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Trade Diversion and Production Sharing

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Abstract. This paper examines the repercussions of cross-border production sharing for the welfare effects of preferential trade liberalization. In a general-equilibrium context, a free trade agreement (FTA), which incorporates production sharing, raises the likelihood of welfare improvement. Thus, two members of a free trade area, who each have comparative disadvantage in the production of a final product relative to a non-member, may nevertheless enjoy net trade creation if they jointly possess comparative advantage in key components of that product. At a minimum, cross-border production sharing reduces the trade-diverting elements of an FTA. It follows, that rules of origin, viewed as constraints on cross-border fragmentation, augment the negative, trade-diverting elements of free trade areas.

JEL Classification: F11, F13, F15
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1. Introduction

As globalization spreads, markets are becoming more integrated across countries and economic activities more linked and intertwined. Continuing progress in trade and investment liberalization, as well as declining communication and transportation costs, play an important role in this process. As economies become more open and market access is improved, trade grows and production spreads across borders. As a result, end products entering into international trade contain parts and components from many countries.

The focus of this paper is on factors that inhibit and factors that encourage cross-border sourcing and their implications for the welfare effects of preferential trade liberalization. This is an important issue, because the welfare effects of cross-border production fragmentation are not independent of the trade policy regime. Under conditions of free trade in a standard trade model, for example, cross-border sourcing of components is welfare-enhancing. Its effects are analogous to those of technical progress. In the context of a most-favored-nation tariff regime (MFN), on the other hand, it may be welfare-reducing.[2]

The simplest models of preferential trade liberalization deal with trade in products that are produced entirely within national boundaries. Comparative advantage considerations then provide ready efficiency assessments and welfare calculations. In this framework, trade creation arises when imports of a finished or intermediate product from a partner country replace domestic production. Trade

diversion, on the other hand, is associated with the shift of imports from low-cost outsiders to higher-cost FTA partners. In this context, the welfare effects of preferential trade liberalization are ambiguous.

Our interest, however, is in a deeper form of preferential trade liberalization, one that facilitates production sharing across borders. Here, the comparison of interest is not between the cost of producing an entire product in the countries involved, but comparison between fully home-based production in the non-member country and cross-border production sharing by the FTA members.

The intuition is that a country may be the world's low-cost producer of a product, without necessarily being the low-cost producer of every one of its components. When production of the product shifts from a nationally integrated set-up in the non-member country to a regionally fragmented production framework inside the preference area, the trade creating and trade diverting elements are rearranged in important ways.

The remainder of the paper proceeds as follows. Section 2 provides a brief review of the welfare effects of cross-border component sourcing under a variety of trade policy regimes. Section 3 employs a two-country general-equilibrium trade model to examine the effects of rules of origin, when these are interpreted as interventions designed to prevent optimal component sourcing. Section 4 examines the effects of cross-border component sourcing on domestic production and welfare in a simple partial-equilibrium framework. Section 5 employs a three-country, partial-equilibrium model to assess the extent of trade diversion in discriminatory trade liberalization with and without component specialization. Section 6 concludes.

2. Production Sharing, the Trade Regime, and Welfare

The welfare effects of cross-border fragmentation and production sharing have received considerable attention in the recent literature.[3] Under conditions of free trade, cross-border production sharing in either the import or the export sector of a small country unambiguously raises national welfare as it extends specialization from the level of products to that of parts, components and assembly. When it takes place in a large country, it generates terms-of-trade effects, which may augment or undermine the welfare effects of production sharing per se. Since it tends to increase domestic output in the sector in which it occurs, it turns the terms of trade in favor of the country when it takes place in the import sector and against it when it occurs in the export sector.[4] These tendencies are reinforced by complementary adjustments in the trading partner, when that country is also large. Then, output of the good subject to production sharing increases there as well, so that the price-depressing effects are enhanced.[5]

In a small country, cross-border fragmentation is also welfare-creating when it is part of a preferential trade agreement, and may thus turn an otherwise trade-diverting PTA into a trade-creating one. For large countries, the effects of production sharing on the terms of trade need to be taken into account along the lines discussed above.

The welfare effects of cross-border production fragmentation are ambiguous, however, when it is introduced in the context of most-favored-nation (MFN) trade policy. It is more likely to be welfare-reducing, the larger the wedge between the tariff-inclusive domestic price and the world price. Technically, the condition for welfare improvement is that the Rybzsynski line must be flatter than the relative world price in the standard general equilibrium trade model.[6]

Cross-border sourcing has potentially important implications for how we assess "exposure" to foreign competition of so-called non-tradables industries. When production is fragmentable, goods and services that are non-tradable as such, may contain parts and components that are. When a non-tradable good or service contains tradable parts and components, its insulation from foreign competition is reduced as the domestic factors of production employed in component production are exposed to competition from abroad.

Cross-border production sharing and component sourcing by non-tradables industries not only affect national welfare (by shifting out the production possibility frontier in a manner similar to technological progress), but also have implications for the real exchange rate, defined as the ratio of tradables prices to non-tradables prices. It is well-known that market-clearing conditions in the non-tradables sector play a key role in determining the real exchange rate (Arndt, 2004). Hence, when offshore sourcing of tradable components reduces costs and thus prices of non-tradables relative to tradables, the resultant increase in the ratio of tradables to non-tradables prices is equivalent to a depreciation of the country's real exchange rate. A shift to offshore sourcing in the non-tradables sector is thus accompanied by real depreciation of the country's currency.

The ability of non-tradables producers to use offshore sourcing of components to increase their competitiveness relative to tradables producers enables them to compete more effectively for domestic resources, and thereby raises output and employment in the non-tradables sector. Meanwhile, the depreciation of the country's real exchange rate, raises output in the tradables sector as well, implying that offshore sourcing by non-tradables industries raises output throughout the economy. The rise in tradables output and decline in tradables demand improve the trade balance.

3. Rules of Origin

Rules of origin, also known as domestic-content requirements, are designed to prevent producers in free trade areas from exploiting differences among members' tariff levels through cross-border sourcing of components from non-members. If country A has a lower tariff on component imports than its FTA partner, country B, the producers in A may use components from non-members to gain a competitive edge in B's markets. Rules of origin are policies specifically designed to control such offshore sourcing.

To the extent that rules of origin restrict country A's producers from third-country sourcing of parts and components, they cause the country's production

possibility curve to contract relative to its optimal, unconstrained position.[7] We examine the welfare implications with the aid of Figure 1. Suppose that the production blocks represent the two countries, A and B, respectively, which have formed a free trade area and that P_{fta} is the intra-FTA relative price. Assume for simplicity that tastes are identical in the two countries, so that the initial equilibrium consumption bundle for each nation is given at point C_o. Production takes place at points Q_a and Q_b, respectively, with country A exporting good Y and importing good X. Suppose further that the conditions depicted by the two production blocks involve offshore sourcing by both countries of components from low-cost non-member sources.[8]

Suppose that country A enforces the rules-of-origin provisions of the treaty. Producers in country B have two options, depending on the relative sizes of applicable tariffs. They can continue to source components outside the FTA and pay the partner's tariff. They can, alternatively, shift the sourcing of components to FTA suppliers in order to avoid the partner's tariff on third-country value-added. The latter will be the preferred course of action, if the cost savings inherent in third-country sourcing are smaller than the tariff.

If the response is to shift component sourcing to intra-FTA suppliers, the effect is to shift B's production possibility curve inward along the X-axis to, say, T_B'. As a result, the intra-FTA price of X rises to $P_{fta'}$, which represents a worsening of country A's terms of trade. Production of good X rises in country A and falls in country B. Consumption in both countries moves to a lower indifference curve to reflect the welfare loss inflicted on both by country A's implementation of the rules-of-origin requirements.[9]

Free trade areas are known to generate both trade-creating and trade-diverting welfare changes. The latter may dominate the former and thus reduce welfare relative to an MFN tariff regime. The foregoing suggests that rules of origin introduce an additional element of trade diversion and thereby increase the likelihood that an FTA will be welfare-reducing.

The situation is made still worse, if country B elects to enforce rules-of-origin provisions against imports of good Y from country A that contain components from non-member sources. If country A responds by shifting to domestic, higher-cost components, then country A's production block will shift inward along the Y-axis and welfare will fall further in both countries.

Note, that while the common external tariff eliminates the need for rules of origin in customs unions, determination of a non-zero common tariff may require some countries to raise duties on component imports from non-members. To the extent that this change inhibits component sourcing from non-members, it has the effect of contracting members' production possibility curves along the axes of sectors engaged in such offshore sourcing and is thus welfare-reducing.

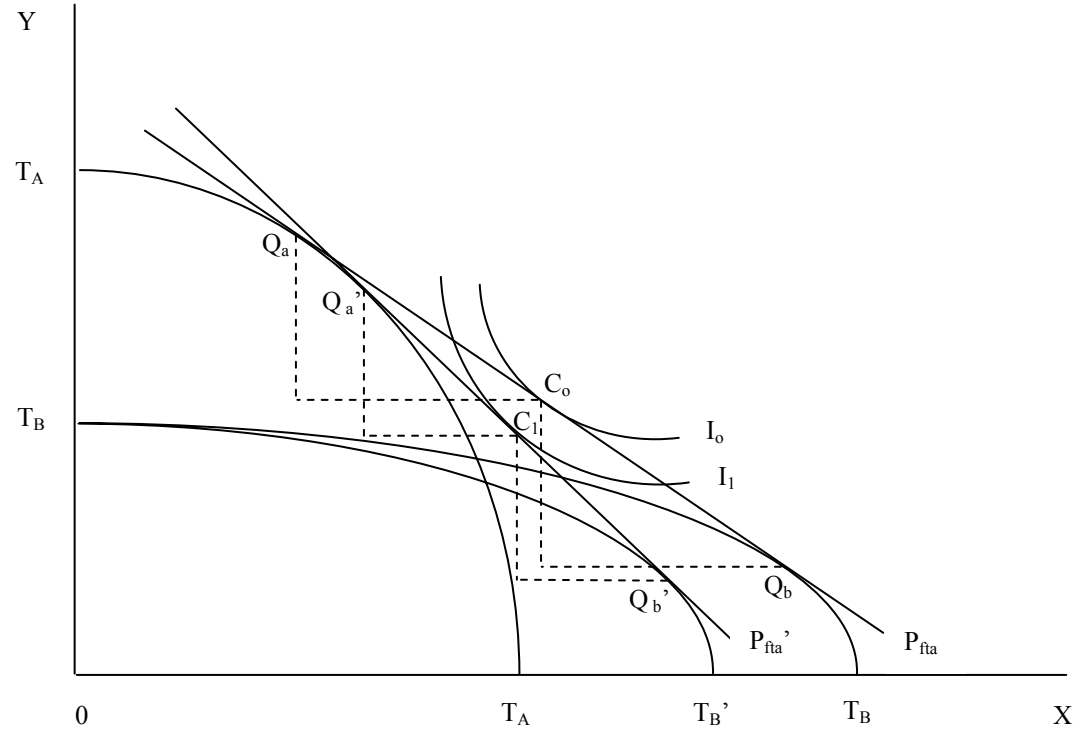


Figure 1

4. Production Sharing and Trade Diversion

As noted above, preferential trade liberalization can be welfare-reducing on balance. The question is whether cross-border fragmentation of production worsens or improves the welfare effect of traditional preferential trade liberalization. It will be recalled that in the traditional set-up, the shift of production from domestic producers to the partner country is an important source of trade creation, while the shift of production from the low-cost outsider to the partner country is the source of trade diversion. From this perspective, therefore, a NAFTA-induced shift of U.S. automobile imports from Japan to Mexico would clearly suggest trade diversion.

While such a conclusion is doubtlessly justified under the assumption that automobiles are produced in their entirety in every country, it is less automatic under conditions of cross-border fragmentation and production sharing between the partner countries. Automobiles imported by the U.S. from Mexico contain components made in the U.S. If Mexico is the low-cost producer of some component or of assembly, then the shift of those activities from Japan to Mexico is an element of trade creation. Any trade diversion can then arise only in the remainder of the production chain. If the U.S. is the low-cost producer of the components it supplies to Mexico, then the extent of trade creation is increased and the range of activities subject to trade diversion is further limited. The net welfare effect of the shift in production, which was once clearly negative, is now ambiguous.

The essential point of the foregoing is that unless Japan is the low-cost producer of every activity in the production chain, cross-border fragmentation and production sharing between the trade area partners reduces the trade-diverting elements of preferential trade liberalization. The intuition may be set out with the help of a simple numerical example. Suppose that the respective costs of the two components of a hypothetical product are $9 and $7 in country A, $10 and $4 in country J, and $17 and $1 in country M. When production takes place entirely within the boundaries of each country, a unit of product costs $16, $14, and $18, in the three countries, respectively, giving country J a comparative cost edge over the other two.

When countries A and M form a free trade area and engage in production sharing, with A producing the first and M the second component, joint cost of a unit of the good declines to $10. While, neither country is able to compete with country J without cross-border fragmentation, intra-product specialization enables them to become competitive.

In order to assess the supply-side implications of cross-border fragmentation and production sharing, we start with a partial-equilibrium representation of the import sector of a partner country. In Figure 2, curve DD represents domestic demand for the imported product, X, while domestic supply in the absence of cross-border fragmentation is given by curve S_{x1+x2}. The product is assumed to be made up of two components, x_1 and x_2, where production of the former is intensive in the country's abundant factor. Line S_{x1+x2*} represents costs of production when the first

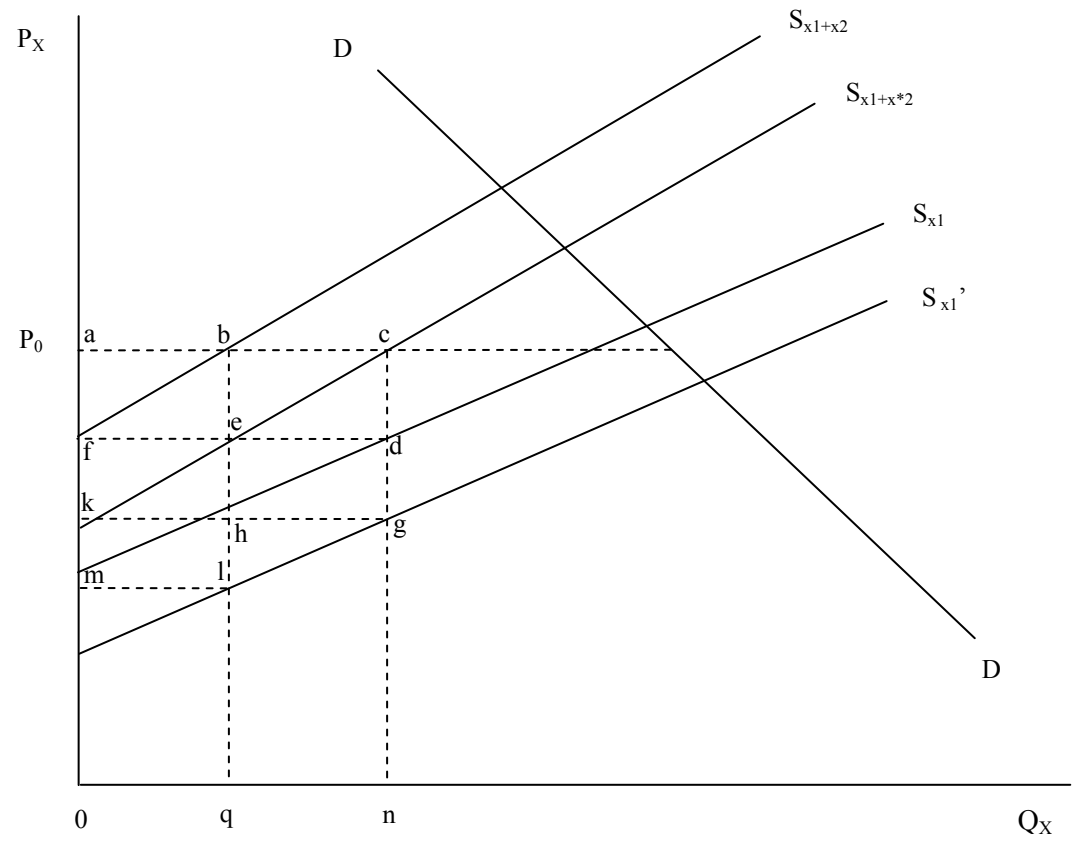


Figure 2

component, in which the country is assumed to have comparative advantage, is produced at home, and the second component is imported from a lower-cost foreign source.

The shift from local production to cross-border fragmentation, represented by the move from the first to the second supply curve, is welfare-increasing. If the country is small and the price of product X is given at P_o, then the gains from cross-border fragmentation accrue in the form of producer surplus (encompassed by area bckf) and increased employment (implicit in the rise in production from 0q to 0n). The value of X-production rises from 0abq to 0acn. Not all of this increase in value accrues to the country, however. The value of imported component x_2 is given by area acdf. The rise in domestic value added is therefore equal to the difference between areas ednq and abef.

Hence, both the quantity of X-production and the value of domestic production increase. While this is clearly positive from the point of view of the domestic industry, workers formerly engaged in producing component x_2 have lost their jobs. If those workers can find employment in production of component x_1, output of which clearly rises, they will remain employed in the industry and new workers may also be drawn into the industry.

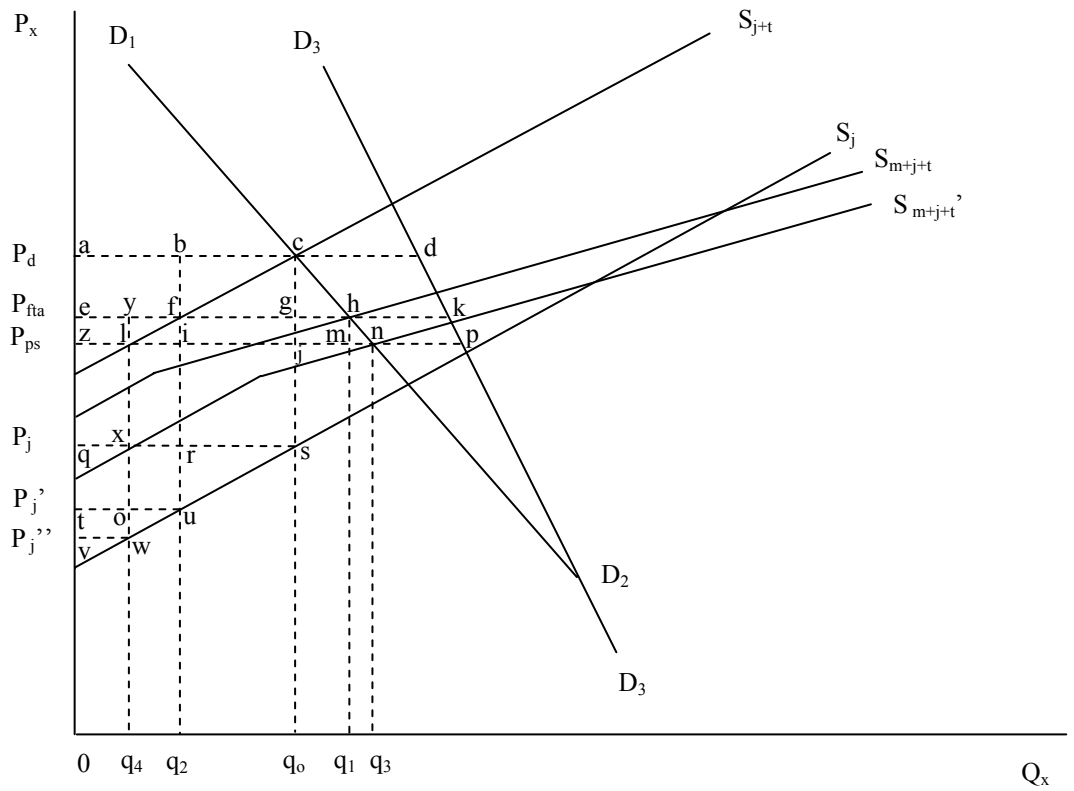
The buffer provided by outsourcing can be seen if it is assumed that the world price of X is falling. In the absence of cross-border sourcing, domestic production of good X declines along supply curve S_{x1+x2}, with output and employment falling in the industry. Cross-border procurement of component x_2, on the other hand, shifts the supply curve out, moving production at the initial price to point c, so that when the negative world price shock occurs, domestic production declines along supply curve S_{x1+x2*}. It is evident, that cross-border fragmentation of production enhances the domestic industry's ability to fend off foreign competition.

The benefits conferred on domestic welfare by cross-border component procurement depend on several factors, including the share of imported components in total production. A rising share shifts down the S_{x1} curve to, say, S_{x1}', which raises the share of foreign value-added and lowers the share of domestic value-added and hence reduces the benefits from cross-border operations.[10]

The net effect also depends on the cost-savings inherent in offshore procurement. A rise in savings widens the gap between the top two supply curves, thereby increasing domestic production when the second component is imported and raising both employment opportunities and domestic value added.

5. A Three-Country Model of Economic Integration with Production Sharing

The focus in Figure 3 is on import demands and export supplies, that is, on the excesses between domestic demand and supply in importing and exporting countries, respectively. Demand curve $D_1D_2D_3$ represents the difference between domestic demand and domestic supply in country A. It is the country's net import demand curve. Curve D_3D_3 is the country's domestic demand curve; it becomes net import demand at point D_2, when domestic production goes to zero. Function S_{j+t} represents


P_x
D_1
D_3
S_{j+t}
S_j
S_{m+j+t}
S_{m+j+t}'
P_d
P_{fta}
P_{ps}
P_j
P_j'
P_j''
a
b
c
d
e
y
f
g
h
k
z
l
i
m_1
n
p
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r
s
t
o
u
v
w
D_2
D_3
0
q_4
q_2
q_o
q_1
q_3
Q_x

Figure 3

the tariff-inclusive net export supply of country J, while S_j is that country's pre-tariff net export supply. The initial MFN equilibrium, given at the intersection of net import demand and country J's tariff-inclusive net export supply, generates the domestic tariff-inclusive price, P_d, at which country A imports quantity $0q_o$ from country J. Output of X in country A is equal to the distance cd.

Introduction of a traditional free trade area between country A and country M reduces the price of X within the area to P_{fta}. This price is determined at the intersection between country A's import demand and supply curve S_{m+j+t}, which represents the sum of tariff-free export supply from country M and tariff-inclusive export supply from country J. Country A's total imports expand from $0q_o$ to $0q_1$, while imports from country J decline from $0q_o$ to $0q_2$. Imports from country M are equal to q_2q_1 (equal to fh). Domestic production in country A falls to hk. The reduction in country A's demand for imports from J forces that country to lower its supply price from P_j to P_j', providing country A with an improvement in the terms of trade.

Formation of the trade area generates the following welfare changes. Area acge represents domestic welfare transfers from government revenue to consumer surplus, while triangle cgh reflects welfare improvements due to trade creation and the consumption effect. Rectangle fgsr represents welfare losses due to trade diversion. It is clear that, terms-of-trade changes apart, the net welfare effect is ambiguous. It appears to be negative as drawn, with the magnitude of the area of trade diversion greater than that of the area of trade creation, but with steeper supply curves it will quickly turn positive. Inspection of the figure suggests further that the free trade area is more likely to be welfare-improving as the gap between supply curves S_{m+j+t} and S_j shrinks.

For large countries, formation of a free trade area will typically involve changes in the terms of trade, brought about by changes in the importing country's demand for goods from non-members. Area qrut (=abfe) gives the welfare gain due to the improvement in country A's terms-of-trade vis-a-vis country J. Terms-of-trade gains help offset welfare losses due to trade diversion.

Suppose that economic integration between countries A and M is deepened by introduction of cross-border component trade, such that country M is able to reduce production costs of good X by obtaining certain components at lower cost from country A. Reduced costs shift down country M's domestic supply curve (not shown), which in turn shifts out the country's export supply curve and thus curve S_{m+j+t} to, say, S_{m+j+t}'. This shift reduces the gap relative to country J's tariff-free supply curve.

Equilibrium moves from h to n, where the new joint export supply curve of countries J and M intersects country A's import demand. The intra-area price of X falls to P_{ps}. Relative to the initial MFN equilibrium, the area reflecting trade creation and consumption gains expands to triangle cjn, while trade diversion is now given by rectangle ljsx. The region of trade diversion thus shrinks vertically by rectangle fgji, but expands horizontally by rectangle lirx. It is clear that the net effect is ambiguous.

The first rectangle will expand and the second shrink as the supply curves become steeper.

In this process of adjustment, area fhmi is the welfare gain due to the lower price at which imports from country M are now available. Area lirx, on the other hand, is welfare-reducing because low-cost imports from Japan (equal to quantity li or q_4q_2) are replaced by higher-cost imports from country M.

The reduction in country A's demand for imports from J is now larger than in the case of a free trade area without production sharing, which forces country J to offer still deeper price concessions. J's supply price falls to P_j". The welfare gains due to this terms-of-trade improvement are given by area qxwv.[11]

Cross-border component sourcing thus allows country M to reduce costs and those cost savings redound to the advantage of consumers in country A.[12] The magnitude of these benefits depends on the cost improvements brought about by cross-border production sharing between the area partners. Greater cost savings generate a more pronounced downward shift of the S_{m+j+t} curve.

The analysis of cross-border production fragmentation has thus far focused on cost savings in the production of X in country M. As the discussion of Figure 2 suggests, however, country A may also enjoy cost savings if its producers are able to obtain low-cost components from country M. Then, A's domestic supply curve (not shown in Figure 3) shifts down, causing A's import demand curve to shift left in Figure 3. This shift reduces the price of good X still further, generating additional changes along all the margins discussed above.

Finally, cross-border fragmentation affects production of components. The shift of X-production from country A to country M reduces component production in country A. In the two-component example discussed above, the decision by country M to source component x_1 in country A raises production of that component in country A. Production of that component will rise still further if country A is able to achieve cost savings by procuring component x_2 from country M and thereby to raise its own X-output along the lines shown in Figure 2. These adjustments generate additional welfare effects.

Taken together, the various elements of the foregoing discussion serve as a reminder that in the presence of cross-border component sourcing, the shift of imports of a finished product from a low-cost non-member to a member complicates the welfare analysis.[13]

6. Concluding Comments

This paper has focused on the welfare effects of preferential trade liberalization which is accompanied by cross-border component sourcing. When trade involves finished products only, the extent of trade diversion depends on the differences among product prices in the countries involved. When production processes are fragmentable and trade integration gives rise to cross-border component sourcing, the prices of final goods are changed and the welfare calculus is altered. This possibility arises from the likelihood that a country may possess comparative

advantage at the product level without commanding comparative advantage at every stage along the production chain.

This issue is explored in both partial- and general-equilibrium terms. It is shown that replacing imports of end products made in their entirety outside a free trade area (FTA) with products subject to production sharing inside the area may reduce the extent of trade diversion. Cross-border component sourcing among the partners of a free trade area is, thus, capable of converting a trade-diverting free trade area into a trade-creating one.

It is further shown that rules of origin, interpreted as policies to prevent efficient cross-border component sourcing, are welfare-reducing.

Notes

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[2] See, for example, Arndt (2001, 2004).

[3] See, for example, Arndt (1997, 1998), Deardorff (2001a, 2001b), Jones (2000), Jones and Kierzkowski (2001) and Kohler (2001). See also Feenstra (1998) and Feenstra and Hanson (1996).

[4] Terms-of-trade effects of cross-border production sharing are examined in Arndt (2001). See also Deardorff (2001a).

[5] The implications of production sharing are examined in a two-country model in Arndt (2001).

[6] For a detailed workout, see Arndt (2004).

[7] Aspects of the analysis in this section will remind the reader of the "effective rate of protection." For an initial treatment, see Corden (1966). For a recent assessment, see Greenaway and Milner (2003) and for a comparative analysis of alternative measures of trade policy distortions, see Anderson (2003).

[8] In this framework, simplifying assumptions play an essential role. Implementation of a free trade area is thus often assumed to shift trade in its entirety away from the low-cost non-member country. Such an extensive reordering of production is due to the assumptions embodied in this model. In the next section, we use a three-country, partial-equilibrium framework to examine scenarios in which non-members continue to supply the FTA market, while sourcing of components and end products shifts to members.

[9] The focus here is on the effect of rules enforcement on the production possibility curve and through it on welfare. If B producers continue to source components among non-members and to pay A's tariff on those components, there will not be a single price of X in the region. There will be upward pressure on the price of good X

in A and downward pressure in B. The price differential between the two countries will reflect the size of the tariff and the share of third-country components in product X.

[10] This development is reminiscent of Hong Kong's experience in the electronics and textiles sectors, where the bulk of production has gradually shifted to the Pearl River Delta.

[11] It is apparent that the welfare gains due to terms of trade changes will vary over the range of possible FTA prices below the MFN price. The nature of the variations is governed by considerations similar to those involved in the theory of optimum tariffs. The elasticities of the relevant export supply and import demand curves are important here.

[12] These adjustments clearly have implications for trade, production and welfare in country M. There are strong, but not perfect, symmetries with the adjustments discussed for country A. For a closer examination of adjustment in a two-country framework, see Arndt (2001).

[13] Country J may also resort to cross-border component sourcing, in which case the analysis is further complicated.

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