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## The Home Market Shadow

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January 2005

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Discussion Paper No. 1462  
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## ABSTRACT

### The Home Market Shadow<sup>\*</sup>

The home market effect (HME) is a distinguishing feature of the “new” theory of international trade, but it is uncertain whether this effect survives if one moves beyond the simplifying setup with only two countries. We present a three-country version of the seminal model by Krugman (1980) and analyse under which circumstances the HME is present once third country effects are taken into account. We show that an exogenous increase in the home country’s expenditure level on the modern good will unambiguously lead to an over-proportional output reaction. If production in the foreign world shifts from a more remote to a better accessible economy, industry location in the home country is negatively affected. Thus, if the expenditure increase is small relative to the foreign expenditure shifting, an under-proportional output reaction in the home country can result. In a more extreme case the industry share of the home country can even decrease. This phenomenon is labelled the “home market shadow”.

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Keywords: new trade theory, home market effect, hub effect

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## 1) Introduction

There are two principal theories of international trade. The “old” neoclassical approach with perfect competition and constant returns to scale focuses on differences in tastes, technology and endowments to explain the pattern of trade flows across countries, whereas the “new trade theory” (Krugman, 1980) stresses the role of increasing returns, imperfect competition and product differentiation. A distinguishing feature of the “new trade theory” is the *home market effect* (HME). The handiest definition of the HME has been provided by Helpman and Krugman (1985). In their well known two-country, two-sector model they show that the larger country will have a world production share of the modern (increasing returns) good that exceeds its world expenditure share, thus making the larger country a net exporter of this good.<sup>1</sup> In a dynamic interpretation, an increase in the expenditure share should therefore result in an over-proportional increase in the production share if the HME is present. But the effect is only properly worked out in a two-country model so far. Such models are very common and it has been proven many times that most of the fundamental insights of international trade theory also carry over to realistic models with more countries.

Recently, however, it has been argued that matters might be more complicated when it comes to the HME. Head and Mayer (2004) point out that it is even difficult to properly define this effect in a context with more than two countries, let alone the question whether the results of Krugman (1980) and Helpman and Krugman (1985) can be generalized to a multi-country setting. This uncertainty is mostly due to *third country effects*. Behrens, Lamorgese, Ottaviano and Tabuchi (2004) [henceforth labelled as BLOT], who develop an M-country version of the model by Krugman (1980), point out that

*“The HME itself may not arise in a multi-country setting [...] This is due to the fact that, once ‘third country effects’ are taken into account, an increase in one country’s expenditure share may well map into a less than proportionate increase in its output share as other countries ‘drain away’ some firms. In more extreme cases, an increase in the expenditure share may even lead to a decrease in industry share (‘HME shadow’).” (BLOT, 2004: p. 5)*

More precisely, BLOT show that an increase in the expenditure share of some country  $i$  (that we might label the “home country”) on the modern good can map into an under-proportional increase or even a decrease in its world production share (the so-called “home market

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<sup>1</sup> Trionfetti (2001) and Davis and Weinstein (2003) have shown that the HME is not present in traditional trade models à la Heckscher-Ohlin or Ricardo. The HME has therefore proved to be a prominent criterion in empirical research to discriminate between the relative explanatory power of the “new” versus the “old” theory of international trade (see Davis and Weinstein 1999, 2003; Brühlhart and Trionfetti, 2004; Head and Mayer, 2004).

shadow”). This can occur if there is a parallel perturbation in the expenditure shares of the other countries and if “geography matters” in the sense that not all countries are equally well accessible. However, they do not provide an analysis about the conditions under which the HME holds, but suffice with pointing out that it is not generally present in a multi-country world.

The purpose of this paper is to show under which circumstances there is a HME and under which there is none. For reasons of transparency we will use the simplest possible model to make our point, namely a three-country version of Krugman (1980). Three-country models are of growing popularity in trade theory and have been used to address a number of related issues. Yet, the fundamental question under which circumstances the HME is present has not yet been analysed. Baldwin and Venables (1995) show that under monopolistic competition and increasing returns the formation of an integration agreement between two countries tends to favour industry location in the bloc to the disadvantage of the outside country. The attractiveness of “transportation hubs” as production locations has been emphasised by Krugman (1993). He shows that if one country offers better (economic) accessibility than the other two, it will host a larger industry share even if all countries are of equal size. Baldwin et al. (2003:ch. 14) study preferential trading agreements (PTAs) with a slightly different set-up, namely a three-country version of the “footloose capital model” initially due to Martin and Rogers (1995). They verify the result of Baldwin and Venables (1995) while showing that economic integration can also magnify spatial inequalities inside the bloc if the trade integrating regions are of different size and/or if one country is a “hub”. This corroborates the findings of Puga and Venables (1997), who study PTAs in a setup that is closer to the “new economic geography” since it allows for endogenous agglomeration forces due to factor mobility.

In our three-country model we explicitly derive the conditions for the pervasiveness of the HME. We call one economy the “home country”, whereas the other two form the “foreign world”. Since Helpman and Krugman (1985) have defined the HME in terms of expenditure and production *shares*, we analyse under which conditions an increase in the former maps into an (over-proportional) increase of the latter for the home country, taking into account parallel developments in the foreign world (“third country effects”). Thinking only in terms of shares is problematic, however, since one can not thoroughly disentangle how these changes are

brought about.<sup>2</sup> We will therefore refer to the corresponding expenditure *levels* and disentangle two separate effects that need to be distinguished clearly.

On the one hand, we show that if there is only an exogenous increase in the expenditure level of the home country, holding constant the levels of the foreign countries, then the HME will always be present. On the other hand, the equilibrium industry share of the home country declines when expenditure in the outside world shifts from a more remote to a better accessible country, even when the expenditure level and the expenditure share of the home country remain constant. In distinguishing these two separate types of changes, which can not be disentangled if one only looks at general perturbations in expenditure *shares*, we show that the HME will only be present if the increase in the home country's expenditure level is sufficiently large to overcompensate negative effects on its output share that result from an expenditure shifting in the foreign world. If the expenditure increase is sufficiently small relative to the third country effects, the home country will even experience a decrease in its production share. This phenomenon is then due to the fact that the home country is located in the "home market shadow" of another, well accessible economy.

## 2) The Model

Consider a world consisting of three countries  $i=1,2,3$ . Each country is populated with  $L_i$  individuals, who inelastically supply one unit of labour. The world population has the size  $\bar{L} = L_1 + L_2 + L_3$ . Labour is the only factor of production and immobile across countries. There are two sectors in each country. In the "traditional sector", a homogenous good is produced under perfect competition and constant returns such that one unit of labour is transformed into one unit of output. The good is freely tradable across countries, hence the law of one price holds. The price of this good is the numéraire and normalized to unity. Thus, if this sector is active in all countries (which we will assume below to obtain an interior equilibrium) we will have factor price equalization and the wage is equal to one everywhere. The "modern" Dixit-Stiglitz sector manufactures a large variety of differentiated products. Each variety is produced by a single firm under increasing returns to scale. Any firm faces a fixed and a variable labour input requirement. The sector is monopolistically competitive, but profits for any firm are equal to zero due to the potential entry of competitors. The amount of firms and

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<sup>2</sup> An expenditure share by definition can change due to an increase if the home country's expenditure level, holding constant the levels of the other countries. But it can also change without any change in the own expenditure level if there are increases or decreases in expenditure in the foreign world. These different reasons for changes in shares are crucial for our argument, and therefore we will explicitly pay attention to expenditure levels. BLOT only argue in terms of expenditure shares to begin with.

varieties is denoted by  $\bar{N} = n_1 + n_2 + n_3$ , where  $n_1 - n_3$  will be endogenously determined. Transportation across countries is subject to the usual “iceberg” costs, where  $\tau_{ij} > 1$  units have to be dispatched in country i in order for one unit to arrive in country j.

## 2.1. Demand and supply

The (homogenous) preferences of the representative consumer in country i are described by the following utility function

$$U_i = X_i^\mu \cdot H_i^{1-\mu} \quad 0 < \mu < 1 \quad (1)$$

where  $H_i$  denotes the homogenous good and  $X_i$  the differentiated consumption aggregate, which is of a CES form.

$$X_i = \left[ \int_{\omega=1}^N x_i(\omega)^{(\sigma-1)/\sigma} \cdot d\omega \right]^{\sigma/(\sigma-1)} \quad (2)$$

The parameter  $\sigma > 1$  measures the own price elasticity and the elasticity of substitution between any pair of differentiated varieties. As it is widely known, this preference structure yields the following aggregate demand from country j for a variety produced in country i

$$x_{ij} = \frac{p_{ij}^{-\sigma}}{P_j^{1-\sigma}} \cdot \mu \cdot E_j \quad (3)$$

$p_{ij}$  is the delivered price in country j (inclusive trade costs),  $E_j$  is the aggregate consumption expenditure in country j and  $P_j$  is the standard CES price index

$$P_j = \left( \sum_i n_i \cdot p_{ij}^{1-\sigma} \right)^{1/(1-\sigma)} \quad (4)$$

A firm must ship  $\tau_{ij}x_{ij}$  units in order for  $x_{ij}$  units to arrive in country j. Taking into account (3) and the fixed and variable input requirements  $F$  and  $c$ , respectively, the profit function for a typical firm in country i is



$$\pi_i = \sum_j \left[ (p_{ij} - c \cdot \tau_{ij}) \cdot \frac{p_{ij}^{-\sigma}}{P_j^{1-\sigma}} \cdot \mu \cdot E_j \right] - F \quad (5)$$

Maximizing (5) with respect to  $p_{ij}$ , taking  $P_j$  as given due to the absence of strategic price setting in this Chamberlinian model of monopolistic competition,<sup>3</sup> yields the familiar pricing rule

$$p_{ij} = \frac{\sigma}{\sigma - 1} \cdot c \cdot \tau_{ij} \quad (6)$$

Inserting (6) in (5) and applying the zero profit condition we find that the equilibrium firm scale in any country is given by

$$x_i = \sum_j \tau_{ij} \cdot x_{ij} = \frac{F(\sigma - 1)}{c} \quad \text{for } i=1,2,3 \quad (7)$$

Using (3), (6) and the fact that  $E_j = L_j$  in any interior equilibrium with factor price equalization, the three equilibrium conditions that are entailed in (7) can also be written as

$$\sum_j \left[ \frac{\phi_{ij} L_j}{\sum_k \phi_{kj} \cdot n_k} \right] = \frac{\sigma F}{\mu} \quad \text{for } i=1,2,3 \quad (8)$$

where  $\phi_{ij} \equiv \tau_{ij}^{1-\sigma} \in [0,1]$  is the usual measure of trade freeness (or, trade “phi-ness”) between countries  $i$  and  $j$ . Multiplying (8) by  $n_i$  and summing across the three countries, we can derive the total number of firms in the modern sector,  $\bar{N} = \mu \bar{L} / F \sigma$ . Finally we express the equilibrium conditions in terms of the expenditure (population) shares  $\theta_i = E_i / \bar{E} = L_i / \bar{L}$ , where  $\bar{E} = \bar{L}$ , and in terms of the production shares,  $\lambda_i = n_i / \bar{N}$ . We obtain

$$\sum_j \left[ \frac{\phi_{ij} \theta_j}{\sum_k \phi_{kj} \cdot \lambda_k} \right] = 1 \quad \text{for } i=1,2,3 \quad (9)$$

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<sup>3</sup> Head, Mayer and Ries (2002) show that the Dixit-Stiglitz setup, which abstracts from strategic interactions between firms, is not crucial for generating the HME. The effect is also present in other models of imperfect competition with variable price-cost mark-ups. However, the analysis of Head, Mayer and Ries (2002) is also restricted to the two-country case.

Referring to the definition of Head and Mayer (2004), the left-hand side of (9) can be understood as the *real market potential* (RMP) of country  $i$ , given the distribution of expenditure (the  $\theta_j$ 's), and the accessibility of the countries (the  $\phi_{ij}$ 's). The three equilibrium conditions in (9) are thus implying that in an interior equilibrium with  $0 < \lambda_i^* < 1$  for  $i=1,2,3$  the RMP of all three countries must be equalized. Note that the  $\theta_i$ 's and the  $\phi_{ij}$ 's are exogenously given, whereas the output shares  $\{\lambda_1, \lambda_2, \lambda_3\}$  are the endogenous variables.

## 2.2. General equilibrium

Using (9), the equilibrium output share of the home country can be written in the following form

$$\lambda_1^* = I_{11}\theta_1 + I_{21}\theta_2 + I_{31}\theta_3 \quad (10)$$

We call  $I_{ji}$  the “impact factor” that depicts the effects of country  $j$ 's size on industry location in country  $i$ . The impact factors depend on the bilateral levels of trade freeness (“geography”) only and can be computed as

$$I_{11} = \frac{f_{11}}{f_{11} + f_{12} + f_{13}} = \frac{1 - (\phi_{23})^2}{1 - \phi_{12} - \phi_{13} + \phi_{12}\phi_{23} + \phi_{13}\phi_{23} - (\phi_{23})^2} \quad (11)$$

$$I_{21} = \frac{f_{12}}{f_{21} + f_{22} + f_{23}} = \frac{-(\phi_{12} - \phi_{13}\phi_{23})}{1 - \phi_{12} + \phi_{12}\phi_{13} - (\phi_{13})^2 - \phi_{23} + \phi_{23}\phi_{13}} \quad (12)$$

$$I_{31} = \frac{f_{13}}{f_{31} + f_{32} + f_{33}} = \frac{-(\phi_{13} - \phi_{12}\phi_{23})}{1 - (\phi_{12})^2 + \phi_{12}\phi_{13} - \phi_{13} - \phi_{23} + \phi_{23}\phi_{12}} \quad (13)$$

In the equations (11)-(13),  $f_{ij}$  is the cofactor  $ij$  of the general trade cost matrix  $\Phi$  that has the following form in our three-country setup with  $\phi_{ij} = \phi_{ji}$  and  $\phi_{ii} = 1$

$$\Phi = \begin{bmatrix} 1 & \phi_{12} & \phi_{13} \\ \phi_{12} & 1 & \phi_{23} \\ \phi_{13} & \phi_{23} & 1 \end{bmatrix} \quad (14)$$

The equilibrium values of  $\lambda_2^*$  and  $\lambda_3^*$  can be computed in an analogous way.

### 2.3. The home market effect (HME)

To analyse the HME in the definition of Helpman and Krugman (1985), we are interested in the effect of an increase in  $\theta_i$  on  $\lambda_1^*$ . To this end, we totally differentiate (10) and obtain

$$d\lambda_1^* = I_{11} \cdot d\theta_1 + I_{21} \cdot d\theta_2 + I_{31} \cdot d\theta_3 \quad (15)$$

It will turn out to be crucial not only to think in terms of the expenditure *shares*, but also in terms of the expenditure levels  $E_i = L_i$ . To do so, note that by the definition of  $\theta_i$  we have

$$d\theta_1 = \left( \frac{E_2 + E_3}{\bar{E}^2} \right) dE_1 - \left( \frac{E_1}{\bar{E}^2} \right) (dE_2 + dE_3) \quad (16)$$

$$d\theta_2 = \left( \frac{E_1 + E_3}{\bar{E}^2} \right) dE_2 - \left( \frac{E_2}{\bar{E}^2} \right) (dE_1 + dE_3) \quad (17)$$

$$d\theta_3 = \left( \frac{E_1 + E_2}{\bar{E}^2} \right) dE_3 - \left( \frac{E_3}{\bar{E}^2} \right) (dE_1 + dE_2) \quad (18)$$

Using (16)-(18) in (15), the change in  $\lambda_1^*$  can be written as

$$d\lambda_1^* = \frac{1}{\bar{E}^2} \left[ \begin{aligned} &I_{11} \left( (E_2 + E_3) dE_1 - E_1 (dE_2 + dE_3) \right) + \\ &I_{21} \left( (E_1 + E_3) dE_2 - E_2 (dE_1 + dE_3) \right) + \\ &I_{31} \left( (E_1 + E_2) dE_3 - E_3 (dE_1 + dE_2) \right) \end{aligned} \right] \quad (19)$$

We now make two additional assumptions and look at a specific situation, namely that all three countries initially have the same (expenditure) size ( $E_1 = E_2 = E_3 = E$ ). Moreover, to properly disentangle “third country-effects” we impose  $dE_2 = -dE_3 = d\tilde{E}$ . That is, we consider an expenditure *shifting* in the foreign world (in levels) from country 2 to country 3. Using these assumptions, (19) simplifies to

$$d\lambda_1^* = \frac{E}{\bar{E}^2} \left[ (2I_{11} - I_{21} - I_{31}) dE_1 + 3(I_{21} - I_{31}) d\tilde{E} \right] \quad (20)$$

or equivalently,

$$\frac{d\lambda_1^*}{d\theta_1} = \left( I_{11} - \frac{1}{2}I_{21} - \frac{1}{2}I_{31} \right) - \left[ \frac{3(I_{31} - I_{21})}{2 \cdot dE_1} \right] d\tilde{E} \quad (21)$$

At this point we need to analyse the signs of the impact factors  $I_{11}$ ,  $I_{21}$  and  $I_{31}$ .<sup>4</sup> In their general M-country model, BLOT have shown that (i) the trade cost matrix  $\Phi$  will be positive definite, and (ii) that a necessary condition for an interior equilibrium with  $0 < \lambda_i^* < 1$  to arise is that  $\varphi_i > \theta_i$  for  $i=1,2,3$ , where  $\varphi_i$  is the sum of the  $i^{\text{th}}$  row elements of the inverse matrix  $\varphi = \Phi^{-1}$ . Using these properties, we can derive a number of results summarized in the following lemma.

**Lemma 1: Impact factors**

- (i) The impact factor  $I_{11}$  is strictly positive.
- (ii) At most one impact factor  $I_{21}$  or  $I_{31}$  can be positive. At least one of the two impact factors  $\{I_{21}, I_{31}\}$  is strictly negative.
- (iii) The sum of the foreign impact factors ( $I_{21}+I_{31}$ ) is always strictly negative. Hence,  $2I_{11}-(I_{21}+I_{31})$  must be strictly positive.
- (iv) If  $\phi_{12} > \phi_{13}$ , i.e. if country 2 is better accessible than country 3 from the point of view of the home country, we have  $I_{31} > I_{21}$ . By part (ii) of this lemma, it must thus be true that  $I_{21} < 0$ . Vice versa, if  $\phi_{12} < \phi_{13}$ , we have that  $I_{21} > I_{31}$  and  $I_{31} < 0$ . If  $\phi_{12} = \phi_{13}$ , then  $I_{21}=I_{31}<0$ .

**Proof:** See Appendix.

We can now pin down under which circumstances there will be a “home market shadow” ( $d\lambda_1^*/d\theta_1 < 0$ ) and in which cases there will be an over-proportional output expansion following an increase in the home country’s expenditure share. Dealing first with the “home market shadow”, equation (21) is positive if and only if

$$dE_1 > \frac{3(I_{31} - I_{21})}{2I_{11} - I_{21} - I_{31}} d\tilde{E} \quad (22)$$

Condition (22), which requires the result  $2I_{11} - (I_{21} + I_{31}) > 0$ , rules out the possibility that the industry share in the home country declines after an increase in the expenditure share. Yet, it does not establish the HME. For the validity of the HME we need

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<sup>4</sup> Since the impact factors depend on transportation costs only, the following results are independent of the assumption that  $E_1=E_2=E_3=E$ .

$$\frac{d\lambda_1^*}{d\theta_1} \cdot \frac{\theta_1}{\lambda_1^*} > 1 \Leftrightarrow \frac{d\lambda_1^*}{d\theta_1} > \frac{\lambda_1^*}{\theta_1} \quad (23)$$

Using (10) and the fact that in the initial situation we have  $\theta_1=\theta_2=\theta_3$ , we can derive that  $\lambda_1^*/\theta_1 = I_{11} + I_{21} + I_{31}$ . Thus, the condition for the pervasiveness of the HME is

$$I_{11} - \frac{1}{2}I_{21} - \frac{1}{2}I_{31} - \left[ \frac{3(I_{31} - I_{21})}{2 \cdot dE_1} \right] d\tilde{E} > I_{11} + I_{21} + I_{31}$$

which can be written in a simpler form as

$$dE_1 > \frac{(I_{21} - I_{31})}{(I_{21} + I_{31})} d\tilde{E} \quad (24)$$

Note that we have used  $(I_{21} + I_{31}) < 0$  in this derivation. With (22) and (24) we readily have

**Proposition 1: Exogenous increase in home expenditure**

If there is no expenditure shift in the foreign world ( $d\tilde{E} = 0$ ) and/or if bilateral trade costs are pairwise symmetric ( $\phi_{12} = \phi_{13} = \phi_{23} = \phi$ ), then the HME will always hold, i.e.  $(d\lambda_1^*/d\theta_1) > \lambda_1^*/\theta_1 > 0$ .

**Proof**

With pairwise symmetric trade costs,  $I_{21} = I_{31} = \phi/(\phi-1) < 0$ . Conditions (22) and (24) reduce to  $dE_1 > 0$ , which must be satisfied for any  $(d\lambda_1^*/d\theta_1) > 0$ . The expressions (22) and (24) also reduce to  $dE_1 > 0$  if  $d\tilde{E} = 0$ .  $\square$

This proposition highlights the crucial importance of “third country effects” and the role of geography for the potential non-validity of the HME. If there is an exogenous increase in the expenditure level of the home country and just an automatic adjustment of all foreign expenditure shares, there will always be a HME. An expenditure shifting is also harmless for the output share of the home country if the foreign countries are equally well accessible. However, in the next section we will show that this no longer holds if accessibility matters from the point of view of the home country.

## 2.4. Expenditure shifting in the foreign world

We now assume that country 2 is better accessible than country 3 from the point of view of the home country. That is, we assume  $\phi_{12} > \phi_{13}$ . Using lemma 1, we know that in this case we have  $I_{31} > I_{21}$ . Consider a pure shift in the expenditure level from country 3 to country 2 ( $d\tilde{E} > 0$ ), whereas the expenditure level of the home country (and also its expenditure share  $\theta_1$ ) remains constant ( $dE_1 = 0$ ). By (20), the effect of this expenditure shifting in the foreign world on the equilibrium industry share in the home country is given by

$$d\lambda_1^* = \frac{(I_{21} - I_{31})}{\bar{E}} d\tilde{E} < 0 \quad (25)$$

In the other case with  $\phi_{13} > \phi_{12}$ , we have that  $d\lambda_1^* > 0$  if  $d\tilde{E} > 0$  and  $d\lambda_1^* < 0$  if  $d\tilde{E} < 0$ . This gives rise to an important insight

### Theorem:

An expenditure shifting in the foreign world towards (away from) a better accessible country negatively (positively) affects the equilibrium industry share in the home country,  $\lambda_1^*$

Note that this theorem does not depend on  $\phi_{23}$ . If  $\phi_{13} < \phi_{12}$  and also  $\phi_{13} < \phi_{23}$ , then country 2 would be a so-called “transportation hub”, since it is better accessible than any other country in this world. One can show that with equal country sizes the economy 2 would host the largest industry share in an initial equilibrium, which corroborates the “hub effect” argument of Krugman (1993). Trade integration with the hub country, i.e. falling values of  $\phi_{12}$  and  $\phi_{23}$ , would magnify the spatial disparities across countries (“magnification effect”) as argued by Baldwin et al. (2003: ch. 14). Yet, as long as we have an interior equilibrium with some modern production in every country, it is important to observe that the direction of the impact of  $d\tilde{E}$  on the industry share  $\lambda_1^*$  does not depend on  $\phi_{23}$ .

Combining the insights of this paper, conditions (22) and (24) set lower bounds for the magnitude of  $dE_1$  relative to the expenditure shifting  $d\tilde{E}$  in order to rule out the “home market shadow” and, respectively, to guarantee the validity of the HME. With  $\phi_{12} > \phi_{13}$ , the coefficients on the right hand sides of the two inequalities are both positive. Furthermore, condition (24) is more stringent than condition (22), i.e.

$$\frac{I_{21} - I_{31}}{I_{21} + I_{31}} > \frac{3(I_{31} - I_{21})}{2I_{11} - I_{21} - I_{31}} \quad (26)$$

To see this suppose (26) were not true, but we would have  $2I_{11} - I_{21} - I_{31} < -3(I_{21} + I_{31})$ . This inequality can be rewritten as  $(I_{11} + I_{21} + I_{31}) = \lambda_1^* / \theta_1 < 0$ , which is a contradiction. For any given magnitude of  $d\tilde{E}$  the exogenous increase in the home country expenditure level  $dE_1$  must be larger to obtain an over-proportional increase of  $\lambda_1^*$  than to merely prevent a decrease in  $\lambda_1^*$ .

## 2.5. Expenditure increase in the foreign world

A final illustrative case is the effect of an exogenous increase in the expenditure level (or size) of one foreign country, say country 2, on the equilibrium industry share of the home country. Using (19) with the assumption of equal initial size of all three economies, the effect of  $dE_2 > 0$  on  $\lambda_1^*$  is easily derived as

$$d\lambda_1^* = \frac{E}{\tilde{E}^2} [(2I_{21} - I_{11} - I_{31})] dE_2 \quad (27)$$

The sign of (27) depends on the term  $(2I_{21} - I_{11} - I_{31})$ . From lemma 1 we know that  $I_{11}$  is positive and either  $I_{21}$  or  $I_{31}$  or both are negative. Furthermore we know that if  $\phi_2 > \phi_3$  it will be true that  $I_{31} > I_{21}$  and  $I_{21} < 0$ . Therefore,  $d\lambda_1^*$  will always be negative in this case. An exogenous expenditure increase makes country 2 more attractive in terms of its market potential, thereby draining away the modern sector from the home country. An inspection of (27) reveals that the effect is more adverse the freer trade with country 2 (the more negative  $I_{21}$ ). What happens in the case when country 2 is more remote for the home country than country 3 ( $\phi_2 < \phi_3$ )? From the above theorem we know that an expenditure shifting from country 3 to country 2 has a positive impact on  $\lambda_1^*$ . The intuition is that the domestic industry is better sheltered from competition if economic activity shifts to a more remote country. However, in the case with an exogenous increase of  $E_2$  the home country now simply faces competition from a larger number of firms, even though they are located in a remote country. It is therefore implausible to expect a positive impact on  $\lambda_1^*$ . Formally, with  $\phi_2 < \phi_3$ , it is guaranteed that  $I_{11} > 0$ ,  $I_{31} < 0$  and  $I_{21} > I_{31}$ , whereas the sign of  $I_{21}$  is uncertain. The sign of  $(2I_{21} - I_{11} - I_{31})$  is thus

also ambiguous, especially in the case where  $I_{21} > 0$ .<sup>5</sup> However, by tedious calculations it is possible to show that  $(2I_{21} - I_{11} - I_{31}) > 0$  interferes with the restrictions that must hold for an interior equilibrium with  $\lambda_j^* > 0$  for  $j=1,2,3$ . Hence, an exogenous increase in the size of a foreign country always has a negative impact on the industry share of the home country, although it is less negative than in the case with  $\phi_{13} < \phi_{12}$ .

### 3) Conclusion

In this paper we have presented a three-country version of model by Krugman (1980). Compared to the two-country setup in this seminal paper, we have shown that the home market effect (which is a distinguishing feature of the “new trade theory”) does not always arise if third country effects occur parallel to an exogenous increase in the home country’s size. The equilibrium industry share in “home” is negatively affected if economic activity in the foreign world shifts from a more remote to a better accessible country. To compensate this effect, the increase in “home’s” spending on the modern good must be sufficiently strong to actually see an over-proportional output reaction. In an extreme case, the industry share in the home country can even decline despite an increase in the expenditure level. This occurs if there is a strong shift in economic activity in the foreign world from a more remote towards a better accessible country. In this case the home country suffers, because it is located in the “home market shadow” of the other economy.

That the home market effect does not easily generalize from a two-country model to a more realistic setting has already been pointed out by Behrens, Lamorgese, Ottaviano and Tabuchi (2004). By explicitly disentangling two separate types of changes, an increase in the expenditure level and a foreign expenditure shifting, the main contribution of this paper is to show more clearly *why* this is the case and under which conditions we can actually expect to see the home market effect in a multi-country world.

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<sup>5</sup> A foreign impact factor  $I_{21} > 0$  implies a (hypothetical) positive impact of an exogenous increase in the foreign expenditure share  $\theta_2$  on  $\lambda_1^*$ . However, a world expenditure share can not exogenously increase with all other shares remaining constant. This again clarifies why arguing only in terms of shares can be misleading.



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## Appendix: Proof of Lemma 1

BLOT have shown that the trade cost matrix  $\Phi$  is positive definite if distance is measured by an Euclidian norm (see their appendix 3), hence the determinant  $|\Phi|$  is strictly positive. They furthermore show that a condition for an interior equilibrium is factor price equalization (FPE) across countries, which arises if the labour demand in the modern sector does not exceed the inelastic total labour supply in every country. They derive a necessary and sufficient condition for an interior equilibrium with some strictly positive value of  $\lambda_i^*$  for every country. Adjusted for our three-country case, this condition reads as

$$\theta_i > \mu \sum_{j=1}^3 \frac{f_{ij}}{f_{1j} + f_{2j} + f_{3j}} \theta_j = \mu \cdot \lambda_i^* \quad \text{for } i=1,2,3$$

The share  $\mu$  of the modern good must be sufficiently small. This entails the (weaker) necessary condition for an interior equilibrium with FPE

$$\theta_i < \varphi_i \equiv \frac{f_{i1} + f_{i2} + f_{i3}}{|\Phi|} \quad \text{for } i=1,2,3 \quad (28)$$

Taking into account that  $|\Phi| > 0$ , we can infer from (28) that it must be true that

$$f_{i1} + f_{i2} + f_{i3} > 0 \quad \text{for } i=1,2,3 \quad (29)$$

Therefore, by equations (11)-(13), the signs of the impact factors  $I_{11}$ ,  $I_{21}$  and  $I_{31}$  are determined only by the signs of the cofactors  $f_{11}$ ,  $f_{12}$  and  $f_{13}$ , respectively. We now prove the four parts of lemma 1 one after the other.

- (i) Since  $f_{11} = 1 - (\phi_{23})^2 > 0$ , we have  $I_{11} > 0$ .
- (ii) Both  $f_{12} = \phi_{13}\phi_{23} - \phi_{12}$  and  $f_{13} = \phi_{12}\phi_{23} - \phi_{13}$  can be either positive or negative. But if  $f_{12} > 0$ , i.e. if  $\phi_{12}/\phi_{13} < \phi_{23}$ , then it can not be true that  $f_{13} > 0$ , i.e.  $\phi_{13}/\phi_{12} < \phi_{23}$ , since  $0 < \phi_{23} < 1$  by definition. Hence, either both  $I_{21}$  and  $I_{31}$  are negative, or at most one of the two is positive.

- (iii) The sum  $(I_{21} + I_{31}) = f_{12}/(f_{12} + f_{22} + f_{23}) + f_{13}/(f_{13} + f_{23} + f_{33})$  can be written as

$$\frac{\phi_{13}\phi_{23} - \phi_{12}}{(\phi_{13} - 1)(\phi_{23} + \phi_{12} - \phi_{13} - 1)} + \frac{\phi_{12}\phi_{23} - \phi_{13}}{(\phi_{12} - 1)(\phi_{23} - \phi_{12} + \phi_{13} - 1)} \quad (30)$$

The denominators of both terms are positive, which implies that  $|\phi_{12} - \phi_{13}| < (1 - \phi_{23})$ . Moreover, we know from part (ii) that at least one enumerator must be negative (if both enumerators are negative,  $(I_{21} + I_{31}) < 0$  follows directly).

Suppose without loss of generality that  $f_{13} > 0$ , i.e.  $\phi_{12}\phi_{23} > \phi_{13}$ . Since  $0 < \phi_{23} < 1$ , it follows that  $\phi_{12} > \phi_{13}$  must be true in this case. Taking everything together, it is not possible that expression (30) is positive, because the denominator of the first term must be smaller than the denominator of the second term, and because  $|\phi_{13}\phi_{23} - \phi_{12}|$  must be larger than  $(\phi_{12}\phi_{23} - \phi_{13})$  if  $\phi_{12}\phi_{23} > \phi_{13}$ . An analogous argument applies if we assume that  $f_{12} > 0$  and  $f_{13} < 0$ . Hence,  $(I_{21} + I_{31})$  is always strictly negative.

- (iv) If  $\phi_{12} > \phi_{13}$ , then the impact factor  $I_{21} = [\phi_{13}\phi_{23} - \phi_{12}] / [(\phi_{13} - 1)(\phi_{23} + \phi_{12} - \phi_{13} - 1)]$  is always strictly negative. In the case with  $I_{31} > 0$ , the result  $I_{31} > I_{21}$  follows directly. We must therefore show that  $I_{31}$  can not be stronger negative than  $I_{21}$ . Considering

$$I_{31} = \frac{\phi_{12}\phi_{23} - \phi_{13}}{(\phi_{12} - 1)(\phi_{23} - \phi_{12} + \phi_{13} - 1)} \quad (31)$$

one can see that the numerator of  $I_{21}$  is stronger negative than the numerator of  $I_{31}$ , since  $(\phi_{12}\phi_{23} - \phi_{13}) < (\phi_{13}\phi_{23} - \phi_{12}) < 0$  would contradict with  $\phi_{12} > \phi_{13}$ . Moreover, the (positive) denominator of  $I_{21}$  is smaller than the (positive) denominator of  $I_{31}$ . Hence,  $I_{31}$  is always larger than  $I_{21}$ .