International Outsourcing and Intra-Industrial Trade

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Krugman (1979) demonstrated that open trade between identical Northern countries leads to a greater variety of consumption and higher real wages. But would the North as a whole be better off when the firms in the North carry out international outsourcing trade? The issue is not well addressed in literature. I therefore present an extension to Krugman’s model, incorporating international outsourcing, to show that, assuming full employment, outsourcing trade not only leads to both higher real wage rates and more product variety, but also raises per capita consumption in the world. The model also suggests that technological improvements in the North raise real wage, per capita consumption, and even product variety.

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Introduction

It has been widely acknowledged that international outsourcing trade between the U.S. and East Asian countries plays a dominant role in depressing inflation rates in the U.S. since the 1990s. The multinational enterprises (MNEs) carry out international outsourcing to take advantages of lower wage costs in East Asian countries (especially China) to press down the retail prices of their final differentiated goods. In order to continuously make more profits and acquire more cost advantages among competitors in the global markets, the MNEs engage themselves into more international outsourcing activities. By the help of innovation in computation, communication, and transportation in the North, the fragmentation of a product process into several steps that are undertaken in different locations substantially could save on total production costs. Once a kind of final differentiated goods can be fragmentized into many stages of production, generally speaking, we should find that some stages are capital-intensive but some are labor-intensive. Low costs of communication and low costs of transportation, resulting from technological innovation, encourage MNEs to locate capital-intensive stages of production at home but locate labor-intensive stages of production in low-wage countries. Therefore, the total production costs reduce with the international outsourcing trade, which leads to lower prices of the consumer goods, implying higher real wages in consequence. That is, technology innovation in the North brings up more international outsourcing trade and then raises its real wage rates. On the other hand, productivity improvement in the South, resulting from knowledge spillovers from foreign direct investment (FDI) or from learning-by-doing, helps reduce the total production costs as well, so that the real wage in the North also increases with productivity improvement in the South. I further argue that the MNEs could deploy their
skill-intensive labor to generate new variety of final-goods when international outsourcing saves its demands for skilled-intensive but relatively expensive labor. It turns out that international outsourcing leads both to rising real wage rates and rising product variety in the world.

It is also well known that Krugman (1979) developed a modified version of the Dixit-Stiglitz (1977) model of monopolistic competition to demonstrate that consumers’ welfare improved through a greater variety of consumption and higher real wages. Fig. 1 illustrates the Dixit-Stiglitz (1977) model. It implies that an increase in the labor endowment in a closed economy leads to a wider variety of differentiated goods, but in smaller quantities. However, real wages will remain on the same level because of the constant elasticity-of-substitution assumption. Instead of applying the Dixit-Stiglitz constant elasticity-of-substitution (CES) utility, Krugman (1979), assuming particular forms of utility, found that the elasticity of demand faced by a representative firm decreases on account of the per capita consumption in an open economy. It seems that many models in trade literature, except for the famous paper by Krugman (1979), are variants of the monopolistic competition framework applying the CES utility function. In this paper, therefore, we apply the customary CES utility function to demonstrate a general equilibrium model of international outsourcing trade.

Figure 1. The Dixit-Stiglitz Model (1977)

Note: An increase in the labor supply shifts the DD curve downward, leading to less per capita consumption, but real wages is fixed.

The nature of international trade has changed dramatically in the last few decades. One element of change has been the emergence of intra-industrial trade among developed countries. Another change has been the growth in international outsourcing from developed to developing countries. Using the input-output tables of the OECD and some emerging market economies, Hummels, Ishii, and Yi (2001) determined that vertical specialization or international
outsourcing accounted for approximately 30% of world exports, growing more than 30% between 1970 and 1990. Grossman and Helpman (2002a, 1) noted:

We live in an age of outsourcing. Firms seem to be subcontracting an ever expanding set of activities, ranging from product design to assembly, from research and development to marketing, distribution, and after-sale services. Some firms have gone so far as to become “virtual” manufacturers, owning designs for many products but making almost nothing themselves.

According to Grossman and Helpman’s model, if technological improvements occurred disproportionately in the South, the North would do more international than domestic outsourcing. This, in turn, would lead to more vertically specialized trade between the North and South. It is common knowledge that some technological catching-up has taken place in recent years. However, is the North worse off because of it? Any answer to that is ambiguous and would depend on the setting of parameters in Grossman and Helpman’s (2002a) model, making it hard to assess whether the general welfare of the North increases with the shift in outsourcing. Therefore, I extend Krugman’s model into the North-South pattern in order to demonstrate that international outsourcing unambiguously causes both the North and South to be better off in terms of higher real wages and more product variety.

What if there is favorable technology shock occurring in the North? In Grossman and Helpman’s (2002a) model, disproportionate technological improvement in the South raises the relative wages in the South and shifts outsourcing activities from the North to the South. If technological improvements occur disproportionately in the North, their model predicts the opposite qualitative effects on the relative wages and on the level of international outsourcing. In that case, final-goods producers would conduct more intensive partner-searching activities in the North than in the South. Feenstra and Hanson (1996) also show that disproportionate technological improvements, reducing general production costs in the North, shift the outsourcing activities back from the South to the North.

On the contrary, our model implies that technological improvements in the North encourage the North to do more international outsourcing trade. In my model, real wages in both countries will rise on account of technological improvements and international outsourcing. The following observation will support this argument. It is well known that innovations in transportation and communication technology have lowered the costs associated with seeking outsourcing partners; computers and the Internet have also facilitated business-to-business matching and reduced the costs of customizing components (Grossman and Helpman, 2002a). However, these innovations have first occurred in the North and have only later been transferred to the South, encouraging, in effect, more international outsourcing activities rather than discouraging them. In other words, the outsourcing process has been helped by improvements in computation, transportation and communication, which enormously reduce the transportation and monitoring barriers against international outsourcing. These innovations especially encouraged the segmentation of production into assembly operations that could be transferred to low-wage areas, while skill-intensive operations remained in the North. That is, technology developments in the North encourage international outsourcing activities.

In recent years, there has been an emphasis on incomplete contracts in terms of international outsourcing trade between the North and the South. The models of Grossman and Helpman (2002a), Antràs (2003) Antràs and Helpman (2003) and Antràs (2004) all present a North-South model of international trade in which differentiated products are developed in the North only. The firms involved chose different strategies, such as foreign outsourcing or vertical
specialization, to maximize their profits. Final-goods producers and suppliers of components engage in relationship-specific investments, which are governed by imperfect contracts. In an incomplete contract environment, the South might under-invest while expecting a hold-up; therefore, the advantage of lower wage-rates in the South could become less attractive because of its unverifiable investment decisions. Hart and Moore (1988) argue that contractual incompleteness, due to the non-verifiability of the relevant state of the world, will lead to under-investment, while a hold-up could occur ex-post. However, Aghion, Dewatripont, and Rey (1994) show that the under-investment problem can be solved if the initial contract has a renegotiation design with default options and a bargaining-power allocation. The renegotiation design, enforced by some contractual provisions, such as performance-specific clauses and penalties for delay (or financial “hostages” refundable without interest), could achieve efficient investments and optimal risk sharing. Moreover, the South could pay license fees for technological transfers from the North to ensure good-quality outputs. Here incomplete contracts are not concerns in my model.

Grossman and Helpman (2002a, 2002b, and 2002c) assume that firms of the North and the South divide the surplus evenly in their partnership. However, as the outsourcing activities of Mattel and Nike demonstrate, that might not be a practical assumption. Feenstra (1998, p. 7) cited a classic example from Tempest (1996) about how a value chain is shared under the conditions of international outsourcing:

Consider the Barbie doll … Of the $2 export value for the doll when it leaves Hong Kong for the United States, about 35 cents covers Chinese labor, 65 cents covers the cost of materials, and the remainder covers transportation and overhead, including the profits earned in Hong Kong. The doll sells for about $10 in the United States, of which Mattel earns at least $1, with the rest covering transportation, marketing, wholesaling and retailing in the U.S. The majority of the added value comes therefore from U.S. activity. … The answer is that outsourcing activities by these corporations support a large U.S. presence: both Mattel and Nike do the design and marketing of their products in the United States.

In the cases of Nike and Mattel, their foreign affiliates or outsourcing partners in either Hong Kong or China are generally unlikely to receive an equal share of the surplus. In fact, the firms in the South usually receive only a tiny share of the surplus from the vertical integration. In our model, the share of the surplus (or added value) of the South is based on its relative contribution to the total added value of the final-goods.

The remainder of this paper is organized as follows. Section 2 sets up a model to demonstrate how technology shocks and international outsourcing influence a country’s welfare. In a way similar to Krugman (1979), I first discuss the point that the welfare of a nation changes with technological shock in a closed economy. Then I turn to a North-South trade model to address how international outsourcing affects the welfare of the world. Section 5 concludes.

The Model

This section demonstrates how trade, international outsourcing and technological shocks affect a nation’s welfare. As in Krugman (1979), my model begins with a closed economy in the North and then turns to outsourcing trade between the North and the South.
Intra-Industrial Trade in the North

Let’s start with an example of a closed economy with only one kind of production factor: labor. As the monopolistic competition model in Krugman (1979) shows, the economy is assumed to be able to produce any of a large number of final goods, with the goods indexed by \( i \). Suppose that these goods are similar and are ordered from 1 to \( n \). All consumers in the closed economy share the same CES utility function (Dixit and Stiglitz, 1993), into which all goods enter symmetrically:

\[
U = u\left( \sum_{i} c_i^\theta \right)^{\frac{1}{\theta}} \quad 1 > \theta > 0
\]

where \( c_i \) is the consumption of the \( i \)th goods. Here \( \theta \) is a constant and \( \frac{1}{1-\theta} \) is the elasticity of substitution between any pair of differentiated goods. All final-goods are similar, having the same costs function. Let’s assume that one representative of final-goods needs \( A \) kinds of differentiated intermediate inputs. The labor used in producing each final-goods is as follows:

\[
l_i = l_0 + \sum_{j=0}^{A} x_j a_j d_j
\]

where \( A \) is the number of stages of production, denoting the number of intermediate-inputs variety. I argue that the intermediate inputs can be substituted for each other; and the final-goods producers tend to adopt the optimum bundle of intermediate inputs, encouraging the introduction of laborsaving technology. It is not far from the truth to argue that the number of intermediate-inputs \( A \) also indicate “quality” of the final goods. It might add more functions to a final product while incorporating new intermediate-inputs. For example, modern cars, which embody computerized equipments, are subtler than the old-fashioned Ford Model-T.

To make the final goods different from others, a firm needs a fixed amount of labor \( l_0 \) to be engaged in R&D, marketing, etc. Here \( a_j \) is the labor requirement for producing one unit of intermediate input \( x_j \). Again, for simplicity’s sake, let’s assume that all intermediate goods are similar, so that \( x_j = x \) and \( a_j = a \), \( \forall j \). We can rewrite (2) as

\[
l_i = l_0 + Aa x
\]

We argue that development in technology help fragment production process, which in turn might save labor demands for producing intermediate-inputs. Therefore, we assume there is a relation to denote the development in laborsaving technology as

\[
\begin{cases}
\frac{dl_i}{dA} < 0 & \text{if } \varepsilon_i > 1 \\
\frac{dl_i}{dA} \geq 0 & \text{otherwise}
\end{cases}
\]
where $\varepsilon_x = -\frac{dx}{dA(A)}$ is elasticity of demand for intermediate goods $i$ with respect to technology development $A$, and $\forall i$. It might not be far from the true to argue that $\varepsilon_x > 1$, although hard evidence of it is difficult to obtain. It is mostly likely, implied from (4), that technology development could raise product variety. Suppose that the amount of final-goods output is as below:

$$Y = \left( \int_0^A x_i^\rho dj \right)^{\frac{1}{\rho}}$$

(5)

where $Y$ is the amount of final-goods and $x_j$ is the number of the intermediate input $j$. Here $\frac{1}{1-\rho} > 1$ is the elasticity of substitution between intermediate inputs. Here we assume that there is substitutability among all intermediate inputs, so that each final producer can adopt the optimal amount of each intermediate input for the use of the final-goods production. Since we assume that all intermediates are similar, we can rewrite (5) as

$$Y = A^\rho x$$

(6)

Plugging (6) into (3), we get

$$l_i = l_0 + aA^{1-1/\rho}$$

(7)

Each individual firm is small relative to the economy, so that the effects of its profit-maximizing behavior on other firms can be ignored. Suppose the representative final-goods producer chooses the price to maximize its profits, as below:

$$\pi = pY - \omega(l_0 + \int_0^A a_j x_j dj)$$

(8)

where $\omega$ is the labor wage rate in this closed economy. Here we drop the subscript $i$ in (8) for simplicity. The first order condition of (8) with respect to final-goods output is

$$\frac{p}{\omega} = \frac{aA^{1-1/\rho}}{(1 - \frac{1}{\varepsilon})}$$

(9)

where $\varepsilon$ is the constant elasticity of demand of differentiated final goods. In contrast to Krugman (1979), $\varepsilon$ is a constant in my model. We can illustrate (9) as a straight line SS as in fig. 2. In the long run, free entry requires zero profit, so we obtain from (8) that
\[ \frac{p}{\omega} = \frac{l_0}{Y} + aA^{\frac{1}{\rho}} \]  \hspace{1cm} (10)

Suppose the economy has a fixed supply of labor \( L \). For each final good, we have \( Y = Lc \). We can then illustrate (10) as a downward sloping curve DD with respect to \( c \), as in fig. 2.

**Figure 2. Technological Shocks in a Closed Economy**

![Diagram showing technological shocks](image)

Technology improvement shifts the DD curve downward to D’D’, and shifts the SS curve downward to S’S’; that is, a larger \( A \) reaches a new equilibrium with a lower \( \frac{p}{\omega} \). In the new equilibrium, from (9) and (10), we have

\[ \frac{p}{\omega} = \frac{\ell_0}{Y} = \frac{\ell_0}{Lc} \]  \hspace{1cm} (11)

A lower \( \frac{p}{\omega} \) implies a larger \( c \) in (11). That is, per capita consumption increases with technology development. Suppose there is a technology shock in this closed economy, leading to a larger stock of knowledge \( A \), which gives a rise to total output \( Y \). It turns out that both the per capita consumption and the real wage increase with the technology development. The illustration is shown as in fig 2.
Assume full employment, so we can determine the number of final goods produced in this closed economy after a favorable technological shock. This shock can be viewed as an improvement in laborsaving technology. The number of product variety is \( n = \frac{L}{l} \). From (4), we find out

\[
\begin{align*}
\frac{dn}{dA} &< 0 \quad \text{if } \varepsilon_x > 1 \\
\frac{dn}{dA} &\geq 0 \quad \text{otherwise}
\end{align*}
\]  

The number of product variety might increase with technology improvement when the development is laborsaving as a whole. However, to some extent, it might not be worse for consumers to have less variety in the other case. As mentioned above, we argue that the number of intermediate-inputs \( A \) indicate “quality” of the final goods. The final-goods might become subtle with better quality with a larger \( A \).

In the models of Dixit-Stiglitz (1977) and Krugman (1979), a rise in labor supply \( L \) implies a larger number of differentiated goods (i.e., a larger \( n \)). We argue from (12) that a rise in technological stock might lead to a larger number of differentiated final goods as well. In contrast to Dixit-Stiglitz and Krugman, my model implies that a favorable technological shock brings higher real wages and higher per capita consumption of each variety to consumers, and likely provides even more variety of consumption.

In a monopolistic competition model, open trade between these identical countries leads to intra-industrial trade (Krugman 1979). The open trade leads to greater variety of consumption, less per capita consumption of each good, and higher real wages. Here we turn to an analysis of international outsourcing trade. Suppose in a world of North and South. They have identical tastes, but different in wage rates, labor supplies, and technologies. In contrast to Krugman (1979), I argue that not only intra-industry trade, but also international-outsourcing trade improves consumers’ welfare in terms of product variety and real wages.

**International Outsourcing Trade between North and South**

In the world of North and South, only the North is engaged in headquarter services to develop differentiated final products, and it carries out international outsourcing to the South for the low-end stages of production. The South imports final-goods in return. Let’s normalize the wage of the South as one. The firm in the North determines to import intermediate-inputs along \([1, zA]\) from the South, where \(1 > z > 0\). Assuming similarity in these intermediate-inputs, the profit maximization of the firms in the North can be simplified as

\[
\pi = pY - \omega(l_0 + (1 - z)Aax) - zAa^*x
\]  

Subject to balance of trade,

\[
\mu(z) pY = zAa^*x
\]
where $\mu(z)$ is the share of final-good that the South could acquire. It is feasible to assume the share $\mu(z)$ increases with outsourcing activity $z$ disproportionately (i.e., $\mu(z)<1$). The more the South is engaged in international outsourcing, the more the South acquires in the value-added chain. However, since all R&D activities stay in the North, we expect $\mu(z)<z$, that is, the sharing in world output is in favor of the North. The first order condition of (13) with respect to output is

$$
\frac{p}{\omega} = a(1-z)A \frac{1}{(1-\mu(z))(1-\frac{1}{\varepsilon})}.
$$

(15)

Note that $\frac{1-z}{1-\mu(z)}$ decreases with $z$ because of $\mu(z)<1$. We can illustrate (15) as a straight line SS with respect to $c$ as in fig. 3. In the long run, free entry requires zero profit, so we obtain from (13) and (14) that

$$
\frac{p}{\omega} = \frac{l_0}{(1-\mu(z))Y} + \frac{1-z}{1-\mu(z)}aA^{\frac{1}{\rho}}
$$

$$
= \frac{l_0}{Lc} + \frac{1-z}{1-\mu(z)}aA^{\frac{1}{\rho}}
$$

(16)

Suppose the South has a fixed supply of labor $L^*$, and each labor consumes $c^*$ amount of each final-good, where $c^*<c$. For each final good, we then have $Y = Lc + L^*c^*$. We can then illustrate (16) as a downward sloping curve DD with respect to $c$, as in fig. 3.

When the exogenous outsourcing index $z$ increases, the D’D’ curve in fig. 2 would shift further downward to D”D”, and the SS curve would shift downward to S’S’. Combining (15) and (16), the new equilibrium is

$$
\frac{p}{\omega} = \frac{eL_0}{(1-\mu(z))Y} = \frac{eL_0}{Lc}
$$

(17)

The new equilibrium shows a higher real wage, implying a larger per capita consumption in (17). Combining with (6), the total product variety becomes

$$
n = \frac{L}{l_0 + (1-z)aYA^{\frac{1}{\varepsilon}}}
$$

(18)

We find out (18) increases with international outsourcing if $z$ is large enough; that is,
\[ \frac{dn}{dz} > 0 \text{ if } \varepsilon_\ell < \frac{z}{1-z} \] (19)

where \( \varepsilon_\ell = dY/d\ell \) is elasticity of substitution of output with respect to outsourcing. It is feasible to assume \( 0 < \varepsilon_\ell < 1 \) because the world output should disproportionately increase with the international outsourcing activity \( z \). When \( z > \frac{1}{2} \), (19) holds. However, it might not require such a large \( z \) to make (19) hold because \( \varepsilon_\ell \) should be less with a small \( z \). It implies from (19) that when the world engages in more international outsourcing activities, the international outsourcing activities encourage generation of new product variety.

The reducing price of final-goods, resulting from international outsourcing, also raises the real wage of the South (i.e., \( \frac{1}{p} \) increases with international outsourcing). The South also benefits from outsourcing with more per capita consumption because it could acquire a larger share of world output with a larger \( z \). Not only intra-industry trade, but also international outsourcing benefits the parties involved with higher real wage and more product variety. In contrary to intra-industry trade, international outsourcing also raises consumers’ per capita consumption. This is the main result of my model.

**Figure 3. Open Trade between North-South**
Conclusion

Krugman (1979) demonstrated that open trade between identical Northern countries leads to a greater variety of consumption and higher real wages by assuming the elasticity of substitution decreases with per capita consumption. For discussing how international outsourcing affects the welfare of the North and the world, I return to CES utility function and incorporate international outsourcing to his model. With an assumption of full employment, my model shows that not only intra-industry trade, but also international outsourcing benefits the parties involved with higher real wage and more product variety. In contrary to intra-industry trade, international outsourcing also raises consumers’ per capita consumption. That is, my model implies that the North as a whole is better off with international outsourcing trade.

Further, in the models of Dixit-Stiglitz (1977) and Krugman (1979), a rise in labor supply $L$ is the only way to generate a larger number of differentiated goods (i.e., a larger $n$). Additionally, my model implies that a favorable technological shock brings the consumers higher real wages and higher per capita consumption of each variety, and maybe more variety of per capita consumption.

Intra-industry trade, international outsourcing trade, and technology improvements are the three forces to make the world better off.

Footnotes

1. With CES utility, it implies that the elasticity of substitution equals the elasticity of demand if the number of differentiated goods is large enough.


4. See Luis and Han (1990)

5. Antràs (2003) assumes a world with a group of countries with different capital-labor ratios. In an environment of incomplete contracts, under-investment could occur if the firms received only a fraction of the marginal return to its ex-ante investment. The higher the capital intensity of an industry, the more value there is in reducing the under-investment in capital. Final-goods producers tend to invest capital themselves to ensure profits. Therefore, trade in capital-intensive intermediate inputs will be transacted from within boundaries (intra-firm trade). On the other hand, under-investment in labor reduces the returns to labor more than to capital in a labor-intensive industry. Trade in labor-intensive goods will instead take place at arm’s length (international outsourcing). It’s basically a North-North trade model.

6. Final-goods producers in the North differ in levels of productivity. In choosing between a domestic and a foreign parts supplier, a final-goods producer trades off the benefits of lower wages in the South against the benefits of lower fixed costs in the North, and takes the
advantage of ownership against outsourcing in terms of bargaining power. This demonstrates that firms with higher headquarter intensity prefer domestic to international outsourcing and favor vertical integration over outsourcing.

7. In Antràs’s (2004) model, the manufacturing stage of production is initially located in the North and shifts to the South to benefit from its lower wages while the goods mature. The model displays a product cycle in which manufacturing is shifted to the South, at first within a firm’s boundaries, and only at a later stage to independent firms in the South.

References


