi^{-\beta} + \frac{N}{\tilde{n}}(1-\beta\theta_L)K}{\varphi^{-\beta} + \left(1-\beta\theta_L - \varphi^{-\beta}\right)\tilde{\kappa}}$$

Whether multinationals substitute or complement trade in the static volume of trade sense (Wong, 1995) depends on the amount of intrafirm trade they create as compared to the trade in brands they substitute for. It can easily be seen from (24) that the former effect is larger and the asset adjusted overall volume of trade is enhanced by multinationals if

$$(25)\quad \theta_L \leq \frac{1-\varphi^{-\beta}}{\beta}$$

According to (25) multinationals complement trade in goods if the cost share of unskilled labour which is employed abroad is sufficiently low implying that a large share of costs falls on headquarter services and intermediate products. Vertical integration across borders is also in this model the main element generating complementarity. On the other hand complementarity is also likely if markets are segmented by high transportation costs or barriers to trade as the volume of trade in final products that could be substituted for by multinationals tends to be rather low.

If countries are not equally endowed they will specialise (although not fully) to take advantage of their abundant factors. In the appendix it is demonstrated that the quasi-integrated equilibrium can indeed reproduced by the separated trade equilibrium, if trade in assets is possible. The difference between the number of brands produced in the two countries and that between the number of multinational firms (or brands produced in multinational firms) headquartered in the two countries is also derived in the appendix. Note that the decomposition of resource constraint does not necessarily lead to balanced trade. This resembles the well known result that in general an integrated equilibrium which can be reproduced by a trade equilibrium may not necessarily exist in the presence of transportation costs (Helpman, Krugman, 1985) .

(26.1) $\frac{\Delta m}{\tilde{n}\tilde{\phi}} = \frac{1}{2}\left[\frac{\Delta h}{\tilde{h}} - \frac{\Delta l}{\tilde{l}}\right]$

(26.2) $\frac{\Delta n}{\tilde{n}\tilde{\phi}} = \frac{\Delta h}{2\tilde{h}} + \frac{\left(1-\varphi^{-\beta}\right)}{\left(1+\varphi^{-\beta}\right)}\frac{\Delta l}{2\tilde{l}}$

where $\Delta h = h - H, \Delta l = l - L$. Equations (26.1) and (26.2) indicate that in the steady state the number of brands which have been developed and which are also produced in each country is equal at any point in time if the countries have identical endowments with both skilled and unskilled labour. That part of brands which is produced by multinational firms instead of exported is also equal in this case. So according to (10') the countries have the same internationalisation ratio and there is no trade in assets ($\eta = 0$). In contrast to the Helpman model (Helpman, 1981, 1985) the model presented here is more in line with Brainard (1993) and Markusen, Venables (1995) who likewise model the emergence of multinationals - in a static framework - as the result of a trade-off between transportation costs (proximity to the market) and fixed set-up cost for additional plants. As in their models we observe both two way trade in goods as well as two-way intrafirm trade between identical countries. Furthermore, in both countries the same number of multinationals is headquartered, i.e. (24.1) is *0* and (24.2) is *1* indicating that only the "intra"-trade component is present. The convergence hypothesis put forward by Markusen, Venables (1995) states that multinational firms increasingly dominate international economic activity by displacing trade as countries become more similar in income and endowments. In this model the number of multinational firms operating in the world is determined by the FDI-condition of the quasi-integrated equilibrium which is independent of factor proportions. It is the share of multinationals headquartered in each country which is determined by the countries' factor endowments. Convergence as defined by Markusen and Venables (1995) only takes place in the sense that the "intra"-component of trade becomes larger as countries become more equal.

If the two countries have the same factor proportions, but differ in size, trade structure can easily be analysed by assuming $H = \lambda h, L = \lambda l$ so that (25.1) and (25.2) reduce to

(26.1′) $\frac{\Delta m}{\tilde{n}\phi}=0$

(26.2′) $\frac{\Delta n}{\tilde{n}\phi}=\left(\frac{1-\lambda}{1+\lambda}\right)\left(\frac{1}{1+\varphi^{-\beta}}\right)>0$ if $\lambda<1$

At any point in time the larger country produces more brands, but does not headquarter more multinational firms. Trade has both an "intra" and "net" trade component, since the large country relies on exports of end products to a greater extent than small countries do (This reflects the general conclusion that market size matters in the presence of transportation costs, Helpman, Krugman, 1985 and resembles the forced comparative advantage phenomenon described by Lanchaster, 1980). The reason for this finding lies in the absence of comparative advantage and the assumption about intrafirm trade in intermediate products. If a large country which produces more brands would have also more multinationals, the market for unskilled labour would not be in equilibrium in both countries. The smaller country, since it has no abundance of unskilled labour by assumption, would have access demand for unskilled labour, whereas the larger country access supply. Form (21) it is also obvious that the smaller country runs a trade deficit in the long run. To finance its trade deficit, some of the firms (brands) in the smaller country are owed by the residents of the larger country and the profits generated by these firms finance the trade deficit which persists forever. So a further implication of the model is that in the presence of transportation costs and multinational firms foreign ownership plays an important role in small countries.

Another interesting case arises if the two country have similar size but differing factor proportions. Define, for simplicity, $h=\mu, H=2-\mu, l=2-\mu, L=\mu$ as in Krugman (1981). If $\mu>1$ the home country is relatively better endowed with skilled labour and exactly the reverse holds true for the foreign country.

(26.1″) $\frac{\Delta m}{\tilde{n}\phi}=\mu-1>0$ if $\mu>1$

(26.2″) $\frac{\Delta n}{\tilde{n}\phi}=\frac{(\mu-1)\varphi^{-\beta}}{1+\varphi^{-\beta}}>0$ if $\mu>1$

The home country, as it is relatively better endowed with skilled labour, produces more brands and more of its firms are multinationals generating an additional net-trade component. With different factor endowments there is also a role for multinational firms in exploiting the comparative advantage of the host country. Multinationals based in the home country employ abundant unskilled labour abroad and concentrate those part of production which is intensive in skilled labour at home. Intrafirm trade, although not absent between equal countries, in this case also possesses an additional endowment basis. This can easily be demonstrated by calculating the trade balance net of "intra"-components. For the home country it reads

$$(21') \quad (1-\beta\theta_L)(\mu-1)-\eta(1-\beta)=-\frac{(\Delta n-\Delta m)\varphi^{-\beta}}{\tilde{n}\tilde{\phi}}=\frac{(\mu-1)\varphi^{-\beta}}{1+\psi^{-\beta}}$$

The skill abundant home country is a net importer of final products, but it faces a trade surplus in intrafirm services. This corresponds to the findings of Helpman, Grossman (1989). Their model also implies that the country well endowed with skilled labour may become a net importer in the course of time (they, however, look at the equilibrium adjustment path to the steady state as they don't model endogenous growth. Furthermore, there are no transportation costs in their model). Inserting in (24.1) (there are now the reversed signs as compared to (24.1)) gives

$$(24.1'') \qquad S_N=\frac{(\mu-1)\frac{\varphi^{-\beta}}{1+\varphi^{-\beta}}+(1-\beta\theta_L)(\mu-1)}{(\tilde{n}-\tilde{m})\varphi^{-\beta}+(1-\beta\theta_L)\tilde{m}}$$

This indicates that the share of net trade in total asset adjusted trade volume increases with the endowments of skilled labour, μ, illustrating the additional endowment basis of trade.

IV. Multinational firms and welfare

The assessment of impact of multinational firms on welfare often has the difficulty that it is not clear as to what the alternative scenario looks like so that the basis of comparison is missing. In the model analysed here, we can make the comparison explicit by fixing a point in time and asking, what would be the effect on welfare if the number of multinational firms is exogenoulsly reduced from this point in time onwards (see also Markusen, Venables, 1995 for a similar approach). The more direct comparison of excluding all multinationals exogenously is not feasible in this framework, however, as multinationals play an important role in transferring know-how between the countries. As can easily be seen from (14) growth would peter out in the quasi-integrated equilibrium if multinationals where completely abandoned (and κ approaches to 0) because of lacking knowledge spillovers. So we concentrate on the assessment of the welfare effects to the case where both countries reduce the share of multinationals reciprocally and exogenously by a small positive number. Starting with the quasi-integrated equilibrium, (14) implies that we have to distinguish two cases as mentioned above: If knowledge spillovers generated by multinational firms are relatively large, the growth rate would be lower in the alternative regime, although less skilled labour is employed to set up additional plants abroad and more resources are available in the research labs generating an increase rate of product development. In the second case spillovers are relatively low and the resource effect more than compensates leading to a higher growth rate in the alternative scenario. In a first step total expenditures are derived using (15):

$$(27) \qquad \tilde{e} = \frac{(g+\rho)\tilde{n}\tilde{\phi}}{(1-\beta)\left(1+\varphi^{-\beta}\right)} = \frac{(g+\rho)\tilde{n}\left(a_{HR}+a_{HM}\tilde{\kappa}^{1+\alpha}\right)}{(1-\beta)a_{HR}} = \frac{\tilde{n}\tilde{\kappa}^{\alpha}\bar{\tilde{h}}}{a_{HR}(1-\beta)} + \frac{\rho\tilde{n}\left(a_{HR}+a_{HM}\tilde{\kappa}^{1+\alpha}\right)}{a_{HR}(1-\beta)}$$

Assuming that at time t the steady state share of multinationals $\tilde{\kappa}$ is exogenously reduced, from (27) total expenditures at time t are unambiguously lower. On the one hand there are losses arising from the reduced knowledge spillovers and on the other hand there is less possibility to economise on transport costs, which releases less resources for the production of final products and generates additional income. This second effect is reflected in the lower valued assets in the case of less multinational firms. The total effect on welfare can calculated from the indirect utility function. Since $\tilde{e}(t) = s(t)p(t)\tilde{\phi}\tilde{n}(t)e^{g\tau}$ instantaneous utility at time $\tau \geq t$ amounts to

$$(28) \qquad \tilde{u}(\tau) = \left[\tilde{n}(t)\tilde{\phi}\right]^{\frac{1-\beta}{\beta}}\left(\frac{\tilde{e}(t)}{p(t)}\right)e^{\frac{(1-\beta)g(\tau-t)}{\beta}}$$

Taking logs, inserting in (2.1) and integrating gives the indirect utility function. The resource constraint for unskilled labour (13.1) implies $\frac{\tilde{l}}{a_{Ls}} = s\tilde{n}\tilde{\phi} = \frac{\tilde{e}}{p}$. Using this and additionally the FDI-condition (10) indirect utility can be expressed as

$$(29) \qquad \tilde{v}(t) = \frac{(1-\beta)g}{\beta\rho} + log\left[\frac{\tilde{l}}{a_{Ls}}\right] + \frac{1-\beta}{\beta}log\left[\frac{\tilde{n}\left(1+\varphi^{-\beta}\right)\left(a_{HR}+a_{HM}\tilde{\kappa}^{1+\alpha}\right)}{a_{HR}}\right]$$

In the first case where multinationals create significant knowledge spillovers, the possibility to set up plants abroad increases the overall level of expenditures *and* the growth rate leading to an unambiguous welfare loss from restricting multinationals for both countries. In the second, more realistic case, a positive static level effect has to be traded-off against a negative dynamic one. Condition (29) illustrates that the static welfare effect of multinationals is lower the larger the share of R&D expenditures in total investments (in R&D and in setting up plants abroad) is, whereas for the dynamic welfare loss arising from multinationals the reverse holds true. To see this multiply by the wage rate for skilled labour:

(30) $$\frac{a_{HR}}{a_{HM}\kappa^{1+\alpha}+a_{HR}}=\frac{\frac{\tilde{n}w_H a_{HR}}{\tilde{n}\tilde{\kappa}^{\alpha}}}{w_H a_{HM}\tilde{\kappa}+\frac{\tilde{n}w_H a_{HR}}{\tilde{n}\tilde{\kappa}^{\alpha}}}=\frac{c_n}{\tilde{\kappa}c_m+c_n}\equiv \upsilon\,,\ \frac{\partial\upsilon}{\partial\tilde{\kappa}}=-\frac{(1+\alpha)a_{HM}\kappa^{\alpha}a_{HR}}{\left(a_{HM}\kappa^{1+\alpha}+a_{HR}\right)}<0$$

Reformulating (29) using (30) and (14) gives

(29′) $$\tilde{v}(t)=\frac{(1-\beta)\upsilon\tilde{\kappa}^{\alpha}\tilde{\bar{h}}}{\beta\rho a_{HR}}+log\left[\frac{\tilde{l}}{a_{Ls}}\right]+\frac{1-\beta}{\beta}log\left[\frac{\tilde{n}\left(1+\varphi^{-\beta}\right)}{\upsilon}\right]$$

Thus in general welfare may or may not be lowered by presence of multinational firms. If multinationals have a role in transferring know-how, if the future gets enough weight and if the share of investments for plants abroad is sufficiently low both countries taken together gain from the presence of multinational firms. Of course the growth-rate as well as the R&D investment decision are endogenously determined, so that the stated condition should be interpreted as an ex-post-criterion.

To see whether the welfare effects are divided evenly between the countries, the indirect utility function is additionally calculated for the home country assuming that the share of multinationals is exogenously changed at the same rate in each countries so that the structure of trade and multinational activity is preserved. Denoting the share of the home countries' expenditures in world expenditures by λ and referring to (18.1) shows (To simplify notation the time index is suppressed):

(30.1) $$e=\lambda\tilde{e}=ps(N\Phi+\Delta n)\,,\ \frac{u}{\tilde{u}\left(\frac{\tilde{n}\tilde{\phi}}{2}\right)}=\frac{(N\Phi+\Delta n)^{\frac{1}{\beta}}s}{\left(\frac{\tilde{n}\tilde{\phi}}{2}\right)^{\frac{1}{\beta}}s}=(2\lambda)^{\frac{1}{\beta}}$$ and

(30.2) $$v-\tilde{v}\left(\frac{\tilde{n}\tilde{\phi}}{2}\right)=log\frac{u}{\tilde{u}\left(\frac{\tilde{n}\tilde{\phi}}{2}\right)}=\frac{1}{\beta}log\,2\lambda\,,$$

(30.3) $$d\,v=\frac{\partial\tilde{v}\left(\tilde{n}\tilde{\phi}/2\right)}{\partial\tilde{\kappa}}\left[\frac{\partial\tilde{\kappa}}{\partial\kappa}d\,\kappa+\frac{\partial\tilde{\kappa}}{\partial K}d\,K\right]=\frac{\partial\tilde{v}\left(\tilde{n}\tilde{\phi}\right)}{\partial\tilde{\kappa}}\left[\frac{n}{\tilde{n}}d\,\kappa+\frac{N}{\tilde{n}}d\,K\right]$$

since the steady state growth rate is equal for both countries. In (30) the proper comparison is the welfare from the consumption of brands divided evenly between the two countries. With λ constant, both countries gain or loose form the existence of multinational firms to the same absolute amount (if $\tilde{\kappa}$ is exogenously restricted and both countries are affected at the same rate). This implies that the larger country participates to a lower extent in welfare gains or losses as compared to its size. This rests on the result that all varieties are consumed in the same quantity and on the fact that in the larger country more brands are produced domestically so that it does not bear that much transportation costs as the smaller country does.

IV. Conclusions

Modelling trade in differentiated products in the presence of transportation costs using a general equilibrium approach requires quite restrictive simplifying assumptions. Nevertheless, it is useful to investigate the relationship of multinational activity trade and growth in a highly stylised model. The model presented here has restricted the attention to the case where two trading countries achieve factor price equalisation despite transportation costs and draw on the same internationally available stock of knowledge. It extends previous work on this subject by integrating the Helpman approach (Helpman 1984, 1985, Helpman, Krugman, 1985) with that of Brainard (1993) and Markusen, Venables (1995) in a simple dynamic setting. The former approach focuses on the geographical separation of headquarters and production facilities among countries whereas the latter is based on a trade-off between proximity to the market and economies of scale at the plant and the firm level. Especially, this trade-off is extended to an investment decision where exporting firms may invest abroad to increase future profits by economising on transportation costs. The main findings can be summarised in the following points.

Under restrictive, but plausible conditions, there exists a steady state equilibrium, where firms develop new brands at a constant rate of growth and existing firms switch from exports to production abroad at the same constant rate even with factor prices equalised. So trade in goods and the number of multinationals firms grow complementarily at the same rate with multinationals substituting part of goods trade but generating additional intrafirm trade.

If the countries are equally endowed there will be both multinationals which engage in intrafirm trade and as well exporting firms engaging in goods trade. This rationalises the widely observed two-way pattern of trade and multinational activity between equally endowed trading partners. For countries with different factor endowments but similar size, trade and multinational activity gets an additional endowment basis as the country relatively better endowed with skilled labour has both more brands developed and more headquarters of multinational firms. It may become a net importer of final products but run a surplus in intrafirm trade.

In the presence of transportation costs market size matters and the larger country tends to be net exporter of brands (Krugman, 1980). Thus trade needs not be balanced. If international trade in assets is feasible, factor price equalisation is nonetheless possible as that country which runs a trade surplus may finance product development abroad and receives future profits from these brands. If the countries differ in size but not in factor proportions, the number of multinational firms tends to be the same in each country implying that the larger country relies relatively more on developing and producing brands for domestic consumption and on exports.

The welfare effects of multinationals are not well understood as the reference scenario in the absence of multinationals is usually not specified. The analysis presented here has investigated the welfare effects of both countries reducing the share of multinationals reciprocally and exogenously by a small positive number. Although it is not possible in this model to derive a general conclusion, the welfare analysis reveals some important aspects. First, multinationals play a role in transferring know-how and the growth and welfare effects of multinational firms depend crucially on this. Secondly, as stetting up plants requires resources which can, in this setting, also be employed in the development and set up of production facilities of new brands, the growth rate with multinational firms may be lower than that without. Opposed to this dynamic welfare loss there is, however, a static welfare gain form multinationals (level effect) since multinationals economise on transportation costs. It is shown that the static welfare gain may outweigh a possible dynamic welfare loss if consumers do not give to much weight to the future and if the effect on the growth rate (depending on the shares of the two investment activities in total investment) is not too high. Furthermore, it is demonstrated that both countries -the small and the large one- will participate in welfare gains or losses from multinationals to the same extent.

References

Brainard, S.L., 1993, A Simple Theory of Multinational Corporations with a Trade-off between Proximity and Concentration, NBER-Working paper 4269

Dinopolous, E., Oehmke, J.F., Segerstrom, P.S., 1993, High-Technology Trade and Investment, *Journal of International Economics* 34, 49-71

Dixit, A., Stiglitz, J.E., 1977, Monopolistic Competition and Optimum Product Diversity, *American Economic Review* 67, 297-308

Dixit, Norman, 1980, Theory of International Trade, Cambridge University Press.

Grossman, G.M., Helpman, E., 1989, Product Development and International Trade, *Journal of Political Economy*, 97 (6), p. 1261-283

Grossman, G.M., Helpman, E., 1991, Innovation and Growth in a Global Economy, MIT-Press, Cambridge, Mass.

Helpman, E., 1984, A Simple Theory of International Trade with Multinational Corporations, *Journal of Political Economy*, 92(3), 451-471

Helpman, E., 1985, Multinational Corporations and Trade Structure, *Review of Economic Studies* LII (3), No. 170, p.443-457

Helpman, Krugman, 1985, Market Structure and Foreign Trade, MIT - Press, Cambridge, Mass.

Horstmann, I.J., Markusen, J.R., 1992, Endogenous Market Structures in International Trade (natura facit saltum), *Journal of International Economics,* 32, 109-129

Krugman, P., 1980, Scale Economies, Product Differentiation, and the Pattern of Trade, *American Economic Review* 70, 950-959

Krugman, P., 1981, Intraindustry Specialisation and the Gains from Trade, *Journal of Political Economy* 89, 959-973

Lancaster, K. 1980, Intra-Industry Trade under Perfect Monopolistic Competition, *Journal of International Economics* 10, 151-175

Markusen, J.R., 1995, The Boundaries of Multinational Enterprises and the Theory of International Trade, *Journal of Economic Perspectives* 9, 169-189

Markusen, J.R., Venables, A.J., 1995, Multinational Firms and the New Trade Theory, NBER-Working paper 5036.

Wong, K-Y., 1995, International Trade in Goods and Factor Mobility, MIT-Press, Cambridge Mass.

Appendix

The following notation is used: $\Delta n = n - N, \Delta m = m - M, \Delta h = h - H, \Delta l = l - L, \overline{h} = h - \frac{a_{Hs}}{a_{Ls}} l$. The resource constraints for unskilled labour can be written as:

(A1.1) $a_{Ls} s[n\phi - \Delta m] = l$

(A1.2) $a_{Ls} s[N\Phi + \Delta m] = L$

Note that (A1.1) and (A1.2) aggregate to the world resource constraint given in (13.1). Substituting (A1.1) and (A1.2) in the resource constraints for skilled labour results in:

(A3.1) $a_{Hs} s n\phi + \frac{g a_{HR} n\phi}{\widetilde{n}\left(1+\varphi^{-\beta}\right)} = h$

(A3.2) $a_{Hs} s N\Phi + \frac{g a_{HR} N\Phi}{\widetilde{n}\left(1+\varphi^{-\beta}\right)} = H$

(A4.1) $\frac{g a_{HR} n\phi}{\widetilde{n}\left(1+\varphi^{-\beta}\right)} = \overline{h} - a_{Hs} s \Delta m$

(A4.2) $\frac{g a_{HR} N\Phi}{\widetilde{n}\left(1+\varphi^{-\beta}\right)} = \overline{H} + a_{Hs} s \Delta m$

Using $\frac{g a_{HR} \widetilde{\phi}}{\left(1+\varphi^{-\beta}\right)} = \widetilde{\overline{h}}$ as well as $s = \frac{\widetilde{l}}{a_{Ls} \widetilde{n} \widetilde{\phi}}$ simplifies (A4.1) and (A4.2) to

(A4.1') $n\phi = \frac{\widetilde{n}\widetilde{\phi}}{\widetilde{\overline{h}}}\left(\overline{h} - \frac{a_{Hs}}{a_{Ls}\widetilde{n}\widetilde{\phi}} \widetilde{l} \Delta m\right)$

(A4.2') $N\Phi = \frac{\widetilde{n}\widetilde{\phi}}{\widetilde{\overline{h}}}\left(\overline{H} + \frac{a_{Hs}}{a_{Ls}\widetilde{n}\widetilde{\phi}} \widetilde{l} \Delta m\right)$

In the next step take the difference of (A.1.1) and (A.1.2) and that between (A4.1') and (A4.2).

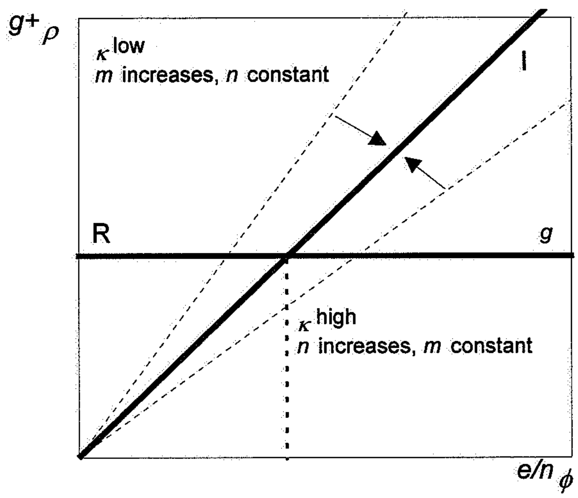
(A5.1) $\Delta(n\phi) - 2\Delta m = \frac{\Delta l \widetilde{\phi} \widetilde{n}}{\widetilde{l}}$

(A5.2) $\Delta(n\phi) = \left(1 + \varphi^{-\beta}\right)\Delta n + \left(1 - \varphi^{-\beta}\right)\Delta m = \frac{\widetilde{n}\widetilde{\phi}}{\widetilde{\overline{h}}}\left(\Delta\overline{h} - 2\frac{a_{Hs}}{a_{Ls}\widetilde{n}\widetilde{\phi}} \widetilde{l} \Delta m\right) \Rightarrow$

(A6.1) $\frac{\Delta m}{\widetilde{n}\widetilde{\phi}} = \frac{1}{2}\left[\frac{\Delta \overline{h}}{\widetilde{\overline{h}}} - \frac{\Delta l}{\widetilde{l}}\right]$

(A6.2) $\frac{\Delta n}{\widetilde{n}\widetilde{\phi}} = \frac{\Delta \overline{h}}{2\widetilde{\overline{h}}} + \frac{\left(1-\varphi^{-\beta}\right)}{\left(1+\varphi^{-\beta}\right)} \frac{\Delta l}{2\widetilde{l}}$

Figure 1


g+ ρ
κ low
m increases, n constant
I
R
g
κ high
n increases, m constant
e/n φ

Medieninhaber (Verleger), Hersteller: Österreichisches Institut für Wirtschaftsforschung • Wien 3, Arsenal, Objekt 20 • A-1103 Wien, Postfach 91 • Tel. (43 1) 798 26 01-0 • Fax (43 1) 798 93 86 • Verlags- und Herstellungsort: Wien

Verkaufspreis: S 100,–.