Trade, market size, and industrial structure: revisiting the home-market effect

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Abstract

- "Home-market effects" (HME) are more complicated
- Market size matters for industrial structure even when both the homogeneous good (HG) and the differentiated goods (DGs) face transport costs
- HME for production structure can arise, disappear, or reverse in sign
- Change common perception about de-industrialization of (small) economies
- Important implications for the empirical research strategies

Motivation

- Krugman 1980; Helpman and Krugman 1985: "Home market effect", (HME): ***large country will tend to have more-than-proportionate share of differentiated industries***, since with increasing returns, transport cost gives an advantage to firms located in larger markets
- Now HME is standard knowledge in economic geography
- Davis (1998): the relative size of trade costs in the differentiated and the homogeneous sectors is an important parameter that could affect the existence of the HME
- $\Longrightarrow$ increasing research interests on the existence of HME
- The purpose of the paper: to show that the **demand elasticity of substitution** (EOS) between the two sectors is also a crucial parameter that may actually affect the nature of HME

History, Background literature, etc.

- Usual: Cobb-Douglas (C-D) specification for aggregate preference $\Longrightarrow$ expenditure shares (ExSh) are constant, independent of the price index of the DGs
- Fujita, Krugman, Venables (1999): the number of varieties of DGs ($\Longrightarrow$ the price index) play important roles
- Yu (2005): replace the C-D with a more general constant elasticity-of-substitution (CES) specification
    - It allow the expenditures to respond to the price index
    - Non-unitary EOS offered by CES makes the ExSh on DGs endogenous and different across countries
    - An endogenous ExSh is important for HME because the different ShEx on DGs across countries would affect the distribution of manufacturing industry (in addition to the relative market size, MS)

Results: CES instead of $C-D$ $\Longrightarrow$ new insight on HME

1. When HG and DGs face transport costs, trade in DGs could be balanced, but MS matters for industrial structure.
   HME depends on EOS between HG and the composite of DGs.
   Intuition: whether EOS>1 will have different effects on relative ExSh on DGs and $\Longrightarrow$ the distribution of manufacturing industry.
2. De-industrialization of small economies under economic integration?
   Helpman, Krugman (1985), Davis (1998): C-D $\Longrightarrow$ prior to trade each country produces DGs in exact proportion to its size.
   In autarky: endogen.ExSh on DGs: MS matters for industr.structure
   Yu (2005): although country's share of differentiated industry in integration is smaller than its relative size, it could be greater than that prior to integration $\Longrightarrow$ it is not correct that the smaller country becomes de-industrialized once it has a less-than-proportionate share of manufacturing industry in integration
3. **Welfare is always higher in the larger economy.** $\Longrightarrow$ concentration of industry in larger economy would always occur if labour were mobile

Comparison with known results

Head, Mayer, Ries (2002): HME under different assumptions: Cournot competition, per unit (instead of iceberg) transport cost, linear demand. Also: Cournot competition when products are differentiated according to nations rather than firms $\Longrightarrow$ **reverse** HME (RHME)

Feenstra, Markusen, Rose (2001): "reciprocal-dumping" $\Rightarrow$ RHME

Yu (2005): RHME is derived from MC model: as in Helpman & Krugman (1985), and Davis (1998), but with CES instead of C-D

Model: following Helpman & Krugman (1985), Davis (1998)

- There are two countries, H and F (*)
- Labour is the only factor of production, and $L > L^*$
- There are two industries (sectors), X and Y
- Industry X produces a large **variety** of DGs (manufactures)
- Industry Y produces a HG (primary products)
- Sector X faces transport cost τ of "iceberg"-type (if $\tau > 1$ units are shipped abroad only 1 unit arrives)
- Sector Y faces transport cost γ of "iceberg"-type
- Technologies are identical in both countries
- Production function for Y: **constant** returns to scale, $Y = L_y$
- Production technology for X: (1) constant marginal and fixed costs: labor requirement to produce x units of any DG is $\ell = \beta_0 + \beta x$, (2) each firm produces only one good/variety
- Preferences are (1) **homothetic** and (2) **identical across countries**

Model: novelities

Utility of a representative consumer is represented by CES function:

$$U = \left((C_X)^\rho + (C_Y)^\rho\right)^{1/\rho}, \qquad \rho \in (-\infty, 1),$$

where C_Y is consumption of HG, C_X is the composite of DGs
EOS between C_X and C_Y is

$$\eta = \frac{1}{1-\rho} \in (0, \infty), \qquad \rho = \frac{\eta - 1}{\eta}$$

The composite of DGs is represented by another CES function:

$$C_X = \left(\sum_{i=1}^{n} (x_i)^\theta + \sum_{i=1}^{n^*} (x_i^*)^\theta\right)^{1/\theta}, \qquad \theta \in (0, 1),$$

n and n^* are the actual number of DGs produced in countries H and F
EOS between **any** two DGs is

$$\sigma = \frac{1}{1-\theta} \in (1, \infty)$$

EOS for CES

$$U(a,b) := (a^\rho + b^\rho)^{\frac{1}{\rho}}$$

$$\mathscr{E}_{U/a,b} := \frac{\frac{\frac{\partial U}{\partial a}}{\frac{\partial U}{\partial b}}}{\frac{a}{b}} \Bigg/ \frac{\partial\left(\frac{\frac{\partial U}{\partial a}}{\frac{\partial U}{\partial b}}\right)}{\partial\left(\frac{a}{b}\right)} = \frac{\frac{\frac{a^{\rho-1}}{b^{\rho-1}}}{\frac{a}{b}}}{\frac{\partial\left(\left(\frac{a}{b}\right)^{\rho-1}\right)}{\partial\left(\frac{a}{b}\right)}} = \frac{\left(\frac{a}{b}\right)^{\rho-2}}{(\rho-1)\left(\frac{a}{b}\right)^{\rho-2}} = \frac{1}{\rho-1}$$

Model: price indices for DGs

Following Dixit & Stiglitz (1977),

$$H: \qquad q = \left(\sum_{i=1}^{n} (p_i)^{\theta/(1-\theta)} + \sum_{i=1}^{n^*} (\tau p_i^*)^{\theta/(1-\theta)} \right)^{(\theta-1)/\theta}$$

$$F: \qquad q^* = \left(\sum_{i=1}^{n} (\tau p_i)^{\theta/(1-\theta)} + \sum_{i=1}^{n^*} (p_i^*)^{\theta/(1-\theta)} \right)^{(\theta-1)/\theta}$$

Price indices depend on both individual prices and varieties of DGs

The known results on HME with the C-D function

Helpman & Krugman (1985): assume $\tau > 1$ (for DGs), $\gamma = 1$ (for HG)
$\Rightarrow$ HME: ??country H imports HG?? +

$$\frac{n}{n^*} > \frac{L}{L^*}$$

Davis (1998): when the assumption about transport costs is relaxed, the HME may disappear. For example, if $\gamma = \tau > 1$ then

- no trade in HG
- wage in DGs: $w > w^*$ such that balance of trade in DGs
- "proportionate equilibrium": $\dfrac{n}{n^*} = \dfrac{L}{L^*}$

$\Rightarrow$ $\dfrac{\tau}{\gamma}$ is an important parameter to study HME

Yu (2005): EOS, η, is an additional, important parameter to see whether and **how** home-market size matters for industrial structure

Balance

$$qC_X = SwL \qquad q^* C^*_X = S^* w^* L^*$$

$$P_Y C_Y = (1 - S)wL \qquad P^*_Y C^*_Y = (1 - S^*)w^* L^*$$

where, for country H,

- S is ExSh on DGs,
- w is wage in DGs (in HG the wage =1)
- P_Y is the price of HG

Free entry $\Rightarrow$ Income is equal to total wages

Y is produced perfect competition, moreover $Y = L_Y$ (i.e. $P_Y = w$)

$\Rightarrow \dfrac{q}{w}$ is the relative price between HG and the composite of DGs

Intuitively, ExSh S should depend on $\dfrac{q}{w}$

ExSh on DGs as function of $\frac{q}{w}$ and EOS

Lemma. ExSh on DGs is a function of relative price and EOS between C_X and C_Y, η:

$$S = \frac{1}{1 + \left(\frac{q}{w}\right)^{\eta - 1}} = \psi\left(\frac{q}{w}\right), \qquad S^* = \frac{1}{1 + \left(\frac{q^*}{w^*}\right)^{\eta - 1}} = \psi\left(\frac{q^*}{w^*}\right)$$

ExSh is decreasing in relative price if EOS is > 1 (i.e., $\psi'(\cdot) < 0$ if $\eta > 1$)
ExSh is constant in relative price if EOS is $= 1$ (i.e., $\psi'(\cdot) = 0$ if $\eta = 1$)
ExSh is increasing in relative price if EOS is < 1 (i.e., $\psi'(\cdot) > 0$ if $\eta < 1$)

Intuitions. (Remark: $\eta = 1 \Longleftrightarrow$ C-D specification)
ExSh on DGs is a function of the relative price between HG and composite of DGs, but whether this function is $\downarrow$ or $\uparrow$depends on η.
$\downarrow \frac{q}{w}$ would $\uparrow$ the demand for DGs, but ExSh on DGs could either $\uparrow$ or $\downarrow$
When $\eta > 1$, a 1% $\downarrow$ of $\frac{q}{w}$ would $\uparrow$ consumption C_X by **more than** 1%, and this would $\uparrow$ ExSh on DGs

Relative wage: the bounds

Proposition. When intra-industry trade is balanced (imports=exports), the relative wage is bounded, with the bounds determined by transport costs and preferences:

$$\frac{w}{w^*} \in \left(\frac{1}{\tau^\theta}, \tau^\theta \right)$$

Discussion. The bounds of the relative wage depend on θ.

But $\sigma = \dfrac{1}{1-\theta}$

$\Rightarrow$ a smaller value of θ means a lower EOS **among** DGs

$\Rightarrow$ **divergence** of $\dfrac{w}{w^*}$ is $\downarrow$ when the substitutability between DGs is $\downarrow$

Intuition. Divergence of $\dfrac{w}{w^*}$ from **demand** (rather than supply) side:

When it is costly to ship goods abroad, the price of import varieties $\uparrow$

$\Rightarrow$ substitution effect (SE) shifts demand to domestic varieties.

$L > L^*(\Rightarrow n > n^*$ under HME) $\Rightarrow$ this SE is stronger for HM

$\Rightarrow$ pressure on the balance of trade for FM.

To bring trade to balance, the relative price $\dfrac{p}{p^*}$ $\left(\Rightarrow \dfrac{w}{w^*}\right)$ must go up

Both sectors have transport costs: when no-trade in HG?

Corollary. When HG sector also has transport costs and $\tau > \gamma \geq \tau^{\theta}$, trade in HG does not occur, and therefore trade in the DGs is balanced

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Discussion. It is not profitable to ship the HG abroad when

$$\frac{1}{\gamma} < \frac{w}{w^*} < \gamma$$

Although wage in country H is higher, the transport cost would make it more expensive to import HG

Notice: $\tau^{\theta} < \tau$, since $\theta \in (0, 1)$. $\Rightarrow$ Davis's (1998) result still holds: **HME disappear when both sectors face identical transport costs (i.e., $\gamma = \tau$)**

Moreover, transport cost of HG could be **smaller** than that of the DGs (as long as $\tau^{\theta} < \gamma < \tau$)

Lemma. When $\tau > 1$ and $\gamma \geq \tau^{\theta}$ ($\Rightarrow$ trade in HG does not occur),

$$\frac{n}{n^*} = \frac{SL}{S^* L^*}$$

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Discussion. Endogeneity of ExSh on DGs is very important for HME. Only with the C-D function (i.e., $S = S^* = const$), we obtain the 'proportionate equilibrium' (i.e., $\frac{n}{n^*} = \frac{L}{L^*}$). In general, however, ExSh depend on the relative prices between HG and the composite of DGs, which in turn depend on the individual prices and the varieties of DGs. Changes in the relative ExSh $\left(\frac{S}{S^*}\right)$ will affect the distribution of differentiated industry.

Main result on HME

Proposition. When $\tau > 1$ and $\gamma \geq \tau^{\theta}$, trade in HG does not occur, moreover

i) $\frac{n}{n^*} > \frac{L}{L^*}$ if $\eta > 1$ (**HME**)

ii) $\frac{n}{n^*} = \frac{L}{L^*}$ if $\eta = 1$ (**no HME**)

iii) $\frac{n}{n^*} < \frac{L}{L^*}$ if $\eta < 1$ (**RHME**)

Discussion. Country H (**large!**) produces a greater number of varieties

$\Rightarrow$ relative price for DGs is lower

$\Rightarrow$ **when** $\eta > 1$: ExSh on DGs $\uparrow$in country H relative to that in country f

$\Rightarrow$ the relative number of DGs $\uparrow$

De-industrialization? C-D and CES

Helpman & Krugman (1985), Krugman (1995): an economy is being 'de-industrialized' (though not fully) when it ends up with a less than proportionate share of manufacturing industry in economic integration

Davis (1998):

asked: "Will Economic Integration Deindustrialize Small Countries?"

concludes: "this should not be expected to deindustrialize small countries"

These discussions are correct within their framework because, with a C-D function, each country produces DGs in exact proportion to its size prior to market integration.

However, this common perception about de-industrialization may not be correct in a general framework.

With a CES utility function, the distribution of DGs in **autarky** is in general no longer proportionate to relative country size. The reason for this is that the price index of DGs for the larger (resp. smaller) country is lower (resp. higher), which affects the relative ExSh on manufacturing goods in autarky.

Suppose n_a (n_a^*) is the number of DGs in autarky for the country H (F)
Lemma. Market size also matters for industrial structure in autarky. In particular, the "pattern of industrial structure" in **autarky** is:

i) $\dfrac{n_a}{n_a^*} > \dfrac{L}{L^*}$ if $\eta > 1$

ii) $\dfrac{n_a}{n_a^*} = \dfrac{L}{L^*}$ if $\eta = 1$

iii) $\dfrac{n_a}{n_a^*} < \dfrac{L}{L^*}$ if $\eta < 1$

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Intuition. The larger country has more domestic varieties of DGs and hence a lower price index of DGs
$\Rightarrow$the total expenditure on DGs $\uparrow$ $EOS > 1$.
ExSh on DGs $\uparrow$ $\Rightarrow$ the number of DGs $\uparrow$.
On the other hand, the smaller country has few domestic varieties and hence a higher price index of DGs.
$\Rightarrow$ total expenditure on DGs $\downarrow$ when $\eta > 1$
$\Rightarrow$a less than proportionate share of DGs in autarky.

How De-industrialization could be misleading

Proposition. If $\tau > 1$ and $\gamma \geq \tau^{\theta}$ (i.e., trade in the homogeneous sector does not occur), and moreover, trade costs $\tau < \left(\frac{L}{L^*}\right)^{\frac{1-\theta}{(1+\theta)\theta}}$, then we obtain that

i) $\frac{n_a}{n_a^*} > \frac{n}{n^*} > \frac{L}{L^*}$ when $\eta > 1$

ii) $\frac{n_a}{n_a^*} < \frac{n}{n^*} < \frac{L}{L^*}$ when $\eta < 1$

Intuition. Recall: if $\tau \to 1$ and $\eta > 1$, then $\frac{w}{w^*} \to 1 \Rightarrow \frac{n}{n^*} \to \frac{L}{L^*}$

Implication: when $\eta > 1$, $\frac{n^*}{n} < \frac{L^*}{L}$ in market integration

$\Rightarrow$ it is no longer appropriate to consider the smaller country as becoming 'de-industrialized'

The smaller country could have a higher share of differentiated industry in market integration than prior to market integration

Helpman & Krugman (1985):

$$\left(\frac{n}{n^*} - \frac{L}{L^*}\right)(U - U^*) > 0$$

Will it still hold in general?

Proposition. When $\tau > 1$ and $\gamma \geq \tau^\theta$ (i.e., trade in HG does not occur), welfare in the foreign country is lower even when it has a more-than-proportionate share of DGs; in general, welfare in the smaller (resp. larger) country is always lower (resp. higher), regardless of the pattern of industrial structure in market integration.

Intuition. The larger country has a lower price index of DGs as long as there are transport costs for this sector. When trade in HG does not arise, an increase in $\frac{w}{w^*}$ reinforces such an effect on welfare. Which country has a more than proportionate share of differentiated industry, however, depends on the EOS.

$\Rightarrow (L - L^*)(U - U^*) > 0$ holds in general.

Implication of the result

If labour (workers) were mobile, they would not necessarily move to the country that has a high ratio of $\frac{n}{L}$ but instead would always move to the larger country.

$\Rightarrow$ trade may not contribute to the geographic concentration of manufacturing industry in the larger economy, but agglomeration in the larger economy would always occur if labour were allowed to move.

$\Leftrightarrow$ with mobile labour, geographic concentration of manufacturing industry in the larger economy would occur regardless of the initial pattern of industrial structure (i.e., $\frac{n}{L} \lesseqgtr \frac{n^*}{L^*}$).

These results are important for understanding the agglomeration process in the 'core-periphery' models in the new economic geography (e.g., Krugman 1991).

Summary of the results

	Helpman-Krugman	Davis	Yu
Utility function	C-D	C-D	CES
Transport costs	$\tau > 1, \gamma = 1$	$\tau > 1, \gamma = \tau$	$\tau > 1, \gamma \geq \tau^{\theta}$
Wages	$w = w^*$	$w > w^*$	$w > w^*$
Trade Pattern	Home exports X and imports Y	X: balance-of-trade No trade in Y	X: balance-of-trade No trade in Y
Industrial Structure	$\frac{n}{n^*} > \frac{L}{L^*}$	$\frac{n}{n^*} = \frac{L}{L^*}$	$\frac{n}{n^*} > \frac{L}{L^*}$ if $\eta > 1$ $\frac{n}{n^*} = \frac{L}{L^*}$ if $\eta = 1$ $\frac{n}{n^*} < \frac{L}{L^*}$ if $\eta < 1$
Economic welfare	$U > U^*$	$U > U^*$	$U > U^*$

Concluding remarks

- A more general analysis of HME.
- In general, the effect of market size on the pattern of trade can be neutralized when both sectors face transport costs; however, the effect on production structure does not.
- HME on production structure could disappear, re-emerge, or even reverse in sign, depending on EOS
- Different ExSh are obtained when $EOS \neq 1$
- The results of the paper are derived for the case in which trade in HG **does not arise**, and thus trade in DGs is balanced ($\gamma \geq \tau^{\theta}$ is a sufficient condition). If $\gamma < \tau^{\theta}$, trade in HG could occur and in equilibrium we always have $w = \gamma w^{*}$ (when the foreign country exports HG).
- This will increase the size of DGs in country H

- ***Thank you***