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**Working Paper**

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Claremont Colleges Working Papers, No. 2002-10

**Provided in Cooperation with:**

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*Suggested Citation:* Arndt, Sven W. (2002) : Production sharing and regional integration, Claremont Colleges Working Papers, No. 2002-10, Claremont McKenna College, Department of Economics, Claremont, CA

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# **Production Sharing and Regional Integration**

**Sven W. Arndt**

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## **1. Introduction**

As preferential trade agreements have proliferated, the environment in which they take place has changed considerably. The early postwar agreements in Europe focused narrowly on trade liberalization among similar economies. Capital controls were ubiquitous, foreign direct investment and the movement of persons were restricted, and batteries of non-tariff barriers ensured that markets remained segmented.

Since then, multilateral trade negotiations have reduced barriers not only on trade in goods and services, but on investment flows and on cross-border business relations. These integrating tendencies have been augmented by cost-saving innovations in transportation and communications technologies.

As preferential trade agreements have spread around the globe, the mix of participating countries has become less similar and more diverse and dissimilar. This has not only encouraged inter-industry trade, but changed the nature of intra-industry trade. Across the breadth of industries, manufacturing has been internationalized as component production and product assembly have spread across borders. This fragmentation<sup>1</sup> of production gives rise to a new form of intra-industry trade which has a strong intra-product dimension.

This paper examines the implications of cross-border production sharing and component trade in the context of regional economic integration. It shows how production sharing between advanced and developing partners of a free trade area enhances global competitiveness, creates jobs, and increases national welfare. Section 2 evaluates the effects of cross-border assembly, while Section 3 examines the role of foreign direct investment in this process. Section 4 concludes.

## **2. Fragmentation in an Integrated Market**

Among advanced countries, intra-industry trade in final products has been important in the post-war period. Trade theory, in general and customs union theory, in particular, reflect this tendency by focusing on trade in end products. In recent years, however, trade in components and offshore assembly have enjoyed a rising share in world trade and economic activity.<sup>2</sup> The emphasis has shifted from mere trade liberalization to economic integration across a broad range of economic activities, including foreign investment, cross-border movement of persons, and right of establishment.

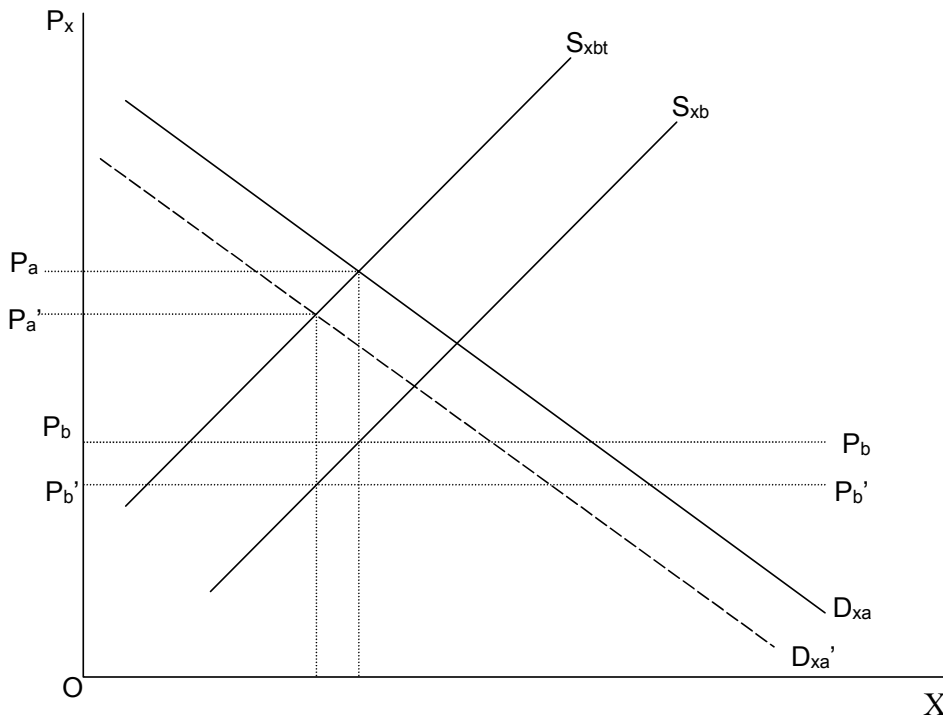
The maquiladora-based interaction between the U.S. and Mexico in the context of the North American Free Trade Agreement is an obvious application. Additional examples may be found around the Pacific Rim and in the proposed enlargement of

the European Union (EU). When an advanced country enters into a preferential agreement with a developing country, the traditional welfare changes are augmented by the effects of component specialization and intra-product trade.

In order to illustrate the possibilities, we turn to Figure 1, where advanced country A imports good X under tariff protection from advanced country B. Country A has barriers in place on trade in components and faces impediments on foreign investment and offshore production and assembly. Figure 1 depicts country A's import demand curve,  $D_{xa}$ , and country B's export supply curve,  $S_{xb}$ , both of which are derived from their respective domestic demand and supply schedules (not shown). Under conditions of free trade, the world price of X is found at the intersection of the two curves.

The tariff-inclusive export-supply curve is  $S_{xbt}$ , where  $t$  represents country A's most-favored-nation (MFN) tariff on imports of X. The intersection of this curve with country A's import demand curve gives the tariff-inclusive price of X in country A,  $P_a$ , while  $P_b$  represents the price at which country B supplies the product. The gap between the two prices indicates the magnitude of the tariff.

*Figure 1: A partial-equilibrium view of cross-border assembly*



Now suppose that country A enters into a preferential trade agreement with country C, one of whose strengths is a relatively abundant supply of low-wage workers. Assume that the preferential arrangement is more than a tariff-reduction exercise, which eliminates bilateral barriers not only on trade, but on cross-border assembly and sourcing of components.

Suppose, that production of good X can be divided into separable constituent activities, consisting of production of parts, provision of component services such as design and marketing, and assembly of the final product. Suppose that these activities can be described in terms of their respective factor intensities and that those factor intensities differ. The factor intensity of the end product, therefore, is the weighted average of the factor intensities of its constituent activities.

Suppose that assembly is among the relatively labor-intensive activities and that it can be performed at significant cost savings in country C. Producers in country A discontinue domestic assembly and elect instead to ship components to C for assembly into the final product. The product is then shipped back to A for distribution and marketing.

The cost-reduction inherent in offshore assembly improves the competitiveness of X producers in country A against their rivals in country B. As a result, the domestic supply schedule (not shown) shifts out and X production rises. This in turn, shifts the country's import demand curve inward from  $D_{xa}$  to  $D_{xa}'$ . The price of X falls to  $P_a'$  in country A and to  $P_b'$  in country B. This improvement in country A's terms of trade is welfare-enhancing. Meanwhile, country B's terms of trade deteriorate and the country is forced to assume more of the burden of country A's tariff. Tariff revenues fall in country A with the decline in imports from country B.

Cross-border assembly increases X production in country A, while the decline in the price of X reduces it. The net effect provides a welfare improvement from the point of view of producers and workers in country A.

It is important to note the effect of cross-border production sharing on the nature of exports and imports. Under the new trade regime, good X is exported to country C in an unassembled state and re-imported from country C as a fully assembled product. Net imports from country C thus consist of X assembly. Implementation of NAFTA appears to have had an analogous effect on U.S.-Mexico trade in a number of industries. In the motor vehicles sector, for example, auto imports from Mexico not only replaced imports from Asia, but unlike their Asian counterparts Mexican auto shipments were full of components made in the U.S.<sup>3</sup>

## 2.1. Employment Effects

Employment in the X sector is subject to two forces with opposing effects. The cross-border relocation of assembly to country C reduces X-sector jobs in country A. On the other hand, the increase in X production raises employment. In the standard two-by-two Heckscher-Ohlin model for a small country, in which the two factors of

production are labor and capital, offshore assembly has been shown to raise employment and wages in the X-sector.<sup>4</sup>

When firms in a high-wage country abandon a labor-intensive production activity in the labor-intensive industry, the unit-value isoquant rotates inward and toward capital usage, so that the average capital-labor ratio rises at the given wage-rental ratio. This causes the economy-wide equilibrium wage-rental ratio to rise, which in turn increases the capital-labor ratio in both sectors. With given factor endowments and relative commodity prices, this shift to higher capital-labor ratios is achieved by relocation of both labor and capital into the X industry.

As we saw in Figure 1, however, when X output rises in a large country, the world price of the commodity falls. When this commodity is the country's import good, the decline represents an improvement in the terms of trade. In domestic factor markets, the terms of trade decline has an effect on the wage-rental ratio that runs in a direction opposite to the effect of cross-border assembly. For the large country, therefore, the net effect on wages depends on the relative strengths of the two influences.

### 3. Regional Integration and Investment Liberalization

Most preferential trade arrangements encompass at least some liberalization of foreign direct investment (FDI) and of rules governing business activities by foreigners. Indeed, the easing of restraints on business activity can give rise to important incentives for cross-border production sharing. In preferential trade arrangements between developed and developing countries, FDI flows from the former to the latter in order to expand productive capacity.

During the U.S. debate on NAFTA, many critics expressed the fear that FDI outflows would come at the expense of domestic investment. Such a zero-sum game is not the only possible outcome, however. Indeed, it is not even the most likely outcome. We, nevertheless, start our analysis with this worst-case scenario in which an FDI outflow reduces the domestic capital stock by an equivalent amount. Assume that domestic capital markets are fully integrated in each country, so that capital can flow freely between the X and Y sectors. Figure 2 presents the situation in country A in terms of the familiar Lerner-Pearce set-up, where capital (K) and labor (L) are the two factors of production and the economy's total endowment is given at point E.

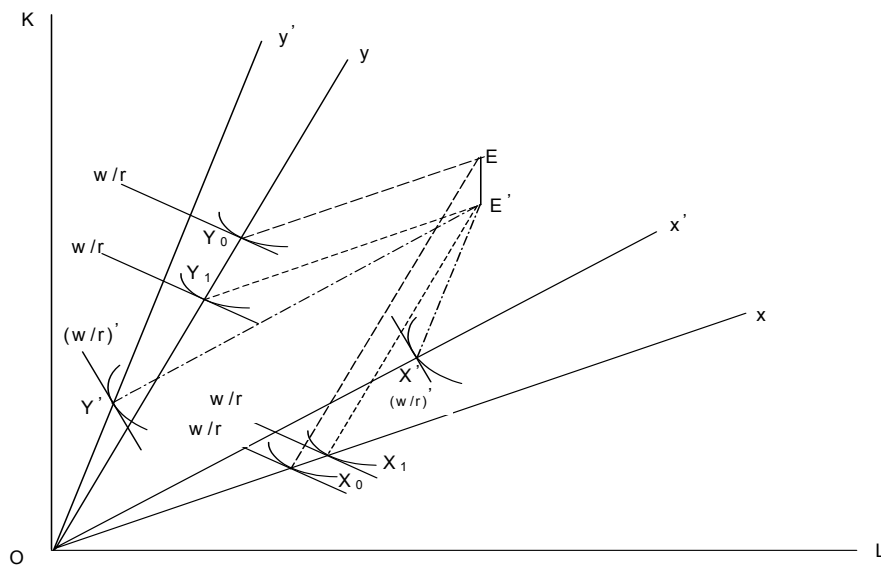
For the initial factor-price ratio,  $w/r$ , output levels are arrayed along expansion paths  $Ox$  and  $Oy$ , respectively. Isoquants  $X_0$  and  $Y_0$  represent the respective equilibrium levels of production. The capital outflow is assumed to reduce the domestic capital stock to the level given at point  $E'$ . According to Rybczynski (1955), this change in factor endowments moves outputs to levels  $X_1$  and  $Y_1$ , respectively. The decline in the capital stock at unchanged relative commodity prices thus reduces output in the sector in which it is used intensively and increases output in the other sector. The wage-rental ratio remains at  $w/r$  in view of the unique relationship between factor prices and commodity prices. From the

point of view of workers in the labor-intensive, import-competing sector, the capital outflow leaves the wage-rental ratio unchanged and increases output and employment in that sector.

When the additional productive capacity financed by the capital outflow comes on stream in country C, assembly of good X is relocated to country C. As noted, cross-border assembly is assumed to reduce the resource cost of producing good X, even after accounting for the cost of shipping components to the offshore facility and re-importing the assembled product. Hence, the level of output originally produced by the quantities of labor and capital given at  $X_0$  can now be produced with smaller amounts of the two factors. In other words, the family of X isoquants shifts inward toward the origin.

Furthermore, abandoning assembly raises the capital-labor ratio of X production in country A, so that the new family of X isoquants will be arrayed along an expansion path steeper than  $Ox$ . The slope of the new path (not drawn) represents the weighted average factor intensity of X production up to, but not including, assembly. It may be important to know exactly how “imports” of assembly are paid for, but for present purposes it is sufficient to suppose that exports of X components are used to pay for imports of X assembly. The important point is that the total resource cost of X must fall as a result of these rearrangements.<sup>5</sup>

Figure 2: Foreign direct investment and cross-border assembly



It is apparent from the foregoing, that the effects of cross-border sourcing are very similar to those of technical progress, with the case under discussion resembling labor-saving technical progress in the labor-intensive sector. The repositioning of  $X$  isoquants reflects the improvement in productivity and profitability in the  $X$  sector and implies that the initial factor-price ratio,  $w/r$ , is no longer an equilibrium price ratio. The factor-price ratio that is tangent simultaneously to the original unit-value isoquant in the  $Y$  sector and to the new unit-value isoquant in the  $X$  sector is necessarily steeper than  $w/r$ , in view of the inward displacement of the  $X$  isoquants.

We assume that this new wage-rental ratio is  $(w/r)'$ . The tangency points of the respective isoquants with the new factor-price ratio occur along rays  $Ox'$  and  $Oy'$ . Thus, economy-wide adjustment to cross-border sourcing in the import-competing industry raises capital intensity in both sectors.

This adjustment brings with it changes in output and employment. As shown in Figure 2, output rises to  $X'$  in the import-competing sector and falls to  $Y'$  in the exportables sector. This result is consistent with the output effect discussed in the partial-equilibrium context of Section 2. Unlike the partial-equilibrium framework, however, the present approach makes clear that the source of the additional resources used in the import-competing sector is the exportables sector,  $Y$ . Note, finally, that the effects of the capital outflow and of cross-border assembly on outputs are reinforcing.

If country  $A$  is small, none of these adjustments has an effect on the terms of trade. We saw in Figure 1, however, that relative prices will change if country  $A$  is large enough to affect the world price of  $X$ . Then the rise in  $X$  output and the fall in  $Y$  output will improve country  $A$ 's terms of trade vis-a-vis country  $B$ . The change in commodity prices requires adjustment in relative factor prices. The fall in the relative price of  $X$  tends to reduce the wage-rental ratio, thus working against the effects of cross-border sourcing. From the point of view of society as a whole, the improvement in the terms of trade is, of course, welfare-enhancing.

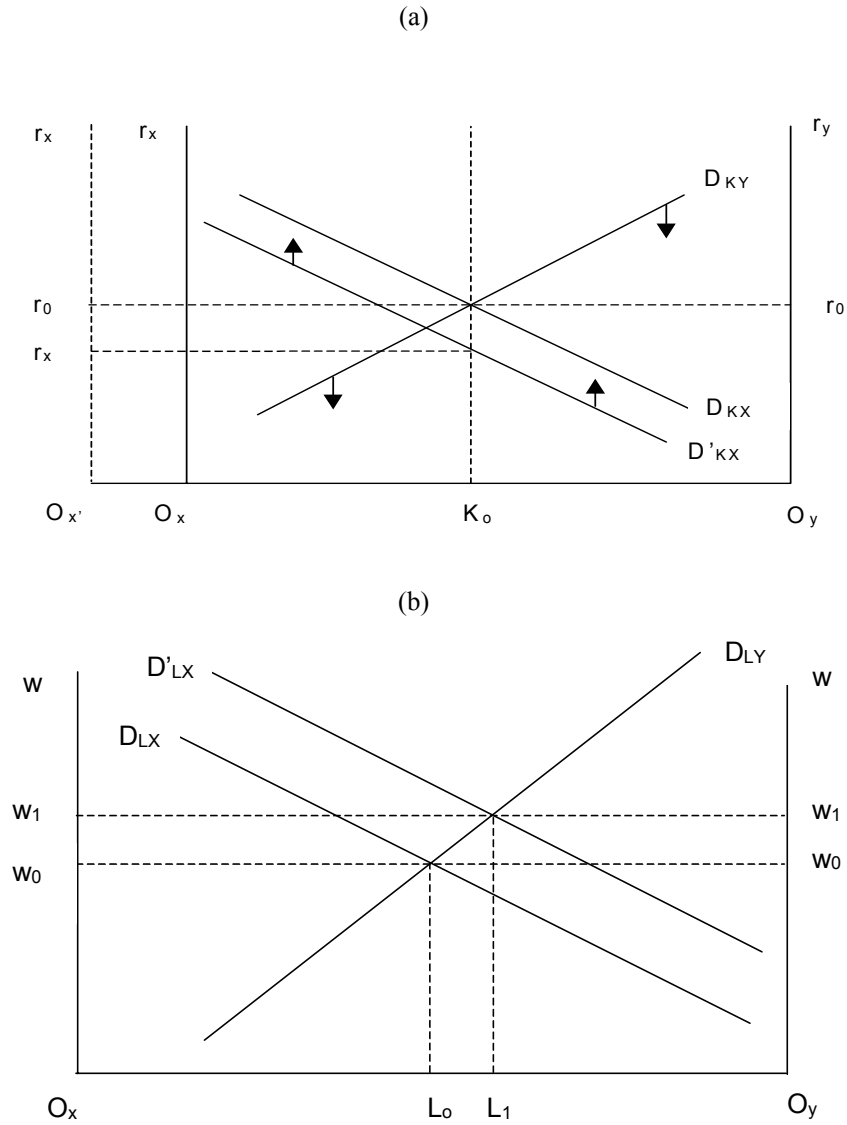
### 3.1. Effect on the Host Country

Applying the standard Heckscher-Ohlin model to the capital-importing country,  $C$ , the inflow of capital raises output in the capital-intensive sector  $Y$  and reduces output in the labor-intensive sector  $X$ . This basic Rybczynski result requires full intersectoral mobility of capital, a condition which is more likely to obtain in the long run. In the short run, market segmentation and factor-specificity tend to dominate.

Suppose, therefore, that the FDI inflow financing an assembly plant in country  $C$ , represents an increase in the  $X$ -sector capital stock. We analyze this case with the aid of the specific-factors model. In Figure 3a, the inflow of capital expands the size of the box from  $Ox$  to  $Ox'$ . Given the initial capital allocation at  $K_0$ , the effect of the inflow is to reduce the return on capital in the  $X$  sector from  $r$  to  $r_x$ . The increase in the sectoral capital stock raises the productivity of and hence the demand

for labor in that sector. This change is represented in panel 3b as a rightward shift of the labor demand curve in sector X. When labor is intersectorally mobile, the effect is to shift labor from Y to X and to increase the economy-wide wage. There will be

Figure 3: Capital inflows and cross-border assembly





secondary effects in both markets, including repercussions from the reallocation of labor which depress the demand for capital in the Y sector and raise it in the X sector. These effects are indicated by solid arrows. In the new equilibrium, wages are higher throughout the economy, capital rentals are lower, particularly in the X sector, and the capital-labor ratio is higher in both sectors.<sup>6</sup>

Overall, therefore, the combined effect of investment liberalization and cross-border production sharing is to raise wages in both countries and to increase the area-wide output of good X. The competitiveness of country A's X-producers improves relative to rivals in country B. If country A is large enough to exact significant commodity price changes, country A's terms of trade improve. While this has the effect of raising overall welfare, it tends to decrease the wage-rental ratio, the net change of which therefore depends on the relative strengths of the production-sharing and terms of trade effects.<sup>7</sup>

#### 4. Concluding Remarks

Regional economic integration has come a long way from its beginnings in the early post-war years. This judgment holds for both theory and practice. Initially, the focus was on protecting trade among similar countries against low-cost outsiders. The specter of trade diversion loomed large.

Preoccupation with tariffs caused other sources of market segmentation to be ignored. Not until the Single Market program did Europe come to grips with those impediments. More recent arrangements, including NAFTA, have tried to deal with these issues from the start by liberalizing investment flows and attacking non-tariff impediments to free and open economic interaction.

As preference areas bring together developed and developing countries, new opportunities arise for enhancing competitiveness both within the area and in relation to outsiders. Comprehensive removal of trade barriers, together with cost-saving innovations in transportation and communications technologies, have encouraged cross-border sourcing and production arrangements, which extend the comparative-advantage calculus to the level of parts and components.

With or without preferential arrangements, cross-border sourcing and assembly are capable of raising wages and increasing employment in industries in which they take place.

#### Notes

1. The implications of offshore sourcing and cross-border production are examined from various perspectives in Arndt (1997, 1998, 2001), Campa and Goldberg (1997), Deardorff (2001a,b), Egger and Egger (2001), Miller (2000), Feenstra (1998), Feenstra and Hanson (1996), Feenstra, Hanson, and Swenson (2000), Hummels, Rapoport and Yi (1998), Jones and Kierzkowski (2000, 2001), Kohler (2001), and Yeates (2001). The term "fragmentation" originated with Jones and Kierzkowski (1990).

2. See Yeats (2001).
3. Arndt and Huemer (2001) provide details.
4. See Arndt (1997, 1998). See also Deardorff (2001) and Jones and Kierzkowski (2001).
5. See Arndt (1997, 1998) for details.
6. This result is consistent with Feenstra and Hanson (1996), for example.
7. The effect of foreign direct investment will be different in country A if capital markets there are also segmented. In that case, the capital rental rises in the X sector relative to Y, while labor productivity falls in the X sector. This, in turn, leads to reallocation of labor out of the X sector, with a decline in the economy-wide wage.

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