On the Pervasiveness of Home Market Effects

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Abstract

Krugman's model of trade between two countries of unequal size predicts that the country with the relatively large number of consumers is the net exporter and host of a disproportionate share of firms in the differentiated good sector. He terms these results "home market effects." This paper analyzes two models that offer alternatives to Krugman's assumptions of Dixit-Stiglitz monopolistic competition with iceberg transport costs. Using a framework of location choice, we generate strikingly similar results for the three models. The common ingredients of these imperfect competition models are trade costs and increasing returns to scale.

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1 Introduction

Does a large home market confer an advantage to the firms that produce there? Krugman's trade model of monopolistic competition yields two related predictions regarding the effects of market size asymmetries on the geographic distribution of industry activity. First, Krugman (1980) demonstrates that the country with the larger number of consumers of an industry's goods will run a trade surplus in that industry. Further development of the model in Helpman and Krugman (1985) shows that a country's share of firms is a linear function of its share of consumers with a slope exceeding one. Helpman and Krugman (1985, p. 209) recognize that their demonstration of these so-called home market effects relies on specific functional form assumptions—Dixit-Stiglitz preferences, firms that are small relative to the size of the market, "iceberg" transport costs—but suggest that the results may well have greater generality:

> We have been able to work only with a highly specialized example; it is probable, however that "home market effects" of the kind we have illustrated here are actually quite pervasive.

This paper explores the pervasiveness of home market effects and the conditions that give rise to them by analyzing three models of imperfect competition: the Krugman model as formulated in Helpman and Krugman (1985); the monopolistic competition model of Ottaviano and Thisse (1998); and the Cournot, segmented markets model analyzed in Brander and Krugman (1983). The addition of the latter two models offers alternatives to Helpman and Krugman's assumptions on the nature of demand, product market competition, and trade costs.

We find strikingly similar results across the three models. First, the share of firms in each country is a linear function of its share of consumers in all three models, with the slope of the line being greater than one. Second, each implies a positive relationship between net exports and the share of consumers. Thus, all three exhibit home market effects.

Determining whether home market effects generalize beyond Helpman and Krugman's "example" is important for three reasons. First, if home market effects are pervasive in models with increasing returns and transport costs, then they can be used as a means to discriminate empirically against alternate models based on constant or decreasing returns. This line of reasoning has been pursued in empirical work by Davis and Weinstein (1998, 1999). Second, as Krugman (1980) shows, imposing balanced trade in equilibrium on industries that would otherwise exhibit home market effects requires the small country to have lower factor prices. This raises the concern that a trade liberalization with a larger partner might lower wages in the small country. Finally, to the extent that workers *are* better off in the larger market, there will tend to be a cumulative process of migration leading to the "core-periphery" pattern described in Krugman (1991).

A recent literature investigates the robustness of home market effects in the Krugman model to alternative modeling assumptions. Davis (1998) examines whether Helpman and Krugman's assumption of zero transport costs in the perfectly competitive homogeneous goods sector is necessary. He finds that the home market effect disappears when there are large transportation costs in the homogeneous sector. Head and Ries (1999) show that if each individual variety demanded by consumers can only be produced in its nation of origin, then a reverse home market effect obtains where the small demand country is the net exporter. Feenstra, Markusen and Rose (1998) develop a Cournot, segmented markets framework with homogeneous goods, free entry, and consumers with Cobb-Douglas utility. They demonstrate a home market effect by starting from symmetric demand and cost conditions and showing that reallocation of demand to one country makes that country become a net exporter. They also show that the result depends crucially on assumptions about entry. If the number of firms is set equal to one in each country, reverse home market effects occur.

Our objective is to provide an integrated derivation of home market effects in the Helpman-Krugman, Ottaviano-Thisse, and Brander-Krugman models. The following section lists the common elements of the models and develops a general framework for deriving home market effects in terms of firms' location decisions. It focuses on the tradeoff between the advantage of locating close to customers and the disadvantage of proximity to competitors. We derive the equilibrium share of firms and net exports for each of the three models in sections 3, 4, and 5. Section 6 expresses the home market effects that arise in the models in terms of figures showing the relation between a country's share of consumers and its share of firms as well as its trade balance. The conclusion discusses the ingredients required to generate home market effects.

2 A General Framework

We consider a two-stage game where firms first locate a single plant in one of two countries (indexed H for home and F for foreign) and then choose prices (Helpman-Krugman and Ottaviano-Thisse) or outputs (Brander-Krugman). The analysis will focus on how a country's share of consumers influences its equilibrium distribution of firms and trade balance in an industry. We employ a common notation in analyzing the three models:

- M = total number of identical consumers.
- x = share of the consumers residing in country H.
- N = total number of firms.
- s = share of firms locating in country H.
- τ = transportation costs of the iceberg or per-unit form.
- ω = constant marginal costs of production.

- K = plant-level fixed cost.

In assuming that marginal costs, ω, are exogenous and equal, we follow Helpman and Krugman in allowing only differences in demand to affect the trade pattern. Thus, our analysis focuses on the effects of changes in demand while *holding other things equal.* The implicit assumptions are a perfectly elastic supply of factors to the industry and that free trade in other goods equalizes factor prices in the two countries.[1]

We also assume that plant-level fixed costs, K, are high enough to ensure that each firm chooses to produce in only one of the two markets. Without this assumption, firms could serve each market with a local plant and the relative size of the two markets would not affect the distribution of plants.

We analyze each model from the perspective of the representative firm's location decision. First we determine the prospective profits in the two locations as a function of the share of firms, s, and the share of demand, x. Then we examine the *difference in profits equation* which can be represented with the following linear approximation of the gain in profits from choosing country H over F:

$$\Delta\pi(s,x) \equiv \pi_H(s,x) - \pi_F(s,x) = cs + dx + e, \tag{1}$$

We will show that coefficient d, which we term the "demand effect," is positive. Firms prefer to economize on transportation costs by locating in the larger market. Coefficient c, the "competition effect," is negative: firms prefer to avoid spatial proximity with their competitors. *Ceteris paribus*, an increase in the number of firms in country H diminishes its relative attractiveness by lowering quantity sold and, in some models, lowering the price. $\Delta\pi(s,x)$ is linear in its two arguments in the Ottaviano-Thisse model as well as the Brander-Krugman model but it is

[1]The exogeneity assumption precludes feedback from location choices or trade balances into factor prices. The equality assumption simplifies the analytical results. Head and Ries (1999) show that home market effects obtain in the Helpman-Krugman model for any given value of relative marginal costs.

nonlinear in the Helpman-Krugman model. In order to encompass all three models, we define the competition effect and the demand effect of location choice as

$$c = \frac{\partial \Delta\pi(s, x)}{\partial s} \quad \text{and} \quad d = \frac{\partial \Delta\pi(s, x)}{\partial x}.$$

The distribution of demand and firms are offsetting terms in the location choice decision that occurs in the first stage of the game. The key to understanding the home market effect is to recognize that the demand effect must dominate the competition effect to generate the home market effect. We establish this result by solving for the interior equilibrium share of firms s which sets $\Delta\pi(s, x) = 0$ to obtain the *share equation* relating equilibrium s to x. For any functional form of $\Delta\pi(s, x)$, the implicit function theorem can be used to show that the slope of this equation at the equilibrium is given by $d/(-c)$. Whenever $d > -c$ the slope exceeds one. In this case, the large country's share of firms exceeds its share of consumers and the home market effect identified in Helpman and Krugman (1985) obtains.

In all three models analyzed in this paper the share equation is linear:

$$s = g + hx. \tag{2}$$

Given the symmetry we impose, $s = 1/2$ when $x = 1/2$. Therefore when $h = d/(-c) > 1$, it must also be that $g = e/(-c) < 0$. Thus, an important corollary of the slope exceeding one is that there will be a critical level of the share of demand that, if exceeded, causes all firms to concentrate in one country. Specifically, all firms locate in H when $x \geq (1 - g)/h$ whereas all firms will locate in F when $x \leq -g/h$. Over those ranges, the slope of the share equation is zero.

The original formulation of the home market effect in Krugman (1980) is that countries are net exporters of the product for which they have a relatively high demand. To explore this formulation of the home market effect in the three models, we calculate the equilibrium *trade balance equation* as

$$B = N(sq_{HF} - (1-s)q_{FH}),$$

where q_{ij} are exports from country i to country j. A home market effect occurs when net exports are increasing in x.

The following three sections analyze the difference in profits, share, and trade balance equations for the imperfect competition models of Helpman and Krugman (1985), Ottaviano and Thisse (1998), and Brander and Krugman (1983). In evaluating the equations, we will find it useful to assume parameter values such that consumers in each country purchase from all firms. Thus, firms in either country find it profitable to export to consumers in the other country. Following terminology in the spatial competition literature (Anderson, de Palma and Thisse, 1992, p. 334), we refer to this as the *overlapping markets condition.* For brevity and clarity, these sections exclude most of the computations that generate the equations. For each model, we present the demand system and firm profit functions and then analyze the three equations of interest. The appendix provides the full set of equilibrium prices and outputs for each model.

3 CES Monopolistic Competition (Helpman-Krugman)

We begin with a model derived from the widely used Dixit and Stiglitz (1977) monopolistic competition framework, applied by Krugman (1980) to international trade. Our treatment follows that of Helpman and Krugman (1985) except that we obtain our solution by equating profits in the two locations rather than assuming that free-entry sets profits equal to zero in both countries.

Each of the identical M consumers has an expenditure on the differentiated good normalized as 1. Consumer preferences exhibit a constant elasticity of substitution, σ, between varieties. The market demand functions from countries F and H for a representative variety produced in each country are given by:

$$q_{HH} = \frac{p_{HH}^{-\sigma}}{P_H^{1-\sigma}} xM, \quad q_{HF} = \frac{p_{HF}^{-\sigma}}{P_F^{1-\sigma}}(1-x)M\tau, \quad q_{FF} = \frac{p_{FF}^{-\sigma}}{P_F^{1-\sigma}}(1-x)M, \quad q_{FH} = \frac{p_{FH}^{-\sigma}}{P_H^{1-\sigma}} xM\tau, \tag{3}$$

where p_{ij} is the delivered price to consumers in j for varieties produced in i and P_j is the price index for market j:

$$P_j \equiv \left(sNp_{Hj}^{1-\sigma} + (1-s)Np_{Fj}^{1-\sigma} \right)^{1/(1-\sigma)}.$$

Cross-border trade entails an "iceberg" transport cost. For each unit consumed, the consumer must order $\tau > 1$ units since a share $\tau - 1$ of the units "melt" en route. The trade flows above, q_{HF} and q_{FH}, correspond to the amount produced for export to the foreign market and the amount produced abroad for import.

The representative firm located in each country has profits of

$$\pi_H = (p_{HH} - \omega)q_{HH} + (p_{HF}/\tau - \omega)q_{HF} - K \quad \text{and} \quad \pi_F = (p_{FF} - \omega)q_{FF} + (p_{FH}/\tau - \omega)q_{FH} - K.$$

In monopolistic competition models, the firm maximizes profits taking P_F and P_H as given. Solving for optimal prices and making substitutions back into the profit equation we obtain the difference in profits as

$$\Delta\pi = \frac{M}{\sigma N} \left[\frac{s(\rho - 1) - \rho + x(\rho + 1)}{s(1-\rho)(1-s) + \frac{\rho}{1-\rho}} \right], \tag{4}$$

where $\rho \equiv \tau^{1-\sigma} < 1$. The competition effect, c, and demand effect, d, are shown below:

$$c = -\frac{M(1-\rho)^2}{\sigma N}\left[\frac{x}{[s(1-\rho)+\rho]^2} + \frac{(1-x)}{[s(\rho-1)+1]^2}\right] < 0, \qquad d = \frac{M(1+\rho)}{\sigma N\left[s(1-\rho)(1-s)+\frac{\rho}{1-\rho}\right]} > 0.$$

Thus, firms prefer the number of competitors to be low in their location and the demand to be high. Setting the difference in profits to zero in order to find the location equilibrium of the game, we obtain

$$s = -\frac{\rho}{1-\rho} + \frac{1+\rho}{1-\rho}x. \tag{5}$$

Since $0 < \rho < 1$, $h = (1+\rho)/(1-\rho) > 1$ and $g < 0$. Denote $p = \sigma\omega/(\sigma-1)$ as the mill price. Then we can express the trade balance as

$$B = \frac{M}{p}[s-x] = \frac{M}{p}\left[\frac{\rho(2x-1)}{1-\rho}\right].$$

Net exports are therefore a linear function of x, positive for $x > 1/2$ and negative for $x < 1/2$. The derivative of the trade balance with respect to x can be expressed as

$$\frac{\partial B}{\partial x} = (M/p)\left(\frac{\partial s}{\partial x} - 1\right)$$

For interior equilibria, $\frac{\partial s}{\partial x} = h > 1$ and $\frac{\partial B}{\partial x} > 0$. When all firms are located in a single country ($s = 0$ or $s = 1$), $\frac{\partial s}{\partial x} = 0$ and the derivative $\frac{\partial B}{\partial x}$ is negative. Intuitively, when production is totally concentrated in the large country, trade occurs in a single direction. A reallocation of consumers to the large country reduces exports, resulting in decreases of the trade balance.

4 Linear Monopolistic Competition (Ottaviano-Thisse)

The model of monopolistic competition presented by Ottaviano and Thisse (1998) builds on a different specification of utility, the quadratic utility form, which yields individual linear demand functions. As shown in the appendix, we can choose units so as to reduce the number of parameters in the individual demand curve to just θ, a measure of substitutability between varieties analogous to σ in the Helpman-Krugman model. Scaling up individual demand curves to obtain each market's demand for each variety, we obtain

$$q_{HH} = xM(1 - (1 + \theta N)p_{HH} + \theta P_H) \quad \text{and} \quad q_{HF} = (1 - x)M(1 - (1 + \theta N)p_{HF} + \theta P_F),$$

$$q_{FF} = (1 - x)M(1 - (1 + \theta N)p_{FF} + \theta P_F) \quad \text{and} \quad q_{FH} = xM(1 - (1 + \theta N)p_{FH} + \theta P_H),$$

with $P_j = N[sp_{Hj} + (1 - s)p_{Fj}]$. The iceberg assumption is replaced with constant per-unit transport costs. Profits are given by

$$\pi_H = (p_{HH} - \omega)q_{HH} + (p_{HF} - \omega - \tau)q_{HF} - K \quad \text{and} \quad \pi_F = (p_{FF} - \omega)q_{FF} + (p_{FH} - \omega - \tau)q_{FH} - K.$$

As with the Dixit-Stiglitz model, firms choose prices to maximize their profits while neglecting the effect of individual price changes on the price index P_j. Unlike the Helpman-Krugman model, it matters in the Ottaviano-Thisse framework whether price discrimination is permitted.[2] We work here with the model in which firms can set different prices for each market. The resulting prices in this model, in contrast to Dixit-Stiglitz, have the desirable feature that they are affected by the number of firms and their location choices.

[2]The firms in Helpman-Krugman perceive the same elasticity of demand in each market and set export prices (net of transport costs) equal to their domestic prices.

After solving for prices and quantities, the difference in profits equation is given by

$$\Delta\pi = \frac{(1+\theta N)\tau M}{2(2+\theta N)}\left[-\tau\theta N s + (2(1-\omega)-\tau)2x - 2 + \frac{\tau}{2}(2+\theta N) + 2\omega\right]. \tag{6}$$

The competition effect is clearly negative, i.e. $c < 0$. We can sign the demand effect by making use of our maintained assumption of overlapping markets. In order for the export price to cover transport costs and marginal costs, then it must be that $\tau(2+\theta N) < 2(1-\omega)$. The overlapping markets condition guarantees $d > 0$.

For the location equilibrium, we obtain

$$s = -\frac{2(1-\omega)-(2+\theta N)\tau/2}{\tau\theta N} + \frac{2(2(1-\omega)-\tau)}{\tau\theta N}x. \tag{7}$$

The overlapping markets condition is also sufficient to guarantee $h > 1$ and $g < 0$. Indeed, the condition is sufficient to set $h > 4$.

Net exports are

$$B = \frac{NM(1+\theta N)}{2(2+\theta N)}[2(1-\omega-\tau)(s-x) + s(1-s)N\theta\tau(2x-1)].$$

Note that $B = 0$ if $x = 1/2$; trade is balanced when countries are of equal size. When the majority of consumers is located in H, we know from the derivations above that the share of firms in H exceeds the share of consumers ($s > x$). Hence all terms are positive and the large country is a net exporter of the product. Conversely, when $x < 1/2$, we have in equilibrium $s < x$ and thus H is a net importer of the good when it has a smaller share of consumers than F.

Taking derivatives with respect to x yields

$$\frac{\partial B}{\partial x} = \frac{NM(1+\theta N)}{2(2+\theta N)} \left\{ 2(1-\omega-\tau)\left(\frac{\partial s}{\partial x} - 1\right) + N\theta\tau \left[2s(1-s) - \frac{\partial s}{\partial x}(1-2s)(1-2x) \right] \right\}$$

When firms concentrate in one country ($s = 1$ or $s = 0$) $\frac{\partial s}{\partial x} = 0$ and the derivative is negative. For interior values of s, $\frac{\partial s}{\partial x} = h > 1$ and the only negative term in the expression is $-h(1-2s)(1-2x)$. To sign the derivative for interior values of s, first consider values in the range $1/2 \leq x \leq (1-g)/h$. The term $(1-2s)(1-2x)$ is uniformly increasing in both s and x. Note also that the only other term in the expression that is a function of x, $s(1-s)$, is at its lowest value (zero) when $s = 1$. Thus, if the derivative is positive when s reaches 1, it will be positive for all $x \geq 1/2$ for all interior equilibria. We therefore substitute $x = (1-g)/h$ into the preceding equation where $s = 1$ to obtain

$$\frac{\partial B}{\partial x} = \frac{NM(1+\theta N)}{2(2+\theta N)} [2(1-\omega-\tau)(h-1) + N\theta\tau(h+2g-2)].$$

Equation (7) implies that $h + 2g = 1$, yielding

$$\frac{\partial B}{\partial x} = \frac{NM(1+\theta N)}{2(2+\theta N)} [2(1-\omega-\tau)(h-1) - N\theta\tau].$$

The overlapping markets condition, $\tau\theta N < (1-\omega-\tau)$, implies $h > 4$ and establishes that net exports are monotonically increasing in x for $1/2 \leq x \leq (1-g)/h$. In our two-country model, the large country's trade surplus is the small country's trade deficit. This implies that the derivative is also positive for $-g/h \leq x \leq 1/2$.

The analysis in this section shows that the assumptions of CES preferences and iceberg transport costs, which Helpman and Krugman acknowledged were chosen for analytical convenience rather than realism, are not important in generating home market effects. We now make a more radical change in assumptions: we abandon monopolistic competition and its assumptions of differentiated products and firms that believe they are too small to affect the market price indexes.

5 Cournot oligopoly (Brander-Krugman)

We assume that each of M identical consumers have individual demand curves given by $1 - P_i$.[3] This implies market demand curves of

$$Q_F = (1 - x)M(1 - P_F) \quad \text{and} \quad Q_H = xM(1 - P_H).$$

Q_i is the total quantity sold to consumers in country i consisting of quantities produced by identical firms located in country F (q_{Fi}) and country H (q_{Hi}). The profit equations are the same as in the previous model. We also allow for price discrimination in the sense that firms choose amounts to ship to each market independently and therefore the export price (net of transport costs) need not equal the price charged to the domestic consumers. This *segmented markets* assumption is necessary to obtain overlapping markets in the homogeneous goods Cournot model. Also, unlike the monopolistic competition models, firms in Brander-Krugman recognize in their maximization problems the impact of their actions on market prices. After solving for equilibrium quantities and prices, the difference in profits can be expressed as

$$\Delta\pi = \frac{2M\tau}{N+1} \left\{ -N\tau s + 2\left[1 - \omega - \tau/2\right] x - \left[1 - \omega - (N+1)\tau/2\right] \right\}. \tag{8}$$

As with Ottaviano-Thisse's model, the competition effect under Cournot is negative and proportional to τ^2. The higher are transport costs, the more important it is to avoid locating near

[3]As detailed in the appendix, with the appropriate choice of units for prices and quantities, this can represent any linear demand function.

one's competitors. A sufficient condition for the demand effect, d, to be positive is overlapping markets condition: $\tau(N+1) < (1-\omega)$.

Setting equation (8) equal to zero and solving for an interior s yields

$$s = -\frac{1-\omega-(N+1)\tau/2}{N\tau} + \frac{2(1-\omega-\tau/2)}{N\tau}x. \tag{9}$$

A home market effect, $h > 1$ and $g < 0$, will obtain whenever the market overlapping condition holds. Indeed, that condition is sufficient to set $h > 2$.

The balance of trade is given by

$$B = \frac{NM}{N+1}[(1-\omega-\tau)(s-x) + s(1-s)N\tau(2x-1)].$$

Again, as in the other models, trade is balanced when $x = 1/2$. Market size asymmetries result in the large country being a net exporter of the industry's goods. The derivative of the net export equation is

$$\frac{\partial B}{\partial x} = \frac{NM}{N+1}\left\{(1-\omega-\tau)\left(\frac{\partial s}{\partial x}-1\right) + N\tau[2s(1-s) - \frac{\partial s}{\partial x}(1-2s)(1-2x)]\right\}.$$

As before, the slope is negative when $s = 1$ or $s = 0$. To sign the derivative for interior values of s we following the approach we employed in investigating this derivative in the Ottaviano-Thisse model. Namely, we evaluate the expression at $x = (1-g)/h$, the value of x where the derivative is smallest for $1/2 \leq x \leq (1-g)/h$. This yields

$$\frac{\partial B}{\partial x} = \frac{NM}{N+1}[(1-\omega-\tau)(h-1) + N\tau(h+2g-2)].$$

Equation (9) gives $h + 2g = 1$, and thus

$$\frac{\partial B}{\partial x} = \frac{NM}{N+1}[(1-\omega-\tau)(h-1) - N\tau]$$

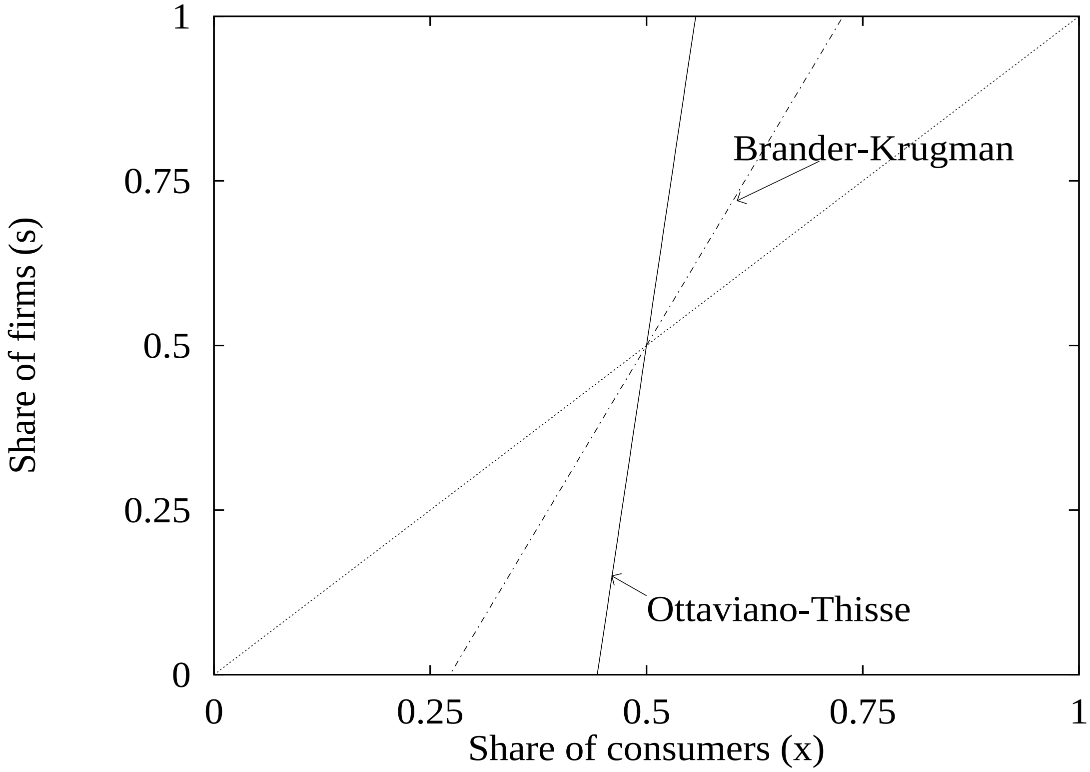
The overlapping markets condition, $\tau(N+1) < (1-\omega)$, yields $h > 2$ and is sufficient to establish that the derivative is positive. Thus, we demonstrate that net exports are uniformly increasing in x for $(1-g)/h \geq x \geq 1/2$. As is the case for the Ottaviano-Thisse model, symmetry implies that the derivative is also positive for $-g/h \leq x \leq 1/2$.

6 Unifying Figures

In this section, we present graphs of the share equation and trade balance equation for the Ottaviano-Thisse and Brander-Krugman models. To do so, we choose common parameter values $M = 1$, $\omega = 0.4$, $\tau = 0.1$, and $N = 5$. These parameters make the overlapping market condition bind at $s = 0$ and $s = 1$. As a result, they lead to the smallest home market effect h that is consistent with overlapping markets. We also must select a value for θ in Ottaviano-Thisse model. We set $\theta = 0.5$ as the authors show that this is the maximum value of this parameter consistent with "love of variety" (see appendix). Recall that in our representation of the demand systems of the Ottaviano-Thisse and Brander-Krugman models, we chose price and output units to normalize coefficients to one. When plotting the relationships, we adjust units in Brander-Krugman to make the two models comparable. We omit the Helpman-Krugman relationships because of the problem of selecting comparable parameter values. The shapes of the Helpman-Krugman equations resemble the plots of the Ottaviano-Thisse model.

All three models have in common the feature that the share of firms is a linear function of the share of demand with a slope greater than one and a negative intercept. Since there cannot be negative shares or shares greater than one, this implies that globally s is a piecewise linear

Figure 1: Share of firms plotted against share of consumers in country H

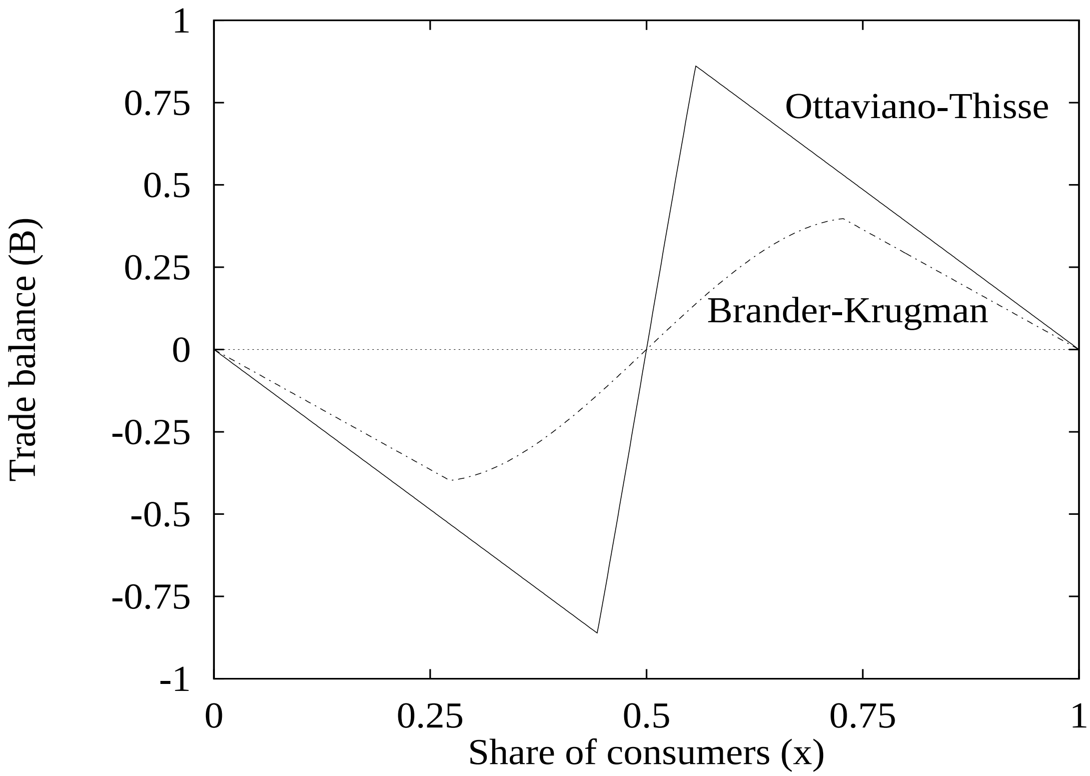


function of x:

$$s = \begin{cases} 0 & \text{if } x < -g/h \\ 1 & \text{if } x > (1-g)/h \\ g + hx & \text{otherwise} \end{cases} \tag{10}$$

Figure 1 plots the relationship between the home country's share of firms and its share of consumers for the Brander-Krugman and Ottaviano-Thisse models. The 45-degree line in Figure 1 indicates the values for which the distribution of firms mimics the distribution of consumers. The piecewise linear relationship is apparent as is the result that there are ranges of high and low values of x where firms completely concentrate in a single country. As can be seen in Figure 1, the home market effect in Ottaviano-Thisse is much more pronounced than that in Brander-Krugman (a slope of 8.8 versus 2.2). This is related to the trade-off between demand and competition effects discussed in the general framework section. Competition is

Figure 2: Net exports of country H plotted against share of consumers in country H



fiercer in Brander-Krugman because firms produce identical products. This results in a much lower coefficient h.

Figure 2 plots the trade balance against the share of consumers in country H. The upward sloping sections of the lines represent ranges of x where, in equilibrium, firms locate in both countries. This demonstrates the home market effect in terms of the relationship between net exports and country size. When production concentrates completely in the large country, the slope is negative. As described previously, in this situation trade occurs in a single direction and shifting consumers to the large country reduces its exports.

A common feature of all three models is that the slope of the share equation flattens as transport costs rise. A smaller slope in this equation implies lower trade balances in the net exports equation. In the Ottaviano-Thisse and Brander-Krugman models, an increase in the number of firms also flattens the slope of the share equation (the slope is independent of N in the case of Helpman-Krugman). Together, these last two observations imply that increases in trade barriers and competition tend to dampen home market effects.

7 Conclusion

The analysis shows that three alternative models of imperfect competition yield remarkably similar predictions regarding the effects of market size asymmetries on a country's share of firms and its net exports. These effects are known as home market effects. Using a location choice framework, we argue that home market effects emerge when the positive demand effect from locating in the larger of two markets overwhelms the negative competition effect of having more firms nearby.

We show that several assumptions that Helpman and Krugman justified on the grounds of tractability rather than realism, are not necessary conditions for their results. First, product differentiation is not required since the homogeneous goods Brander-Krugman model exhibits home market effects. Second, we show that the result is also robust to relaxing the Helpman-Krugman assumptions of transport costs of the iceberg form. Finally, we find that home market effects do not hinge on the Dixit-Stiglitz model's lack of price responsiveness to the proximity of competitors.

The common set of ingredients in the three models suggest the underlying sources of home market effects. One ingredient is *trade costs*. Firms economize on trade costs by locating in proximity to consumers. Interestingly, even though positive trade costs are essential to home market effects, a reduction in these costs makes the home market effect more pronounced. A second key ingredient is *increasing returns*; plant-level fixed costs compel firms to choose between one location and the other. Trade costs and increasing returns combine to create a force that encourages firms to locate in the large market. The exact model of imperfect competition appears to matter very little.

Appendix: Additional material used in proofs

The body of the paper does not report intermediate steps in the derivation of the difference in profits, share, and trade balance equations. This appendix lists the reduced-form equilibrium prices and output equations for each model as well as other information used in the derivation of the three equations of interest.

Helpman-Krugman

Helpman and Krugman's model assumes that the representative consumer has a utility function of

$$U = D_0^{\alpha} \left(\sum_{k=1}^{N} D_k^{\frac{\sigma-1}{\sigma}} \right)^{\frac{(1-\alpha)\sigma}{\sigma-1}}$$

Maximization subject to an income of y results in the consumer spending $(1-\alpha)y$ on varieties $k = 1$ to N with the share spent on each variety given by $p_k^{1-\sigma} / \sum_{\ell=1}^{N} p_\ell^{1-\sigma}$. We normalize $(1-\alpha)y = 1$ in order to pose the model in terms of M consumers who spend one dollar each on the differentiated product sector.

Using demand and profit functions given in section 3, we find the usual optimal price for each producer: $p_{ij} = \sigma\omega\tau_{ij}/(\sigma-1)$ with $\tau_{ij} = 1$ for $i = j$ and $\tau_{ij} = \tau$ for $i \neq j$. Let $p \equiv \sigma\omega/(\sigma-1)$ and $\rho \equiv \tau^{1-\sigma}$. Plugging into the quantities equations you get the following equilibrium quantities:

$$q_{HF} = \frac{\rho}{s\rho + (1-s)} \frac{(1-x)M}{Np} \quad \text{and} \quad q_{FF} = \frac{1}{s\rho + (1-s)} \frac{(1-x)M}{Np}$$

$$q_{FH} = \frac{\rho}{s + (1-s)\rho} \frac{xM}{Np} \quad \text{and} \quad q_{HH} = \frac{1}{s + (1-s)\rho} \frac{xM}{Np}$$

Ottaviano-Thisse

Let individual consumption of variety k be given by $D(k)$. The Ottaviano-Thisse utility function for the representative consumer is given by

$$U = D_0 + \alpha \int_0^N D(k)dk - (\beta/2) \int_0^N D(k)^2 dk - \gamma \int_0^N \int_0^N D(k)D(\ell)dkd\ell,$$

where there are N varieties and D_0 is consumption of the numeraire good. Ottaviano and Thisse (1999) derive the standard demand curves for these preferences for the representative individual as

$$D(k) = \frac{\alpha}{\beta + N\gamma} - \frac{1}{\beta + N\gamma} p(k) + \frac{\gamma}{\beta(\beta + N\gamma)} \int_0^N [p(\ell) - p(k)]d\ell.$$

We choose to measure quantities in units of $\alpha/(\beta+N\gamma)$ and prices in units $1/\alpha$. After redefining D and p in terms of these new units, we re-express the demand curve as

$$D(k) = 1 - p(k) + \theta \int_0^N [p(\ell) - p(k)]d\ell,$$

where $\theta \equiv \gamma/\beta$. The demand equation in the body of the paper is obtained by rearranging, imposing symmetry, and substituting in the formula for the price index. Ottaviano and Thisse (1999) show that for the consumer to weakly prefer q units of N different varieties to Nq units of a single variety for all N, it must be the case that $\beta \geq 2\gamma$. Thus, for preferences to exhibit a weak "love of variety" it must be the case that $\theta \leq 1/2$.

Using demand and profit functions, the equilibrium prices and quantities can be shown to be equal in this model to:

$$p_{FF} = \frac{2(1+\omega(1+\theta N)) + \tau\theta s N}{2(2+\theta N)} \quad \text{and} \quad p_{HH} = \frac{2(1+\omega(1+\theta N)) + \tau\theta(1-s) N}{2(2+\theta N)}$$

$$p_{FH} = p_{HH} + \tau/2 \quad \text{and} \quad p_{HF} = p_{FF} + \tau/2$$

$$q_{HH} = (p_{HH} - \omega)(1+\theta N), \quad \text{and} \quad q_{FF} = (p_{FF} - \omega)(1+\theta N)$$

$$q_{HF} = (p_{HF} - \omega - \tau)(1+\theta N), \quad \text{and} \quad q_{FH} = (p_{FH} - \omega - \tau)(1+\theta N)$$

The overlapping markets condition can therefore be stated as $\tau < \frac{2(1-\omega)}{2+\theta N}$. This ensures that $(p_{ij} - \omega - \tau)$ is positive and independent of the geographic distribution of firms, thereby guarantying that both exports and price net of transport and production costs are positive.

Brander-Krugman

The preferences for Brander-Krugman may be obtained as a restricted form of those for Ottaviano-Thisse. The assumption is that a single variety, D_1, is produced and that $\gamma = 0$. In that case the representative consumer's utility function is

$$U = D_0 + \alpha D_1 - (\beta/2) D_1^2.$$

This implies a standard demand curve of $D_1 = \alpha/\beta - P/\alpha$. We now choose to measure quantities in units of α/β and prices in units of $1/\alpha$. This gives rise to the individual demand curved invoked in the text of $D_1 = 1 - P$. Note that while we measure Brander-Krugman and Ottaviano-Thisse prices in the same units, the units for quantity are larger in Brander-Krugman. Hence, whenever we want to compare results involving quantities across the two models, we scale up Brander-Krugman results by factor $1 + \theta N$.

Solving for equilibrium quantities in the Cournot subgame yields the following shipments to each market for a firm deciding to locate in country F:

$$q_{FF} = \frac{(1-x)M(1-\omega+sN\tau)}{(N+1)}, \quad q_{FH} = \frac{xM(1-\omega-\tau-sN\tau)}{(N+1)}. \tag{11}$$

Equilibrium quantities shipped to each market by a firm producing in country H are given by

$$q_{HH} = \frac{xM(1-\omega+(1-s)N\tau)}{(N+1)} \quad q_{HF} = \frac{(1-x)M(1-\omega-\tau-(1-s)N\tau)}{(N+1)}. \tag{12}$$

Equilibrium prices are thus decreasing functions of the number of firms in the considered country :

$$P_H = \frac{1+N(\omega+(1-s)\tau)}{N+1} \quad \text{and} \quad P_F = \frac{1+N(\omega+s\tau)}{N+1}.$$

The overlapping markets condition, $\tau(N+1) < (1-\omega)$, can be obtained by setting $q_{FH} = 0$ at $s = 1$.

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