

# The Home Market Effect and the Agricultural Sector <sup>\*</sup>

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April 23, 2005

## Abstract

The “home market effect” (HME) is an essential topic within the new trade theory. Assuming that transport costs exist only for manufactured goods, Krugman (1980) shows that the country with the larger market size is a net exporter. Davis (1998) finds that the assumption of free transport of the agricultural good is not innocuous, and indeed matters a great deal. However, we find that the homogeneous-agricultural-good assumption in Davis’ model yields the discontinuity of inverse demand functions, which causes the disappearance of the HME. Assuming two differentiated agricultural goods in two countries, we establish an analytically solvable model and show that the HME does exist even if the transport cost of the agricultural goods is positive. (*JEL* F1, R1)

*Keywords:* home market effect, agricultural sector, market size, industrial structure, trade cost.

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<sup>\*</sup>The first author acknowledges financial support from the Japan Society for the Promotion of Science, Grant-in-Aid for Science Research 14730017 and 13851002. The second author is grateful to the Ministry of Education, Culture, Sports, Science and Technology of Japan for support of the 21st Century Center of Excellence Project. Both authors thank F. Dei, M. Fujita, S.-I. Mun, N. Schmitt and T. Tabuchi for helpful comments and discussions.

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# 1 Introduction

Based on a model of increasing returns to scale, Krugman (1980) finds that a country with relatively larger local demand succeeds in attracting a more-than-proportionate share of firms in a monopolistically competitive industry. This is called the home market effect (HME) in the literature. As explained in Hanson and Xiang (2004, P. 1109), the home market effect implies a link between a country's market size and its exports that does not exist in trade models that are based solely on comparative advantage. The HME has become a standard element of the "new trade theory" (Brühlhart, 1998).

Helpman and Krugman (1985) reformulated the model of Krugman (1980) and confirmed the HME. In their model, there are two countries and each country has two sectors: the manufacturing sector produces a differentiated product, and the agricultural sector produces a homogeneous product. To make the model tractable, they assume that the homogeneous product is costlessly tradable and both countries produce it after trade. However, Davis (1998) finds that the assumption of zero transport costs for the homogeneous good is consequential. Specifically, if the transport costs for the homogeneous good are the same as the transport costs for the manufactured goods, then the HME disappears. In Davis' framework, the transport costs for the homogeneous good are large enough to preempt the trade of the homogeneous good. Furthermore, firms contemplating a shift in differentiated-goods production from the "proportional equilibrium" toward the larger market will find it unprofitable to do so (Davis, 1998, p. 1265). Davis' model has been further extended by Yu (2005), who assumes there is no trade of the homogeneous good. Yu uses a CES function to replace the Cobb-Douglas function in the models of Krugman and Davis finds that the HME of the production structure can arise, disappear, or even reverse in sign, depending on the demand elasticity of substitution between the homogeneous good and the manufactured goods. The intuition is that the elasticity of substitution determines the relative share of expenditure on the differentiated goods and, hence, the distribution of the manufacturing industry (Yu, 2005, p. 256).

Contrary to the results of Davis (1998), other papers find that the HME is pervasive.

Empirically, Davis and Weinstein (1999, 2003) find that the HME is important for a broad segment of manufacturing industries in Japan and OECD countries. Theoretically, Head, Mayer and Ries (2002) find the HME using two other models. Moreover, Holmes and Stevens (2005) establish a model with a continuum of industries that includes the models of Krugman (1980) and Davis (1998) as special cases. The authors find that market size reemerges as a relevant force in determining industrial structure. Specifically, the industry types range from zero minimum efficient scale to high minimum efficient scale in their model. If trade costs are the same in all industries, goods with low minimum efficient scale are not traded, and the small country pays for imports of high range goods with exports of medium range goods. Meanwhile, Hanson and Xiang (2004) establish another model with a continuum of industries and they find that industries with high transport costs and more differentiated products tend to be more concentrated in large countries. Unfortunately, both models are not completely analytically solvable.

Both Davis (1998) and Yu (2005) show that the agricultural sector is worthy of more attention, but their artificial assumption of no trade of the agricultural goods is crucial in their model. The purpose of this paper is to clarify the relation between the agricultural sector and the HME when the agricultural goods are traded between countries. This relation is partially hidden by the tradition of treating a single agricultural good as the numéraire in the literature in two respects. First, in the models of Davis (1998) and Yu (2005), the agricultural production in the two countries yields one homogeneous good. As Fujita, Krugman and Venables (1999) note (p. 105), the assumption of homogeneity of agricultural output is the simplest and most natural assumption to make but is empirically unsatisfactory: different regions (and, of course, countries) usually produce different crops. In the real world, the wool in New Zealand is different from the rice in Japan, and furthermore, Japanese rice is different from Thai rice. In empirical study, the “homogeneous good” of Rauch (1999) (referred to as the organized exchange category) also consists of more than one variety. In addition to being empirically unsatisfactory, the assumption of homogeneous agriculture and positive transport costs means that the

price of the agricultural good in a country jumps when that country imports (even a little of) the agricultural good from the other country. To avoid such difficulties, we treat the agricultural goods of the two countries as differentiated. The second reason why the HME is obscured in the models of Davis (1999) and Yu (2005) is because it is the numéraire of the economy. Therefore, positive agricultural transport costs automatically imply positive transport costs for the numéraire. Selling manufactured goods in the foreign country means exchanging the manufactured goods for the foreign numéraire, and it is necessary to transport the exchanged numéraire from the foreign country to the home country to pay the workers. This makes the model extremely complicated and the latter transport costs are not explicitly included by Davis (1999) and Yu (2005) because trade is balanced within the manufacturing sectors in their models. To simplify our analysis, here we separate the agricultural goods from the numéraire and assume that the transport cost is zero for the numéraire but positive for the agricultural goods.

A sister version of the new trade theory is the new economic geography (see Fujita *et al.* 1999), in which skilled workers are mobile. As in the new trade theory, the framework of Cobb-Douglas preferences and iceberg transport costs is traditional in the literature, but this generally causes analytical intractability. To overcome this difficulty, Ottaviano, Tabuchi and Thisse (2002) reconstruct the core-periphery model with a framework of quadratic utility and linear transport costs which turns out to be completely solvable. Their framework is applied to analyze the HME in Section 3.2.2 of Ottaviano and Thisse (2004). Their framework is also extended to include the agricultural sector by Picard and Zeng (2005), and it is found that the transport cost of the agricultural good is important. Fortunately, the framework of Picard and Zeng (2005) can be extended to examine the HME in an analytically solvable way and can indicate how the trade pattern changes when both the manufacturing and agricultural goods are subject to transport costs. This framework can be considered as complementary to Davis (1998), although the results are completely different.

The paper is organized as follows. Section 2 develops the basic model modified from

Ottaviano and Thisse (2004) and Picard and Zeng (2005). The model is simple and analytically solvable, and we are able to examine the HME when the transport costs of agricultural goods are positive in Section 3. Surprisingly, the results of this paper show that an HME does exist even when the transport costs of agricultural goods are positive. Finally, Section 4 summarizes the results and suggests some conclusions.

## 2 The Model

Our model simply extends that of Ottaviano and Thisse (2004, Section 3.2.2) by reconstructing its agricultural sector. Specifically, assume that the world consists of two countries: North ( $n$ ) and South ( $s$ ). There are  $H$  capitalists and  $L$  workers in the world, which are endowed to countries  $n$  and  $s$  with the same fractions  $\theta$  and  $1 - \theta$ , respectively.<sup>1</sup> Each capitalist holds a unit of capital and each worker represents a unit of labor. Capital services, but not capital-owners, are perfectly mobile between countries whereas labor is immobile. Without loss of generality, we let  $\theta \in (1/2, 1)$  so that North is bigger than South.

There are three kinds of goods in the economy: manufactured goods, agricultural goods and the numéraire. The manufacturing sector produces a continuum of varieties indexed by interval  $[0, N]$ , whose production requires both capital and labor under increasing returns to scale. In contrast, there are only two agricultural goods, each of which is produced in a country by labor only, under constant returns to scale and perfect competition. For example, the reader can think of the agricultural goods as the rice of Japan and the wool of New Zealand. Finally, the numéraire good is homogeneous and produced by nature. The numéraire is initially allocated evenly among  $L$  workers and  $H$  capitalists. Let the quantity given to each individual be  $\bar{q}_0$ . The numéraire can be used to buy manufactured goods and agricultural goods, or consumed directly.

As in Picard and Zeng (2005), the preferences of a representative worker in both

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<sup>1</sup>In this way, we rule out comparative advantage à la Heckscher-Ohlin.

countries are given by the utility function

$$(1) \quad U^r(q_0, q_m, q_a) = \alpha_m \int_0^N q_m^r(x) dx - \frac{\beta_m - \gamma_m}{2} \int_0^N [q_m^r(x)]^2 dx - \frac{\gamma_m}{2} \left[ \int_0^N q_m^r(x) dx \right]^2 \\ + \alpha_a (q_a^{nr} + q_a^{sr}) - \frac{\beta_a - \gamma_a}{2} [(q_a^{nr})^2 + (q_a^{sr})^2] - \frac{\gamma_a}{2} [q_a^{nr} + q_a^{sr}]^2 + q_0,$$

where  $q_m^r(x)$  is the quantity of industrial variety  $x \in [0, N]$  in country  $r$ ,  $q_a^{nr}$  (resp.  $q_a^{sr}$ ) is the quantity of the agricultural product of country  $n$  (resp. country  $s$ ) in country  $r$ , and  $q_0$  is the quantity of the numéraire. In this expression,  $\alpha_m$  (resp.  $\alpha_a$ ) expresses the intensity of preferences for the industrial (resp. agricultural) differentiated product, whereas  $\beta_m > \gamma_m$  (resp.  $\beta_a > \gamma_a$ ) means that consumers are biased toward a dispersed consumption of varieties. In particular,  $\beta_a = \gamma_a$  represents the situation in which consumers do not distinguish between the two agricultural goods, which is the basis of the model of Davis (1998).

To transport one unit of any variety of good in the manufacturing sector costs  $\tau_m$ , and to transport one unit of any variety of good in the agricultural sector costs  $\tau_a$ . Both  $\tau_m$  and  $\tau_a$  are positive. We assume that trade costs are low enough that all goods in both sectors are consumed in both countries. This is called the *overlapping markets condition* in the literature (Anderson *et al.*, 1992, p. 334; Head *et al.*, 2002, p. 378). In our notation, this implies the following inequalities:

$$(2) \quad \tau_m < \frac{2a_m}{2b_m + c_m N}$$

$$(3) \quad \tau_a < \min \left\{ \frac{(1 - \theta)L - N\phi}{(b_a + 2c_a)(H + L)(1 - \theta)}, \frac{\theta L - N\phi}{(b_a + 2c_a)(H + L)\theta} \right\}.$$

The parameters  $a_m$ ,  $b_m$ ,  $c_m$ ,  $b_a$  and  $c_a$  are defined in (6), (9) and (10) later. Finally, the numéraire is assumed to be transported at no cost.

### 3 Equilibrium

We begin by exploring the consumers' behavior and then derive the equilibrium in this economy.

### 3.1 The Consumer

Each consumer maximizes his or her utility given the budget constraint

$$\int_0^N p_m(j)q_m(j)dj + p_a(n)q_a(n) + p_a(s)q_a(s) + q_0 = y + \bar{q}_0,$$

where  $y$  is the wage income,  $p_a(\cdot)$  and  $p_m(\cdot)$  are the consumer prices and  $y$  is the consumer's income. The initial endowment  $\bar{q}_0$  is assumed to be sufficiently large for the equilibrium consumption  $q_0$  of the numéraire to be positive for each individual. This implies that each individual consumes all varieties (provided that prices are low enough, which is assumed below). Because marginal utility for the numéraire is equal in each country, its price can be normalized to one without loss of generality.

We denote by  $p^{kl}(\cdot)$  and  $q^{kl}(\cdot)$  the price and the quantity of a variety produced in country  $k \in \{n, s\}$  and sold in country  $l \in \{n, s\}$ . Obviously, since country  $n$  (resp.  $s$ ) does not produce the agricultural variety  $s$  (resp.  $n$ ), we know that  $q_a^{nn}(s) = q_a^{ns}(s) = q_a^{sn}(n) = q_a^{ss}(n) = 0$ . We can therefore drop the reference to the varieties of agricultural goods and denote the quantities of variety  $r$  by  $q_a^{nn}$  and  $q_a^{ns}$ , and the quantities of variety  $s$  by  $q_a^{ss}$  and  $q_a^{sn}$ . The first order conditions for the consumer yield the demands for agricultural goods in country  $n$ , given by

$$(4) \quad q_a^{nn} = a_a - (b_a + 2c_a)p_a^{nn} + c_a(p_a^{nn} + p_a^{sn}) \quad \text{for variety } n, \text{ and}$$

$$(5) \quad q_a^{sn} = a_a - (b_a + 2c_a)p_a^{sn} + c_a(p_a^{nn} + p_a^{sn}) \quad \text{for variety } s,$$

where the parameters

$$(6) \quad a_a = \frac{\alpha_a}{\beta_a + \gamma_a}, \quad b_a = \frac{1}{\beta_a + \gamma_a}, \quad c_a = \frac{\gamma_a}{(\beta_a - \gamma_a)(\beta_a + \gamma_a)}$$

measure the size of the demand for agricultural goods, its price sensitivity and the degree of product substitutability between agricultural varieties respectively. For  $c_a = 0$ , varieties  $n$  and  $s$  are independent, while they are perfect substitutes for  $c_a \rightarrow \infty$ . The demands for agricultural products in country  $s$  are given by symmetric formulae.

Symmetry between varieties in the manufacturing sector implies that  $q_m^{kl}(i) \equiv q_m^{kl}$  for all varieties  $i$  produced in country  $k$  and sold in country  $l$ . Following the derivation of

expression (3) in Ottaviano *et al.* (2002), and (3) and (4) of Picard and Zeng (2005), the first order condition for the consumer with respect to the consumption of each manufactured variety,  $q_m^{kn}$  with  $k \in \{n, l\}$  yields the following demands for manufactured varieties in country  $n$ :

$$(7) \quad q_m^{nn} = a_m - (b_m + Nc_m)p_m^{nn} + c_m P_m^n$$

$$(8) \quad q_m^{sn} = a_m - (b_m + Nc_m)p_m^{sn} + c_m P_m^n$$

where the size of the demand for manufactured goods, the price sensitivity and the degree of product substitutability between manufactured varieties are measured by

$$(9) \quad a_m = \frac{\alpha_m}{\beta_m + (N-1)\gamma_m}, \quad b_m = \frac{1}{\beta_m + (N-1)\gamma_m},$$

$$(10) \quad c_m = \frac{\gamma_m}{(\beta_m - \gamma_m)[\beta_m + (N-1)\gamma_m]}.$$

These demand functions include the price index of manufactured products in country  $n$ :

$$P_m^n = \lambda N p_m^{nn} + (1 - \lambda) N p_m^{sn},$$

where  $\lambda$  is the share of firms that locate in country  $n$ . The demands in country  $s$  are given by symmetric formulae.

### 3.2 Production and the HME

Recall that the economy is endowed with  $H$  capitalists and  $L$  workers each supplying one unit of their corresponding factor. Capital services, but not capital-owners, are perfectly mobile between countries whereas labor is immobile.

The manufacturing sector produces a continuum of horizontally differentiated varieties under increasing returns to scale. For convenience, we assume that production by a firm in the manufacturing sector necessitates only the fixed costs of 1 unit of capital and  $\phi$  units of labor.<sup>2</sup> Therefore, the total number of firms is  $N = H$ .

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<sup>2</sup>The assumption of increasing returns to scale does not necessarily imply zero marginal cost. However, the assumption of no marginal cost captures the essence of increasing returns and makes the analysis



The agricultural sector of each country produces one original product under constant returns to scale and perfect competition. Labor is assumed to be the only input into agricultural production. For convenience, we define units so that a unit of labor produces a unit of the agricultural good in each country. Therefore,  $p_a^{nn} = w^n$ ,  $p_a^{ss} = w^s$ .

Let  $\lambda$  be the fraction of the manufacturing sector located in country  $n$ . Then the amount of manufacturing labor is  $\lambda N\phi$  in country  $n$ , and  $(1 - \lambda)N\phi$  in country  $s$ . The agricultural population is  $\theta L - \lambda N\phi$  in country  $n$  and  $(1 - \theta)L - (1 - \lambda)N\phi$  in country  $s$ .

Choosing units so that a unit of labor produces a unit of the agricultural good in each country, the prices of agricultural goods become the wages  $w^n$  and  $w^s$  in their respective countries. Then

$$\begin{aligned}\theta L - \lambda N\phi &= \theta(L + H)[a_a - (b_a + 2c_a)w^n + c_a(w^n + w^s + \tau_a)] \\ &\quad + (1 - \theta)(L + H)[a_a - (b_a + 2c_a)(w^n + \tau_a) + c_a(w^n + w^s + \tau_a)], \\ (1 - \theta)L - (1 - \lambda)N\phi &= \theta(L + H)[a_a - (b_a + 2c_a)(w^s + \tau_a) + c_a(w^n + w^s + \tau_a)] \\ &\quad + (1 - \theta)(L + H)[a_a - (b_a + 2c_a)w^s + c_a(w^n + w^s + \tau_a)].\end{aligned}$$

Solving these equations yields

$$\begin{aligned}w^n &= \frac{a_a}{b_a} - \frac{b_a(\theta L - \lambda N\phi) + c_a(L - N\phi)}{b_a(b_a + 2c_a)(H + L)} - (1 - \theta)\tau_a, \\ w^s &= \frac{a_a}{b_a} - \frac{b_a[(1 - \theta)L - (1 - \lambda)N\phi] + c_a(L - N\phi)}{b_a(b_a + 2c_a)(H + L)} - \theta\tau_a.\end{aligned}$$

Then, substituting into (4) and (5) we obtain

$$\begin{aligned}q_a^{nn} &= \frac{L\theta - N\lambda\phi + (H + L)(b_a + 2c_a)(1 - \theta)\tau_a}{H + L}, \\ q_a^{sn} &= \frac{L(1 - \theta) - N\phi(1 - \lambda) - (H + L)(b_a + 2c_a)(1 - \theta)\tau_a}{H + L}.\end{aligned}$$

Similarly, for country  $s$ , it holds that

$$q_a^{ss} = \frac{L(1 - \theta) - N(1 - \lambda)\phi + (H + L)(b_a + 2c_a)\theta\tau_a}{H + L},$$

more convenient. Furthermore, although Ottaviano and Thisse (2004) include the marginal cost  $m$  into their model, their results do not substantially depend on  $m$ . Therefore, as in Ottaviano *et al.* (2002) and Picard and Zeng (2005), we keep this assumption to gain tractability.

$$q_a^{ns} = \frac{L\theta - N\lambda\phi - (H+L)(b_a + 2c_a)\theta\tau_a}{H+L}.$$

Let  $r$  be the profit obtained from one unit of capital. Then the profit of a firm in country  $n$  is

$$\pi_m^n = p_m^{nn}q_m^{nn}\theta(L+H) + (p_m^{ns} - \tau_m)q_m^{ns}(1-\theta)(L+H) - r - w^n\phi.$$

According to (7) and a formula similar to (8), the FOC of maximizing  $\pi_m^n$  implies

$$\begin{aligned} a_m - 2(b_m + Nc_m)p_m^{nn} + c_m[\lambda Np_m^{nn} + (1-\lambda)Np_m^{sn}] &= 0, \\ a_m - 2(b_m + Nc_m)(p_m^{ns} - \frac{\tau_m}{2}) + c_m[\lambda Np_m^{ns} + (1-\lambda)Np_m^{ss}] &= 0. \end{aligned}$$

Similarly, for a firm in country  $s$ , it holds that

$$\begin{aligned} a_m - 2(b_m + Nc_m)p_m^{ss} + c_m[\lambda Np_m^{ss} + (1-\lambda)Np_m^{ns}] &= 0, \\ a_m - 2(b_m + Nc_m)(p_m^{sn} - \frac{\tau_m}{2}) + c_m[\lambda Np_m^{sn} + (1-\lambda)Np_m^{sn}] &= 0. \end{aligned}$$

Solving the above four equations, we have

$$\begin{aligned} p_m^{nn} &= \frac{2a_m + c_mN(1-\lambda)\tau_m}{2(2b_m + c_mN)}, & p_m^{sn} &= p_m^{nn} + \frac{\tau_m}{2}, \\ p_m^{ss} &= \frac{2a_m + c_mN\lambda\tau_m}{2(2b_m + c_mN)}, & p_m^{ns} &= p_m^{ss} + \frac{\tau_m}{2}. \end{aligned}$$

Then

$$\begin{aligned} q_m^{nn} &= \frac{b_m + c_mN}{4b_m + 2c_mN}[2a_m - (1-\lambda)c_mN\tau_m], \\ q_m^{ns} &= \frac{b_m + c_mN}{4b_m + 2c_mN}\{2a_m - [2b_m + c_mN(1-\lambda)]\tau_m\}, \\ q_m^{ss} &= \frac{b_m + c_mN}{4b_m + 2c_mN}[2a_m + c_mN\lambda\tau_m], \\ q_m^{sn} &= \frac{b_m + c_mN}{4b_m + 2c_mN}[2a_m - (2b_m + c_mN\lambda)\tau_m]. \end{aligned}$$

For costs  $\tau_m$  and  $\tau_a$  which satisfy (2) and (3),  $q_a^{ns}$ ,  $q_a^{sn}$ ,  $q_m^{ns}$  and  $q_m^{sn}$  are all positive. In other words, the goods made in each sector by each country are traded.

Due to the free entry of firms, it should hold that  $\pi_m^n = \pi_m^s = 0$ . These expressions are rewritten as

$$\frac{(b_m + c_mN)(L+H)}{4(2b_m + c_mN)^2} \left( \theta[2a_m + (1-\lambda)c_mN\tau_m]^2 + (1-\theta)\{2a_m - [2b_m + c_mN(1-\lambda)]\tau_m\}^2 \right)$$

$$\begin{aligned}
&= r + \phi \left( \frac{a_a}{b_a} - \frac{b_a(\theta L - \lambda N\phi) + c_a(L - N\phi)}{b_a(b_a + 2c_a)(H + L)} - (1 - \theta)\tau_a \right), \\
\frac{(b_m + c_m N)(L + H)}{4(2b_m + c_m N)^2} &\left( \theta[2a_m - (2b_m + c_m N\lambda)\tau_m]^2 + (1 - \theta)(2a_m + c_m N\lambda\tau_m)^2 \right) \\
&= r + \phi \left( \frac{a_a}{b_a} - \frac{b_a[(1 - \theta)L - (1 - \lambda)N\phi] + c_a(L - N\phi)}{b_a(b_a + 2c_a)(H + L)} - \theta\tau_a \right).
\end{aligned}$$

Subtracting the second equation from the first, we obtain

$$\begin{aligned}
&\frac{(b_m + c_m N)(L + H)\tau_m}{4(2b_m + c_m N)} [2(2\theta - 1)(2a_m - b_m\tau_m) + (1 - 2\lambda)c_m N\tau_m] \\
&= \phi \left( (2\theta - 1)\tau_a + \frac{(1 - 2\theta)L - (1 - 2\lambda)N\phi}{(b_a + 2c_a)(H + L)} \right).
\end{aligned}$$

The above expression can be rewritten as

$$\begin{aligned}
(2\lambda - 1) &\left[ \frac{c_m N(b_m + c_m N)(L + H)\tau_m^2}{4(2b_m + c_m N)} + \frac{N\phi^2}{(b_a + 2c_a)(H + L)} \right] \\
&= (2\theta - 1) \left\{ \frac{(b_m + c_m N)(L + H)(2a_m - b_m\tau_m)\tau_m}{2(2b_m + c_m N)} + \phi \left[ \frac{L}{(b_a + 2c_a)(H + L)} - \tau_a \right] \right\}
\end{aligned}$$

and hence

$$(11) \quad \lambda - \theta = \Delta \times \left( \theta - \frac{1}{2} \right),$$

where

$$(12) \quad \Delta = \frac{\frac{(b_m + c_m N)(L + H)\tau_m[2a_m - (b_m + c_m N)\tau_m]}{4(2b_m + c_m N)} + \phi \left[ \frac{L - N\phi}{(b_a + 2c_a)(H + L)} - \tau_a \right]}{\frac{c_m N(b_m + c_m N)(L + H)\tau_m^2}{4(2b_m + c_m N)} + \frac{N\phi^2}{(b_a + 2c_a)(H + L)}}.$$

Because of the overlapping markets conditions of (2) and (3), the numerator of (12) is positive. Therefore,  $\Delta > 0$  and  $\lambda > \theta$  holds at equilibrium from (11), which shows the home market effect. The above is summarized as follows:

**Theorem 1** (The home market effect). *Under the overlapping markets conditions, the market equilibrium involves a more-than-proportionate share of the manufacturing sector in the larger country.*

In the framework of Davis (1998) and Yu (2005) there is only one agricultural good. This corresponds to the case in which  $\beta_a = \gamma_a$  in our model, which implies that  $c_a \rightarrow \infty$

and (3) is violated for any positive  $\tau_a$ . This explains those previous studies fail to observe the HME.

On the other hand, if we exclude the parameters in the agricultural sector, (11) reduces to

$$(13) \quad \lambda - \theta = \frac{2[2a_m - (b_m + c_m N)\tau_m]}{c_m N \tau_m} \left( \theta - \frac{1}{2} \right) > 0,$$

which is consistent with (25) of Ottaviano and Thisse (2004).<sup>3</sup> Comparing (11) with (13), we find that including the agricultural sector does not decrease the HME. In contrast, Chapter 7 of Fujita *et al.* (1999) and Picard and Zeng (2005) show that the agricultural transport costs are essential to the models of new economic geography. This is because mobile skilled workers suffer from the high price of agricultural goods in an agglomerated region in new-economic-geography models, but the mobile capital in our model does not suffer any loss from agglomeration.

## 4 Summary and Conclusions

The results of Davis (1989) show that the over-simplification of the agricultural sector in traditional new-economic-geography models is not innocuous. Recently, Yu (2005) extended the result of Davis (1989) and found that the home market effect may either disappear, be reversed, or remain when the transport costs of the agricultural good are positive. Although their results overturn Krugman's result to a certain degree, their models treat the agricultural good as the numéraire, which over-simplifies the agricultural sector again. To avoid possible misinterpretation of their results, this paper reconstructs the agricultural sector in two respects. First, we separate the agricultural goods from the numéraire, which allows us to distinguish their impact on the home market effect. Second, we differentiate two agricultural goods produced in two countries so that the importation of a small amount of the agricultural good from a foreign country does not change the price of a home country's agricultural good catastrophically. In this way,

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<sup>3</sup>Note that our model further assumes that  $f = 1$  and  $m = 0$  for simplicity.

we obtain the surprising result that the home market effect does not disappear because of positive transport costs for the agricultural goods. Therefore, we can conclude that the results of Davis (1998) and Yu (2005) are contingent on the absence of trade in the agricultural sector between countries.

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