Dynamic Gains from International Trade with Imperfect Competition and Market Power

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Abstract

This paper revisits the gains from trade under imperfect competition by explicitly modeling strategic competition and entry. The paper highlights a welfare cost of imperfect competition, due to inefficiently high entry. Through increasing competition, international trade lowers price–cost markups and reduces excessive entry. This adds on a “competitive” channel for gains from trade to the well-known “product diversity” channel from previous literature. Both channels will increase the return to investment and raise the steady-state capital stock. An alternative case is possible, however, where there is inefficiently low entry. In that case, trade tends to be “anticompetitive,” raising price–cost markups and encouraging increased entry.

1. Introduction

It is often suggested that one of the important benefits of international trade is the intensified competition from world markets, and the erosion of domestic monopoly powers. In the literature on the gains from trade, however, much of the discussion has been concentrated on the traditional production and consumption gains from comparative advantage, or the alternative gains due to intraindustry trade developed by Krugman (1979, 1980, 1981) and Helpman and Krugman (1985).

This paper focuses on the welfare gains from trade specifically due to competition. It follows an argument first developed by Markusen (1981) in which trade tends to increase competition and reduce monopoly price-setting in economies where domestic firms have some monopoly power. It differs from the strategic trade policy literature (e.g., Brander and Spencer (1983); Smith and Venables (1988)) by focusing on a dynamic general-equilibrium environment with endogenous entry, where full welfare evaluation can be done using a representative consumer approach.

At the same time, the paper relates to the work on the dynamic gains from trade, developed by Grossman and Helpman (1991) and many others.1 In these settings, resource reallocation due to opening international markets may lead to either increased long-run capital accumulation, or higher rates of long-run trend growth.

We develop a simple but tractable model in which international trade can induce welfare gains specifically by enhancing international competition. The framework is a general-equilibrium model of imperfect competition. The model is dynamic, with both the capital stock and the level of firm entry being endogenous. There is a large number of industries, but within each industry there is a relatively small number of firms. Thus, firms have market power, and interact strategically with one another. Firms will always set prices above marginal cost.

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The effects of strategic interaction in the model depend critically on the size of the elasticity of substitution between products within an industry relative to the elasticity of substitution between the composite products across industries. In the presumptive case of the model, the within-industry elasticity of substitution exceeds the across-industry elasticity of substitution.

The presence of imperfect competition causes two sources of inefficiency. First, the excess of price over marginal cost will bias down the steady-state capital stock; although, perhaps surprisingly, it does not effect the steady-state level of labor supply. Second, because firms interact strategically with one another, the industry markup will depend on the size of the market. This generates an inefficient level of entry into each industry. In the presumptive case, entry will be inefficiently high.

We show that, in this framework, opening markets to international trade tends to alleviate both sources of inefficiency. Trade leads to intensified competition, forcing down price–cost markups and reducing the inefficient over-entry into each industry. The lower markups lead to an enhanced incentive for capital accumulation, and increase the steady-state capital stock in each country.

Conceptually, in the model there are two sources of gains from international trade. The first is the familiar gain to product diversity or “variety” in the sense of Krugman (1980). With fixed costs of entry, increasing the size of the market increases the range of goods. The second gain is purely due to competition. This captures the fact that, independent of any desire for variety in preferences, increasing the size of the market will enhance competition, drive down markups, and reduce inefficient over-entry.

Our model allows us to separate these welfare gains from one another. Thus it is possible to isolate the pure gains to competition, in the absence of any benefit of variety in commodity composition.

In the case of each of these separate gains from trade, there will also be secondary “dynamic” gains, since both the variety effect and the competition effect increase the return to investment and imply a higher steady-state capital stock.

One important feature of our results is that the gains from trade are greater for smaller countries. This result is implied by both the product diversity effect and the competitive effect through which gains from trade can occur. With respect to the latter, when a small country joins together with larger countries in a trade agreement, it will experience proportionally greater declines in its equilibrium price–cost markup. The benefits of eliminating excessive entry will then be greater for a smaller country, and the dynamic gains coming from a higher long-run capital stock will also be proportionally greater for a smaller country.

While in the presumptive case of the model, international trade reduces industry markups, the analysis admits the possibility of “anticompetitive” effects of trade. If the “across-industry” elasticity of substitution between goods exceeds the “within-industry” elasticity, then opening up to international trade will increase price–cost markups, and encourage increased entry into each industry. Despite this, trade will still increase welfare, because in this instance, firm entry is inefficiently low in a market equilibrium.

Section 2 develops the basic model. Section 3 constructs an equilibrium. Section 4 outlines the social planning solution. Section 5 explores the qualitative effects of international trade in the “presumptive” case of the model. Section 6 discusses the implications of the model in the “nonpresumptive” case. Section 7 reports the results of a calibration of welfare gains. Section 8 concludes.
2. The Model

We first develop a basic general-equilibrium model where there exists strategic interaction between firms. Goods are differentiated in two dimensions. There is a continuum of sectors of measure 1, and consumers will wish to consume goods from each of these sectors. But within any sector, there is a finite number of firms who produce differentiated goods. We sketch out the structure of the model as follows.

Preferences

Let consumers have utility given by:

$$\sum_{i=0}^{\infty} \beta^i U(C_i, 1-L),$$

(1)

where

$$C = \left[ \int_0^1 C_i^{1-\frac{1}{\rho}} di \right]^{\frac{1}{1-1/\rho}}$$

$$C_i = \left[ \sum_{j=1}^{N} c_{ij}^{1-\frac{1}{\lambda}} \right]^{\frac{1}{1-1/\lambda}}.$$

Here $C$ is a composite consumption, and $L$ is labor supply. We assume that $U(.)$ satisfies the usual curvature conditions. In addition, we make the assumption that

$$U(C, 1-L) = \frac{1}{1-\sigma}(C^\sigma(1-L)^{1-\gamma})^{1-\sigma}.$$  

There is a continuum of industries ranged over the interval $[0, 1]$. Within an industry, there is a finite number of firms, denoted $N$. $N$ is endogenous, determined by free entry subject to a fixed cost. The fixed cost is large so that $N$ is relatively small. The elasticity of substitution between goods within an industry is $\lambda$.

Consumers have the budget constraint given by:

$$\tilde{P}_i C_i + \tilde{P}_i I_i = W_i L_i + R_i K_i + \Pi_i,$$

(2)

where

$$\tilde{P}_i = \left[ \int_0^1 p_{ij}^{1-\rho} di \right]^{\frac{1}{1-\rho}}$$

and

$$P_i = \left[ \sum_{j=1}^{N} p_{ij}^{1-\lambda} \right]^{\frac{1}{1-\lambda}}.$$

Here $p_{ij}$ represents the price of the good $j$ within industry $i$. $I_i$ represents the number of units of the composite investment good. The investment good is constructed in the same manner as the composite consumption good. Given the level of investment $I_i$, the consumers’ capital stock evolves as:

$$K_{t+1} = K_t (1 - \delta) + I_t,$$

(3)

where $\delta$ is the rate of depreciation in investment. $W_i$ is the wage rate, and $R_i$ is the rental rate to capital. Finally, $\Pi_i$ represents total domestic profits of the good.
From the optimal choices of consumers, it is easy to see that the inverse demand curve facing a firm $ij$ will be:

$$p_{ij} = \left( \frac{x_{ij}}{X_i} \right)^{\frac{1}{\lambda}} \left( \frac{X_i}{X} \right)^{\frac{1}{\rho}} P,$$  \hspace{1cm} (4)

where $x_{ij} = c_{ij} + i_{ij}$, and

$$X_i = \left( \sum_{j=1}^{N} x_{ij} \right)^{\frac{1}{1-\lambda}},$$ etc.

The optimal labor leisure choice is determined by:

$$U_1(C_t, 1 - L_t) \frac{W_t}{P_t} = U_2(C_t, 1 - L_t).$$ \hspace{1cm} (5)

In addition, the capital stock is implicitly determined by the Euler condition:

$$U_1(C_t, 1 - L_t) = \beta U_1(C_{t+1}, 1 - L_{t+1})(R_{t+1} + (1 - \delta)).$$ \hspace{1cm} (6)

**Firms**

Firms in industry $i$ will choose output $x_i$ to maximize profits subject to the demand curve (4). We make the explicit assumption that firms will take into account the effect of their actions on the industry $i$ subcomposite $X_i$ when they choose $x_{ij}$. This is because they are not small relative to the size of the market. Firms therefore act as Cournot–Nash competitors, choosing production taking as given the production levels of other firms in the industry, and also taking as given the output levels of other industries.

Each firm faces a technology given by: $x_{ij} = \theta K_a^{\alpha} L_{ij}^{1-\alpha} - \phi$, where $x_{ij}$ is sales, $L_{ij}$ is labor input, and $\phi$ represents a fixed cost of production.

The firm’s profit is defined as:

$$\Pi' = p_{ij} x_{ij} - \left[ \frac{q(W_t, R_t)}{\theta} \right] (x_{ij} + \phi),$$ \hspace{1cm} (7)

where the term in square brackets represents the unit cost function of the firm at its cost-minimizing allocation of labor and capital.

In a Cournot–Nash equilibrium, firm $ij$ will choose $x_{ij}$ to maximize profits taking the outputs of all other firms in the industry as given. The resulting optimum for the given firm $ij$ will lead to a markup of price over cost given by:

$$p_{ij} = \mu_{ij} \frac{q(W_t, R_t)}{\theta},$$ \hspace{1cm} (8)

where $\mu_{ij}$ is the markup, given by:

$$\mu_{ij} = \frac{\lambda}{\lambda - 1 - \rho (\lambda - \rho) \frac{x_{ij}^{1-\lambda}}{\sum_{k=1}^{N} x_{jk}^{1-\lambda}}}.$$ \hspace{1cm} (9)
The intuition behind (9) is as follows. The elasticity of demand facing firm \( ij \) depends on its own production, relative to the production of the other firms within its industry, and on the output of its industry, relative to the output of all other industries. When the firm has a very small share of industry output, an increase in its output has a negligible effect on industry output, and its elasticity of demand is \( \lambda \); the within-industry elasticity of substitution. But when the firm has a large share of industry output, an increase in its production will substantially increase industry output. The implication for the firm’s elasticity depends upon two conflicting effects. First, the greater the firm’s share of the industry, the less will a unit increase in its output raise its output \textit{relative to industry output}. This gives the firm more monopoly power within the industry, and implies a lower elasticity of demand. This we term the “within-industry” effect. There is a second effect, however. The greater the firm’s share of the industry, the more will a unit increase in its output raise industry output, \textit{relative to output of all other industries}. This increases the degree to which the firm is competing with other industries, and implies a higher elasticity of demand. We call this the “across-industry” effect. If \( \lambda > \rho \), the within-industry effects dominate the across-industry effects, and the firm’s elasticity will be lower, the greater its share of industry output. But if \( \lambda < \rho \), the across-industry effect dominates the within-industry effect, and the firm’s elasticity of demand is declining in its share of industry output.

We focus on a symmetric equilibrium where the number of firms within an industry is the same for all industries, and the fixed costs and sales per firm is the same for all firms. It then follows that (a) the common elasticity of demand facing all firms will be decreasing (increasing) in the number of firms in the market as \( \lambda > \rho \) (\( \lambda < \rho \)); and (b) from (9) the price–cost markup is higher (lower) than that of monopolistic competition (which would be \( \lambda(1 - \lambda) \)) as \( \lambda > \rho \) (\( \lambda < \rho \)).

It would seem reasonable to assume that \( \lambda > \rho \), so that goods within an industry are better substitutes for one another than goods between industries. For most of the paper we maintain this assumption. In section 6, however, we investigate the implications of the alternative assumption.

In a symmetric equilibrium, \( P = P^*, P^* = N^{\theta(1-\lambda)}p, C = C, \) and \( C_i = N^{\theta(1-1/\lambda)}c, \) etc. Then equilibrium markups in each industry will be:

\[
\mu(N) = \frac{\lambda}{\lambda - 1 - (\lambda - \rho)} \frac{1}{\rho N}.
\]

Firms will enter each industry as long as profits exceed fixed costs.\(^4\) The free-entry condition then implies that \( N \) is determined by:

\[
p_i x_i - \frac{q(W_i, R_i)}{\theta} (x_i + \phi) = \mu(N_i) \frac{q(W_i, R_i)}{\theta} x_i - \frac{q(W_i, R_i)}{\theta} (x_i + \phi) = 0,
\]

or

\[x_i (\mu(N_i) - 1) = \phi.
\]

Moreover, in a symmetric equilibrium, \( x = (\theta K^\alpha L^{1-\alpha})/N - \phi, \) so that we have the condition:

\[x
\]
\[
N = \frac{\theta K^a L^{1-a}}{\phi \lambda} \left( 1 + \frac{\lambda - \rho}{\rho N} \right). \tag{10}
\]

The equilibrium number of firms in each industry will depend positively on the scale of total output, but negatively on the fixed cost of entry.

It is easy to establish that equilibrium factor prices will satisfy:

\[
W_i = (1 - \alpha) \frac{p_i \theta K_i^a L_i^{1-a}}{\mu(N_i)}, \tag{11}
\]

\[
R_i = \alpha \frac{p_i \theta K_i^{a-1} L_i^{1-a}}{\mu(N_i)}. \tag{12}
\]

**Market Clearing**

We make the normalization \( \hat{P}_t = 1 \). This implies that the price of an individual product is given by \( p_t = N_i^{\frac{1}{\lambda(\lambda - 1)}} \). Entry of a new firm raises individual product prices, relative to the CPI, owing to the “variety effect” that is familiar from this type of model. Using this, and (10), the aggregate market-clearing condition can be written as:

\[
C_t + K_{t+1} - (1 - \delta) K_t = N_t^{\frac{1}{\lambda(\lambda - 1)}} \left( \theta K_i^a L_i^{1-a} - \phi N_i \right). \tag{13}
\]

The right-hand side of (13) indicates that firm entry has two effects on total output of the economy. First, it increases output directly through the “variety effect” of a more extensive number of differentiated goods. This effect is captured by the \( N_i^{\frac{1}{\lambda(\lambda - 1)}} \) term. On the other hand, higher entry imposes a fixed cost, reducing output that can be devoted to consumption and investment.

### 3. Equilibrium

Now using equations (5), (6), (9'), (10), (11), (12), and (13), we can define an equilibrium for this economy in terms of the following equations:

\[
N_t = \frac{\theta K_i^a L_i^{1-a}}{\phi \lambda} \left( 1 + \frac{\lambda - \rho}{\rho N_i} \right), \tag{10'}
\]

\[
(1 - \alpha) \frac{p_i \theta K_i^a L_i^{1-a}}{\mu(N_i)} = \frac{1 - \gamma}{\gamma} C_t \frac{1}{1 - L_t}, \tag{14}
\]

\[
C_t = \left[ N_t^{\frac{1}{\lambda(\lambda - 1)}} (\theta K_i^a L_i^{1-a} - \phi N_i) - K_{t+1} + (1 - \delta) K_t \right], \tag{15}
\]

\[
U_t \frac{1}{C_t} = \beta U_{t+1} \frac{1}{C_{t+1}} \left[ \theta N_i^{\frac{1}{\lambda(\lambda - 1)}} \frac{1}{\mu(N_i)} \right] + 1 - \delta, \tag{16}\]

where \( U_t = [(C_t(1 - L_t)^{1-\gamma})/(1 - \sigma)] \).

Given the definition of \( \mu \) from (9'), equations (10'), (14), (15), and (16) may be solved for the time path of \( L_t, C_t, N_t, \) and \( K_t \).
Steady State

How does the strategic entry decision affect the steady-state capital stock? From (10) and (14)–(16) we may derive the steady-state values of \( L, C, N, \) and \( K \). Using (10), and (14)–(15), we may obtain the steady-state level of labor supply as:

\[
L = \frac{\psi}{\psi + \eta},
\]

where

\[
\psi = \frac{(1 - \beta(1 - \delta))}{(1 - \beta(1 - \delta(1 - \alpha)))}, \quad \eta = \frac{1 - \gamma}{\gamma(1 - \alpha)}.
\]

Thus, steady-state employment is unaffected by the markup (or preference) parameters \( \lambda \) or \( \rho \). A higher markup reduces the real wage through (11), leading households to substitute out of employment. But the higher markup induces entry, and the fixed costs of entry generate a negative income effect which leads households to work more hours. In a steady state these two effects exactly counterbalance each other, and there is no impact on total employment.\(^5\)

Then (10) and (16) may be written in the steady state as:

\[
\frac{N^2}{N + \frac{(\lambda - \rho)}{\rho}} = \frac{\theta K^\alpha L^{1-\alpha}}{\phi \lambda}, \quad (18)
\]

\[
K^{1-\alpha} = \frac{\beta \alpha}{(1 - \beta(1 - \delta))} N^\frac{1}{\lambda - 1} L^{1-\alpha} \mu(N). \quad (19)
\]

Equations (18) and (19) give two equations in steady-state \( N \) and \( K \). These are illustrated in Figure 1. Equation (18) describes the entry decision and is illustrated by the NN curve. It is increasing and concave.\(^6\) Equation (19) describes the long-run

Figure 1.
Euler equation for the determination of the capital stock. It is illustrated by the KK curve. This curve is increasing and convex.

A rise in the fixed cost parameter \( \phi \) will shift the NN curve down towards the right, holding the KK curve constant. This will imply a lower steady-state capital stock, and a smaller number of firms in the market.

The important message of Figure 1 is that the number of firms in the market will rise by less than in proportion to the size of the market itself.

4. The Social Planning Outcome

How does the presence of strategic interaction reduce economic welfare in this economy? We now compare the equilibrium described by the last section with the social planning outcome.

If the social planner has access to a sufficiently rich set of instruments, then the social planning solution can be described by the results of choosing the sequence of \( N_t, L_t \), and \( K_t \) to maximize (1) subject to the resource constraint (13). It is easy to establish that the solution to this gives:

\[
N_t = \frac{\theta K_t^{\alpha} L_t^{1-\alpha}}{\phi \lambda},
\]

\[
(1-\alpha)\rho \theta K_t^{\alpha} L_t^{\alpha} = \frac{1-\gamma}{\gamma} C_t \frac{1}{1-L_t},
\]

\[
C_t = \left[ N_t^{\frac{1}{\lambda-1}} (\theta K_t^{\alpha} L_t^{1-\alpha} - \phi N_t) - K_{t+1} + (1-\delta)K_t \right].
\]

\[
U_t \frac{1}{C_t} = \beta U_{t+1} \frac{1}{C_{t+1}} \left( \alpha N_t^{\frac{1}{\lambda-1}} \theta K_t^{\alpha-1} L_t^{1-\alpha} + 1 - \delta \right).
\]

Equation (23) indicates that the social planner will realize a higher return to capital than the private market. In addition, the social planning optimum for the entry of firms is not affected by the price markup.

In a steady state, the social planning outcome for \( L \) is identical to that of the private market. From (20)–(23) we may derive the analogous equations to (18) and (19), for the social planner. These are given by:

\[
N = \frac{\theta K^{\alpha} L^{1-\alpha}}{\phi \lambda},
\]

\[
K^{1-\alpha} = \frac{\beta \alpha}{(1-\beta(1-\delta))} N^{\frac{1}{\lambda-1}} L^{1-\alpha}.
\]

In terms of Figure 1, the social planner’s representation for the locus NN is below and to the right of the private-market NN locus along its length. For a given capital stock, the social planner will choose a smaller number of firms in each industry than would be determined by competitive entry in the private market. Thus, conditional on \( K \), there is “excess entry” in the economy with Cournot–Nash competition.
The social planning representation for the KK locus is below and to the right of the private-market KK locus. Since the social planner realizes a higher return to capital, for any given level of \( N \), the optimal capital stock for a given \( N \) is higher in the social planning solution.

At first glance, the comparison between the private market case and the social planner’s case might seem ambiguous. But in fact, the social planner’s capital stock must exceed that of the private market. To see this, note that the steady-state investment rule for the social planner is given by:

\[
K = \frac{\beta \alpha}{1 - \beta(1 - \delta)} N^{1-\gamma} (K^a L^{1-a} - \phi N). \tag{26}
\]

The value of \( N \) that maximizes the right-hand side of (26), conditional on \( K \), is that given by (20). On the other hand, the private-market investment rule is given by (26) in the presence of the \( N \) rule given in (10). The right-hand side of (26) must be lower in the latter case. Thus, the steady-state level of capital in the social planning equilibrium must be greater than that of the decentralized private market.

Note, however, that while the social planner follows an entry policy that leads to fewer firms per industry, conditional on the capital stock, it may well be that in a social planning equilibrium the efficient number of firms exceeds that of the private market, since the equilibrium capital stock itself is higher in the former case.\(^7\) An interesting special case obtains when \( \lambda \to \infty \), and there is perfect substitutability between goods within an industry. In this case, the social planning solution for \( N \), given by (23), would be bound by the \( N \geq 1 \) constraint, and the social planner would choose a single firm in each industry—a natural monopoly. But in the private market case, there may still exist an oligopolistic situation, since when \( \lambda \to \infty \), \( N \) is determined by the condition:

\[
N = \sqrt{\frac{\theta K^a L^{1-a}}{\phi \rho}}.
\]

Thus, there may be excess entry, even when goods are perfectly substitutable.

5. The Effects of International Trade

We now look at the effects of this country opening up to international trade. Let’s say there is now free trade in the goods of all industries. Assume that there are \( M \) countries in the world economy. Countries are identical in technology and preferences, but may differ in their population size. Let \( g_h \) represent the population of country \( h \), and \( G = \sum_{h=1}^{M} g_h \) be the world population. With free trade, there will be \( N^w = \sum_{h=1}^{M} N_h \) world firms in a typical industry. A firm \( ij \) in any country will compete with other firms in its own country and in all other countries. The optimal price cost markup for the \( ij \)th firm will be:

\[
\mu_{ij} = \frac{\lambda}{\lambda - 1 - (\lambda - \rho) \frac{x_{ij}^{1-1/\lambda}}{\sum_{h=1}^{N^w} x_{ih}^{1-1/\lambda}}}.
\]
We will focus on a symmetric equilibrium where markups of all firms and all countries are identical. Since technology and preferences are identical in all countries, such an equilibrium is valid. What this implies is that output per firm will be identical across countries, although the number of firms will not be identical, owing to population size differences between countries. Thus, the world equilibrium markup is now:

$$\mu = \frac{\lambda}{\left(\lambda - 1 - \frac{\lambda - \rho}{\rho} \frac{1}{\sum_{h=1}^{M} N_h}\right)},$$

(27)

where $N_h$ is the number of firms in country $h$.

In a steady state, country $h$ will then have the budget constraint:

$$\tilde{P}_h (C_h + \delta K_h) = p(g_h K_h^\alpha L_h^{1-\alpha} - \phi N_h),$$

(28)

where $C_h$ and $K_h$ represent the consumption and capital stock per capita in country $h$, and $\tilde{P}$ and $p$ represent, respectively, the common world composite good price and the common world price of the industry good. Again making the numéraire such that $\tilde{P} = 1$, we have:

$$1 = \left( \sum_{i=1}^{M} N_h \right)^{1-\lambda} \mu.$$

(29)

Since countries are identical in technology and preferences, and face identical prices, equilibrium per capita labor supply will be identical, and equal to (17) above. The determination of firm entry within each country $h$ is governed by the condition:

$$(\mu - 1)(g_h K_h^\alpha L_h^{1-\alpha} - \phi N_h) = \phi N_h.$$

Thus, the steady-state number of firms in country $h$, conditional on the capital stock, is given by:

$$N_h = g_h (\mu - 1) \frac{K_h^\alpha L_h^{1-\alpha}}{\phi \mu}.$$

(30)

Finally, since all countries have identical rates of time preference, the steady-state interest rate is identical across countries and equal to $1/\beta(1 - \beta(1 - \delta))$. Thus, the steady-state capital stock for country $h$ is governed by equality between the return to capital and the equilibrium interest rate:

$$\frac{p \alpha K_h^{\alpha-1} L_h^{1-\alpha}}{\mu} = \frac{1}{\beta} (1 - \beta(1 - \delta)).$$

(31)

Rearranging this expression gives the steady-state capital stock as implicitly determined by:

$$K_h^{1-\alpha} = \frac{\beta \alpha}{(1 - \beta(1 - \delta))} \frac{(N^u)^{\frac{1}{\alpha-1}} L_h^{1-\alpha}}{\mu}.$$

(32)
It follows that the steady-state capital stock, per capita, is identical across countries. Then, from (30), we may sum across countries so that:

\[
N^w = G \frac{K^a L^{1-\alpha}}{\phi \lambda} \left( 1 + \frac{\lambda - \rho}{\rho} \frac{1}{N^w} \right).
\]  

(33)

**Gains from Trade**

Since steady-state employment is not affected by trade, we can describe the welfare gains from trade by their effects on steady-state consumption. Equations (33) and (32) allow us to explain the nature of the gains from trade. First note that steady-state consumption per capita, for any country, is given by:

\[
C = p \left( K^a L^{1-\alpha} - \phi \frac{N_h}{g_n} \right) - \delta K
\]

\[
= N^{w/(\lambda-1)} \frac{K^a L^{1-\alpha}}{\mu} \left( 1 - \frac{\beta \alpha \delta}{(1 - \beta)(1 - \delta)} \right).
\]  

(34)

First, imagine that the steady-state capital stock was unaffected by opening up to international trade. Then from (33) the only effect of trade is to increase the number of firms selling in each industry. From (34) this has two separate effects on welfare. First, holding \( \mu \) constant, then the increase in \( N^w \) will directly increase consumption by raising the industry price \( p \) (given that the price of the composite consumption good is fixed at unity). With a constant \( \mu \), the rise in \( N^w \) is proportional to the increase in the size of the market. The number of firms per country, \( N_h \), will remain unchanged. This represents the standard “variety” gains to trade (Krugman, 1980; Helpman and Krugman, 1985), arising from the utility benefits to a more extensive line of differentiated commodities within each industry.

But in the presence of strategic interaction between firms at the industry level, there is a secondary gain due to the fact that trade will increase competition and reduce industry markups. This is the pure “competitive” gain to trade. The fall in the markup will, from (30), reduce \( N_h \) for each country. This has the effect of reducing \( p \). But consumption must rise, because \( N_h \) is inefficiently high for each country to begin with. From the first line of (34), the positive effect of the fall in \( N_h \), reducing fixed costs, must outweigh the negative impact of the fall in \( p \).

Thus, in the presence of the competitive effects of international trade, the number of firms in each industry will rise less than in proportion to the growth of the market. The effect of international trade will be such that each country will lose some of its existing firms. But the elimination of inefficient over-entry increases the resources available for consumption.

It is possible to isolate exactly these two separate channels for welfare gains from trade by looking at special cases. In the case \( \lambda = \rho \), the price–cost markup is constant at \( \lambda/(\lambda - 1) \), firm entry is efficient, and entry per-country is unaffected by trade. Then the only welfare gains are attributable to the pure “variety” effects. On the other hand, when \( \lambda \to \infty \), goods within an industry are perfect substitutes, and there is no variety effect. But international trade will still eliminate inefficient over-entry since, when \( \lambda \to \infty \), we have:
After opening trade, the number of firms in each world industry rises, but by less than in proportion to the population size of the trade agreement. There are fewer domestic producers in each country, and welfare rises. In this case, then, the gains to trade are attributable purely to “competitive” effects.

Both welfare channels imply that smaller countries will benefit more from international trade. The variety channel is more beneficial to a smaller country that begins with a narrow product line. But the competitive channel is also more beneficial to a smaller country. Autarky markups will be higher, the smaller is the country size. In a steady-state trading equilibrium, however, markups are identical across countries. Thus, markups fall proportionally more, following the introduction of international trade, in smaller countries.

Up to now, we have been holding the steady-state capital stock fixed. But in fact equation (32) makes clear that the capital stock will increase as a result of international trade. Both welfare channels combine to produce this result. The variety channel increases the return to investment by increasing the price of each industry good, relative to the price of a unit of investment, \( p \). The competitive channel increases the return to investment by reducing industry markups and raising the rental rate on capital. As a result, the steady-state capital stock must increase.

As \( G \) rises (the size of the trade agreement increases), the world markup will approach the monopolistic competitive level \( \lambda/(\lambda - 1) \). In this case, the welfare loss due to excess entry is asymptotically eliminated, and the number of firms in each world industry approaches its socially efficient level. But the distortion due to monopoly pricing is still present. International trade alone cannot achieve the social planning outcome in this model.

6. The Implications of Alternative Elasticity Rankings

We have maintained the assumption \( \lambda > \rho \) for the analysis so far. It is reasonable to argue that this is the “presumptive” case. However, we might ask how the results change when \( \rho > \lambda \). If the across-group elasticity exceeds the within-group elasticity, then the results with respect to the inefficiency of entry in a market equilibrium are reversed. Now the elasticity facing a firm is higher, the larger the share of the firm in the industry. This is because when \( \rho > \lambda \) the sensitivity of the firm’s price due to across-industry substitution exceeds the sensitivity due to within-industry substitution. At the market-equilibrium entry level, the addition of one more firm within an industry then tends to raise profits for all other firms. It follows that the market equilibrium will exhibit inefficiently few firms. (The NN curve in Figure 1 will be increasing and convex.)

The opening of international trade is still welfare-enhancing in this alternative scenario. But the direction of effects is very different. First, the larger market tends to reduce the elasticity facing any given firm, and will encourage increased entry, so that with trade, the number of firms per country will be higher. Equilibrium price–cost markups rise in each industry after trade. In this sense, trade might be said to be anti-competitive! But welfare still increases. In terms of equation (34), the effects of trade...
are (i) an increase in \( p \), for a given markup, due to the larger market; (ii) a rise in \( N_h \) (and therefore \( p \)), due to the rise in the industry markup. The first effect will always increase consumption, as before. But the second effect will also increase consumption, despite the rise in the industry markup, because \( N_h \) is inefficiently low to begin with. The inefficiently low entry in the market equilibrium guarantees that the welfare effects of the increase in product price always dominate the increased fixed costs of higher entry.

The two channels whereby international trade affects the steady-state capital stock now conflict with one another. On the one hand, the product diversity effect will increase the productivity of capital and stimulate investment. But the increase in the price–cost markups will reduce the incentive to invest. Nevertheless, the steady-state capital stock must rise, since the first effect will dominate the second, under exactly the same conditions that international trade increases consumption when the capital stock is held fixed.

7. A Quantitative Evaluation

We conduct an exercise to assess how the magnitude of steady-state welfare gain from international trade varies with various parameters of the model. In the evaluation of welfare gains, we disaggregate the total welfare into “variety” and “competitive” percentages and examine how the two proportions vary with different parameters. We follow Cole and Obstfeld’s (1991) measurement of welfare gain by using the percentage increase in steady-state consumption implied by opening up to trade. This is justified because, in our analytical model, consumers’ steady-state labor choice is not affected by trade.

The parameters are taken from previous studies (mostly on US data). We set \( \beta = 0.96 \) and \( \delta = 0.1 \), which are equivalent to the annualized values used in the real business cycle literature (e.g., Hansen, 1985). The labor share parameter, \( 1 - \alpha \), is chosen to be 0.71 which follows from Greenwood et al. (1988). The budget share \( \gamma \) is set to 0.35 so that the consumers spend approximately 32% of their time endowment to working in the steady state. The fixed cost \( \phi \) is set to 1% for most of the experiments. We also assume \( \sigma \) to be 2, and this implies that the intertemporal elasticity of substitution is 0.5. This assumption affects only the magnitude of welfare gains from trade but not the ranking of these gain across different parameters. The higher the intertemporal elasticity of substitution, the greater are the welfare gains from trade.

The parameters \( \lambda \) and \( \rho \) in the model are chosen such that \( \lambda > \rho \), where the elasticity of substitution is greater within each industry than across industries. In the case where \( \lambda = \rho \), the markup is a constant and it is not affected by firm entry. Here, the gains from trade will be derived purely from the increase in variety. Without loss of generality, we set \( \rho = 1 \) so that the expenditure on the composite good in each industry is constant. We also check that the integer constraint on firm entry is respected in our evaluation.

We first study how the welfare gain from trade for each country varies with the scope of the trade agreement, \( G \). First let each country have population 1.25 and \( \lambda = 8 \). Panel A of Table 1 reports the calibration result, where \( M \) is the number of countries in the trade agreement. The numbers in parenthesis are obtained under the autarky regime. We observe that without trade, there is “over-capacity” and each country has 11 firms in each industry. The number of entrants per country falls as trade opens up between
### Table 1. Steady-State Welfare Gains from Trade

<table>
<thead>
<tr>
<th>Firm entry, N</th>
<th>Markup, μ</th>
<th>Percentage increase in K</th>
<th>Percentage welfare gain (variety, efficiency)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.</strong> $M$ ($\lambda = 8$, $g_h = 1.25$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>1.2030</td>
<td>20.97</td>
</tr>
<tr>
<td></td>
<td>(11)</td>
<td>(1.2571)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>1.1688</td>
<td>48.19</td>
</tr>
<tr>
<td></td>
<td>(11)</td>
<td>(1.2571)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>1.1590</td>
<td>65.28</td>
</tr>
<tr>
<td></td>
<td>(11)</td>
<td>(1.2571)</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>9</td>
<td>1.1504</td>
<td>94.40</td>
</tr>
<tr>
<td></td>
<td>(11)</td>
<td>(1.2571)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>9</td>
<td>1.1492</td>
<td>101.06</td>
</tr>
<tr>
<td></td>
<td>(11)</td>
<td>(1.2571)</td>
<td></td>
</tr>
<tr>
<td><strong>B.</strong> $g_{l}/G$ ($\lambda = 8$, $M = 2$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>2</td>
<td>1.2030</td>
<td>163.23</td>
</tr>
<tr>
<td></td>
<td>(3)</td>
<td>(1.7143)</td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td>4</td>
<td>1.2030</td>
<td>77.16</td>
</tr>
<tr>
<td></td>
<td>(5)</td>
<td>(1.4286)</td>
<td></td>
</tr>
<tr>
<td>30%</td>
<td>6</td>
<td>1.2030</td>
<td>46.98</td>
</tr>
<tr>
<td></td>
<td>(7)</td>
<td>(1.3333)</td>
<td></td>
</tr>
<tr>
<td>40%</td>
<td>8</td>
<td>1.2030</td>
<td>31.07</td>
</tr>
<tr>
<td></td>
<td>(9)</td>
<td>(1.2857)</td>
<td></td>
</tr>
<tr>
<td>50%</td>
<td>11</td>
<td>1.2030</td>
<td>20.97</td>
</tr>
<tr>
<td></td>
<td>(10)</td>
<td>(1.2571)</td>
<td></td>
</tr>
<tr>
<td>60%</td>
<td>12</td>
<td>1.2030</td>
<td>13.85</td>
</tr>
<tr>
<td></td>
<td>(13)</td>
<td>(1.2381)</td>
<td></td>
</tr>
<tr>
<td>70%</td>
<td>14</td>
<td>1.2030</td>
<td>8.48</td>
</tr>
<tr>
<td></td>
<td>(15)</td>
<td>(1.2245)</td>
<td></td>
</tr>
<tr>
<td>80%</td>
<td>16</td>
<td>1.2030</td>
<td>7.30</td>
</tr>
<tr>
<td></td>
<td>(16)</td>
<td>(1.2191)</td>
<td></td>
</tr>
<tr>
<td>90%</td>
<td>18</td>
<td>1.2030</td>
<td>3.30</td>
</tr>
<tr>
<td></td>
<td>(18)</td>
<td>(1.2101)</td>
<td></td>
</tr>
<tr>
<td><strong>C.</strong> $\lambda$ ($g_h = 1.25$, $M = 2$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>1.3659</td>
<td>47.52</td>
</tr>
<tr>
<td></td>
<td>(21)</td>
<td>(1.4035)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>1.2030</td>
<td>20.97</td>
</tr>
<tr>
<td></td>
<td>(11)</td>
<td>(1.2571)</td>
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</tr>
<tr>
<td>16</td>
<td>7</td>
<td>1.1487</td>
<td>17.29</td>
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<td>(1.2191)</td>
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<tr>
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<td>6</td>
<td>1.1285</td>
<td>8.82</td>
</tr>
<tr>
<td></td>
<td>(8)</td>
<td>(1.1823)</td>
<td></td>
</tr>
<tr>
<td>$\infty$</td>
<td>5</td>
<td>1.1111</td>
<td>7.28</td>
</tr>
<tr>
<td></td>
<td>(7)</td>
<td>(1.1667)</td>
<td></td>
</tr>
</tbody>
</table>
the countries and reaches a stable level of 9 per country as $M$ increases. The total number of firms per industry is increasing in $M$. If there are five countries in the trade agreement, the number of firms per industry is 45 under free trade compared to 11 under autarky. Therefore, consumers will gain from an increase in variety with free trade. On the other hand, we observe that there is a reduction in over-capacity. Each country has 9 firms with trade as opposed to 11 without trade. The breakdown of the welfare gain shows that the percentage gain due to the “variety” effect is slightly larger than the gain due to the “competitive” effect.

Now we look at a two-country world economy where both countries differ in population size. We assume the world population $G$ to be constant at 2.5 so as not to vary the scope of trade agreement. In this case, the results will not be compounded by the scope effect described above. The results are reported in panel B of Table 1. The markup is the same for both countries in the presence of trade, but the autarkic markup varies inversely with the size of the country. A smaller country has fewer firms owing to its resource constraint. This in turn leads to higher markups in the autarky regime. Consequently, the degree of inefficiency (due to markups) is also higher when the country is smaller. In this case, a smaller country will benefit more from trade. We observe bigger welfare gains with smaller countries in panel B. Moreover, the percentage gain due to the “competitive” effect varies negatively with the size of the country, while the percentage gain due to “variety” effect varies positively with the size of the country.

Finally, we examine how our results will be affected by different values of $\lambda$. The results are reported in panel C of Table 1. The rise in capital and welfare gain with trade falls as $\lambda$ increases. The intuition is as follows. As the elasticity of substitution increases, households shift across goods in the same industry more easily. If firm entry is kept constant, then:

$$\frac{\partial \mu}{\partial \lambda} = \left( \frac{\mu}{\lambda} \right)^2 \left( \frac{1}{N} - 1 \right) < 0.$$  

Hence, firms have less leverage to impose a higher markup as $\lambda$ increases. The number of entrants will fall as a result. In the extreme case where $\lambda \rightarrow \infty$, all the goods within any industry become identical and there are no gains to product variety. In this case, the welfare gain from trade is derived solely from increased competition. In general, welfare gains from international trade are reduced as $\lambda$ increases.

8. Concluding Remarks

This paper has introduced elements of market power and strategic interaction into a dynamic, general-equilibrium model of international trade. It highlights an intuitive welfare gain from trade due to enhanced competition between firms in world markets. This augments the standard welfare gains to increased product variety. We show that in general equilibrium, this competitive gain from trade will manifest itself by reducing the profitability of local oligopolies, and in so doing will tend to alleviate the inefficiency due to excessive entry of firms. In a dynamic context, this competitive effect of trade will stimulate investment, and raise the steady-state GDP of all countries.
References


Notes

1. The model can also be seen as an application to an international trade environment of the dynamic general equilibrium method of imperfect competition, developed in papers such as Rotemberg and Woodford (1991, 1995), Hornstein (1993), and others. Rotemberg and Woodford (1995) and Hornstein (1993) focus on monopolistic competition without market power. Rotemberg and Woodford (1991) construct a (closed-economy) model where firms do interact strategically, and use trigger strategy equilibria to derive time-varying markups. The papers most closely related to the present paper are perhaps Van de Klundert and Smulders (1995, 1997). We discuss these below.

2. As shown below, given the preferences and technologies in the model, the income and substitution effects of higher price–cost markups on labor supply exactly offset each other.
3. Two papers that are close precursors of the present work are Van de Klundert and Smulders (1995, 1997). They develop general-equilibrium endogenous growth models in which firms interact strategically as in this paper. The primary focus of these papers is on the impact of market structure on innovation and growth. Van de Klundert and Smulders (1995) show that economic integration will increase economic growth, as it leads to enhanced competition within each country, reducing the number of monopolistic firms and reallocating demand towards research-producing sectors. By contrast, our paper abstracts from innovation and growth, and focuses primarily on a decomposition of the welfare effects of international trade in a strategic setting, and a comparison of the market and social planning outcomes within a strategic setting. In addition, our results, allowing for both “procompetitive” and “anticompetitive” effects of trade, turn out to be quite different.

4. A complication arises due to the fact that \( N \) should be integer-valued. Since the qualitative results of the model are unaffected by treating \( N \) as continuous, we abstract away from the integer constraint in the exposition. In the quantitative analysis of the gains from trade analyzed in the later section, however, we do impose the requirement that \( N \) be integer-valued. In general, the trade theory literature has abstracted away from the integer constraint; e.g., Brander and Krugman (1981).

5. Of course this result is dependent on the functional form assumption for preferences, in particular the assumption that there is a unitary elasticity of substitution between consumption and leisure. But it is worth noting that such an assumption is necessary for the existence of a balanced growth path in the standard neoclassical growth model (e.g., King et al., 1988).

6. It is necessary that \( N \geq 1 \) in the figure, to be consistent with the interpretation of the model.

7. Quantitative experiments establish that the number of firms in a social planning equilibrium is more likely to exceed the market equilibrium, the more similar are the two elasticities, \( \lambda \) and \( \rho \), and the higher is the share of capital in output, \( \alpha \). In the first case, when \( \lambda \) and \( \rho \) are exactly equal, entry under a social planner must strictly exceed that in the market equilibrium, because in this case the entry rules (18) and (24) coincide, and owing to the elimination of the markup distortion under the social planner, the capital stock is higher. By continuity, it follows that for \( \rho \) only slightly below \( \lambda \), entry will be higher with a social planner. In the second case, the higher the share of capital, the higher is the impact of eliminating the markup distortion on the capital stock (and therefore the size of the market), so the higher is the impact on entry.

8. To shorten the exposition, we deal only with the case where \( \lambda > \rho \) in this section.