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Abstract

The present note shows the interaction between technological differences between countries and the level of trade costs as a determinant of trade patterns. It takes the work of Kikuchi et al.(2008)'s Chamberlinian-Ricardian model as its point of departure, and extends the analysis to include both a continuum of industries, as did Dornbusch et al. (1977), and iceberg transport costs. It will be shown that trade liberalization drastically changes the nature of trade patterns, particularly the emergence of intra-industry trade.

Keywords: comparative advantage, trade liberaliation, trade costs

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1 Introduction

Over the last several decades a vast literature has developed on the emergence of intra-industry trade (i.e., two-way trade of differentiated products). Among several competing models of intra-industry trade, Chamberlinian monopolistic competition models of trade have been extensively investigated since the groundbreaking work of Krugman (1979). Helpman's (1981) influential work on the integration of the monopolistic competition trade model into a neoclassical framework, which has been extended and made popular by Helpman and Krugman (1985), has led to the widely held belief that neoclassical and new trade theories are complementary in nature.[1] Those models are very successful in explaining the emergence of intra-industry trade.

To focus on the role of increasing returns and imperfect competition, a standard one-factor model assumes cross-country technical homogeneity: each firm in the monopolistically competitive sector incurs an identical fixed cost and a constant marginal cost. As a result, there has been little investigation into the role of technical heterogeneity among countries. However, the Ricardian comparative advantage, which plays a basic role in the traditional international-trade context, is worthy of more attention. To address this point, Kikuchi et al. (2008) explored cross-country technical hetero-

[1]See Wong (1995) for the comprehensive surveys of the relevant literature.

geneity in both fixed costs and marginal costs as a determinant of trade patterns. Within a two-country, many-industry framework, they showed that the extent of cross-country technical differences among industries plays an important role as a determinant of trade within each industry. However, they assumed away any trade costs between countries.

The present note takes the work of Kikuchi et al. (2008) as its point of departure, and extends the analysis to include both a continuum of industries, as did Dornbusch et al. (1977), and iceberg transport costs. In each industry, fixed costs can differ between countries. It will be shown that the equilibrium specialization pattern is determined by the interaction between technical heterogeneity (i.e., the differences in fixed costs) and the level of iceberg transport costs. It will also be shown that trade liberalization drastically changes the nature of trade patterns, particularly the emergence of intra-industry trade.

This note is closely related to the research of Venables (1999), which explored the division of industries between countries in a multi-industry framework with cross-country technical differences. However, he used a framework in which there are both transport costs and linkages through intermediate inputs: his focus was on the interaction between technical differences and agglomeration forces via input-output linkages. In contrast, in this note,

we assume away such aspects (e.g., sources of agglomeration forces such as input-output linkages) and focus on the interaction between cross-country technical differences and trade liberalization.

This paper is organized as follows. Section 2 provides the basic setup of the model of monopolistic competition. Section 3 examines the impact of trade liberalization.

2 The Model

Suppose there are two countries in the world, Home and Foreign. Each country is endowed with L units of labor and the only source of income is the wage, w ($\tilde{w}$). We assume that there is a continuum of industries on the unit interval. Industry-specific variables will be indexed by industry label i ($i \in [0,1]$). Consumers have Cobb-Douglas preferences and purchase equal values of the output of all industries. The market structure of each industry is monopolistically competitive. Each industry is modeled as a Dixit-Stiglitz (1977) monopolistically competitive industry, so the quantity index of industry i takes the form

$$X^i = \left(\sum_{k=1}^{n^i} (d_k^i)^{(\sigma-1)/\sigma} + \sum_{\tilde{k}=1}^{\tilde{n}^i} (d_{\tilde{k}}^i)^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)}, \quad \sigma > 1 \tag{1}$$

where n^i ($\tilde{n}^i$) is the number of products produced in industry i in Home (Foreign), d_k^i ($d_{\tilde{k}}^i$) is the quantity of product k ($tildek$) in the Home market, and $\sigma > 1$ is the elasticity of substitution between every pair of products. Trade between countries is costly. We assume that, for every t units shipped, only one unit arrives. Thus, the price of imported differentiated product to the home consumers will be $t\tilde{p}$, where $\tilde{p}$ is the producer's price for the Foreign product. The price index of industry i can be obtained as:

$$P^i = \left(\sum_{k=1}^{n^i} \left(p_k^i\right)^{1-\sigma} + \sum_{\tilde{k}=1}^{\tilde{n}^i} \left(tp_{\tilde{k}}^i\right)^{1-\sigma} \right)^{1/(1-\sigma)}, \tag{2}$$

where p_k^i ($p_{\tilde{k}}^i$) is the price of the k ($\tilde{k}$) th differentiated product produced by industry i in Home (Foreign).

There is cross-country technical heterogeneity: fixed costs are assumed to differ across countries: each Home (Foreign) firm in industry i has α^i ($\tilde{\alpha}^i$) units of labor as a fixed input. We assume, however, that marginal costs are the same for all industries and for both countries, being equal to β units of labor. With the number of firms being very large, the elasticity of demand for each product becomes σ. Thus, each product is priced at a markup over marginal cost:

$$p_k^i = \frac{\sigma\beta w}{\sigma - 1}, \quad p_{\tilde{k}}^i = \frac{\sigma\beta\tilde{w}}{\sigma - 1}.$$

We chose units so that $\beta = (\sigma - 1)/\sigma$, which implies that $p^i = w$. Free entry ensures that the equilibrium output per product is constant, but differ across

countries, and independent of the level of trade costs:

$$x^i = \alpha^i \sigma, \quad \tilde{x}^i = \tilde{\alpha}^i \sigma.$$

For cross-country differences in fixed costs, we would like to employ the following specification.[2]

$$\alpha^i = 1 + i, \tag{3}$$

$$\tilde{\alpha}^i = 2 - i. \tag{4}$$

The production technologies are mirror images of each other. By virtue of market symmetry, factor prices will be the same in all markets, thus w is identical across all countries; henceforth we set $wL = \tilde{w}L = 1$. The symmetry assumptions imply that trade yields a relative wage of one.

Product market equilibrium requires that supply equal demand for each product. By substituting the zero-profit condition into this equilibrium condition and denoting $\tau \equiv t^{1-\sigma}$yields the following equilibrium condition for a home product and its foreign counterpart in industry i:

$$\alpha^i \sigma = \left(\frac{1}{n^i + \tau \tilde{n}^i}\right) + \left(\frac{\tau}{\tau n^i + \tilde{n}^i}\right), \tag{5}$$

$$\tilde{\alpha}^i \sigma = \left(\frac{\tau}{n^i + \tau \tilde{n}^i}\right) + \left(\frac{1}{\tau n^i + \tilde{n}^i}\right). \tag{6}$$

[2]See Yi (2003) and Neary (2003).

Its solution is

$$n^i = \frac{1}{\sigma(\alpha^i - \tilde{\alpha}^i\tau)} - \frac{\tau}{\sigma(\tilde{\alpha}^i - \alpha^i\tau)}, \tag{7}$$

$$\tilde{n}^i = \frac{1}{\sigma(\tilde{\alpha}^i - \alpha^i\tau)} - \frac{\tau}{\sigma(\alpha^i - \tilde{\alpha}^i\tau)} \tag{8}$$

If trade cost τ is small enough so that

$$\tau < min\left[\frac{\alpha^i}{\tilde{\alpha}^i}, \ \frac{\tilde{\alpha}^i}{\alpha^i}\right] \tag{9}$$

Then all the denominators are positive. The difference in the number of firms in i-th industry is

$$n^i - \tilde{n}^i = \frac{(\tilde{\alpha}^i - \alpha^i)(1+\tau)^2}{\sigma(\alpha^i - \tilde{\alpha}^i\tau)(\tilde{\alpha}^i - \alpha^i\tau)}$$

It is positive when $\tilde{alpha}^i > \alpha^i$ and (7) are satisfied. The degree of specialization will depend on both (a) the level of trade cost t, and (b) the level of difference in fixed (or comparative advantage).[3]

3 The Impact of Trade Liberalization

By combining (5), (6) and (7), we can obtain two cutoffpoints determining specialzation patterns: $\underline{i}$ $(\alpha^{\underline{i}}/\tilde{\alpha}^{\underline{i}} = \tau)$ and $\bar{i}$ $(\tilde{\alpha}^{\bar{i}}/\alpha^{\bar{i}} = \tau)$.

[3]Since marginal costs levels differ quite a lot across countries, it is more natural to include those differences. In order to make analysis tractable, however, we concentrate on the technical differences in fixed costs and downplay differences in marginal costs. This kind of extension needs further consideration.

For $0 \leq i \leq \underline{i}$, only Home will produce those products, whule only Foreign firms are active for $\bar{i} \leq i \leq 1$. Within the range of $\underline{i} < i < \bar{i}$, both countries firms are active and intra-industry trade occurs between countries. These trade patterns are summarized in Figure 1: the vertical axis shows both the relative fixed costs and the freeness of trade (τ), while the horizontal axis shows the index of industries. In contrast to the findings in the previous literature, we found that intra-industry trade occurs in the middle range of industries.

[Take in Figure 1]

It is important to note that this result is crucially dependent on the assumption of the monopolistically competitive industres. If firms in each industry produce *homogeneous* products as in Dornbusch et al. (1977), there are few incentives of intra-industry trade between countries. In our model, intra-industry trade occurs since each firm produces *differentiated* products and those firms are distributed between countries.

Now we turn to the impact of trade liberalization, which is captured by a decrease in t (i.e., an increase in τ). Reducing trade costs has two effects. First, trade liberalization intensifies import competition: a fall in t reduces the industry price index due to the extra firms competing for a

share of a limited domestic market demand ((2)). This leads to a fall in domestic demand for domestically produced products in each country. The industry price indices fall more greatly in less competitive industries (i.e., industries with relatively higher fixed costs) since firms with larger fixed costs are exposed to more import competition compared to firms with lower fixed costs. Second, trade liberalization makes it easier to gain access to the export market: a fall in t leads to an increase in exports to each country. The relative strength of the two effects determines equilibrium trade patterns: the import competition effect dominates since sales in the domestic market are more significant than exports in the presence of positive trade costs.[4] Firms with relatively higher fixed costs find the gain in exports does not offset the sales lost in the domestic market so the amount of output they can sell is insufficient to cover (higher) fixed costs and this leads to the exit of some firms in the sectors with comparative disadvantage. The reverse is true for the firms with relatively lower fixed costs, so there is entry in the sectors with comparative advantage. Summarizing these changes, due to trade liberalization, Foreign (resp. Home) firms will be wiped out in the sectors around $\underline{i}$ ($\bar{i}$): the range of sectors with intra-industry trade will become narrower (see Figure 1).

[4]See Amiti (1998) for the similar argument in the two-sector setting.

Proposition: *Due to trade liberalization, the range of sectors with intra-industry trade becomes narrower.*

This result cannot be obtained under the assumption that technologies are identical across both countries. This implies that it is important to extend the standard model of monopolistic competition to include both technological heterogeneity and many sectors. The present note must be regarded as very tentative. Hopefully it provides a useful paradigm for considering how trade liberalization works as a driving force for industrial reformulation.

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