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## Offshore Sourcing and Production Sharing in Preference Areas

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## 5

### **Offshore Sourcing and Production Sharing in Preference Areas**

**Sven W. Arndt**

#### I. Introduction

The traditional approach to trade analysis has shown a strong preoccupation with trade in end-products. There is, of course, a comprehensive and elegant literature on trade in intermediate products,<sup>1</sup> but it leads a rather separate and cloistered existence. This emphasis finds its underpinnings in the assumption that production is a spatially concentrated and functionally integrated process. We are used to thinking about products as “made” in a country. Trade in components and cross-border dispersion of production, both characteristics of intra-product specialization, have no place in this approach.

In the real world, by comparison, offshore component production and assembly have been among the more noticeable features of recent advances in globalization. Trade in components is growing rapidly and the shares of foreign value-added in exports and of domestic value-added in imports are expanding everywhere.

Multinational enterprises (MNEs) play an important role in the cross-border dispersion of production, especially where technology transfer and coordination are important. This suggests that the phenomenon may be studied from the firm, as well as the country, perspective. Markusen (1984) examines the implications of multiplant operations by MNEs when economies are present in the concentration of “headquarters” activities such as R&D, marketing, finance, etc., while production is geographically dispersed.

This paper examines the implications of offshore sourcing under alternative trade policy regimes. As shown in Section II, offshore sourcing is unequivocally welfare-enhancing under free trade, but may raise or lower welfare when trade restrictions are present. Section III looks at offshore sourcing in low-wage developing countries and examines the implications of rules of origin in that context. Section IV concludes the discussion.

## II. Component specialization and trade policy

At given world prices, the cost savings achieved through offshore sourcing improve competitiveness and create profit opportunities which raise output and employment.<sup>2</sup> When world prices are variable, such cost-savings allow firms to lower end-product prices and thereby increase sales and raise market

share.

We start with the traditional model involving trade in two final products,  $X$  and  $Y$ , produced with two factors of production, capital,  $K$ , and labor,  $L$ . Figure 5.1 presents the basic analytical structure, where unit-value isoquants  $X_0$  and  $Y_0$  reflect the traditional pattern of spatially concentrated and functionally integrated production technologies. The initial factor-price ratio,  $w/r$ , is consistent with given world commodity prices.

[Figure 5.1 about here]

We introduce the possibility of offshore sourcing by assuming that good  $X$ , the country's labor-intensive, import-competing product consists of two activities,  $x_1$  and  $x_2$ , the first more and the second less capital-intensive than the product overall.<sup>3</sup> Suppose that technological breakthroughs make it possible to physically separate the location of the two activities and that the labor-intensive component may be obtained from a trading partner at significant cost savings.

Assume that the factor cost of assembling product  $X$  is included in the cost of activity  $x_1$ .<sup>4</sup> This implies that the  $X$ -industry's production function is now fully described by its  $x_1$ -isoquants. The factor content of a unit of  $X$  is the quantity of capital and labor employed in activity  $x_1$ , plus the amounts of labor and capital needed to produce the quantity of  $x_1$  that will pay for imports of  $x_2$ .

Thus, if imports of  $x_2$  were available at zero cost, then the  $x_1$ -isoquant associated with the original  $X$ -isoquant,  $X_0$ , would fully describe the resource cost of producing  $X_0$  units of  $X$ . Otherwise, the resource cost of imports of  $x_2$ , measured in terms of exports of  $x_1$ , must be taken into account. Then, the  $x_1$ -isoquant representing the full resource cost of  $X_0$  units of  $X$  will lie farther away from the origin along ray  $ox_1$ . We suppose that  $X_{11}$  is that isoquant.

With prices of final goods given in the world market, the cost savings open up profit opportunities that must be eliminated in order to reestablish equilibrium. Factor prices adjust until the new factor-price ratio,  $(w/r)'$ , is tangent to the original  $Y$ -isoquant and the new  $X$ -industry isoquant,  $X_{11}$ . Capital-labor ratios increase in both industries.<sup>5</sup>

To determine the effect on output and employment, we turn to Figure 5.2. The improvement in productivity in the  $X$ -industry shifts out the production possibility curve along the horizontal axis.<sup>6</sup>

If  $P_d$  is assumed to represent the relative price between the two final products under free trade, then the introduction of offshore sourcing moves the production equilibrium from  $Q_1$  to  $Q_2$ . This shift clearly raises national welfare.

[Figure 5.2 about here]

### *MFN Trade Policy*

We now turn to examine the effect of component specialization in the presence of trade restrictions. Suppose that our focus country, country A, imposes a non-discriminatory tariff on imports of good X. Suppose that  $P_w$  is now the free trade price ratio, so that  $P_d$  becomes the domestic price corresponding to tariff rate  $t$ . The initial equilibrium before the introduction of offshore sourcing is given by points  $Q_1$  and  $C_1$ . When component specialization is introduced in the import sector, the production possibility curve moves out along the X-axis to  $TT''$ . The small-country assumption ensures that in the world market for end-products, the relative price ratio remains undisturbed at  $P_w$ . The outward rotation of the production possibility curve causes its tangency with the domestic price line to move in a south-easterly direction to point  $Q_2$ , where X-output is larger than before and Y-output smaller. Consumption moves to point  $C_2$  on indifference curve  $I_2$ . This change represents a clear reduction in national welfare.<sup>7</sup>

This is, however, not the only possible outcome. Consider a steeper world price ratio for the end products like  $P_w'$ . For convenience, we choose quantities such that a smaller tariff,  $t'$ , applied to the world price ratio  $P_w'$  again yields a domestic price ratio equal to  $P_d$ . This allows the production points for the two cases to be identical and thus directly comparable at points  $Q_1$  and  $Q_2$ . The

difference in outcomes lies in the consumption equilibria and the change in welfare. In the second case, consumption is at point  $C_1'$  before component specialization and at point  $C_2'$  after its introduction. The change represents an unambiguous improvement in welfare.

We conclude, therefore, that introduction of component specialization into an *MFN* tariff situation may raise or lower welfare. Welfare is more likely to fall as the distortion due to the tariff rises relative to the efficiency gains generated by component specialization. In the cases examined, the efficiency gains are identical by construction, but the tariff is larger in the first, welfare-reducing situation. The key result, here, is that implementation of component specialization into a protectionist environment may reduce welfare, whereas its introduction under free trade raises welfare unambiguously.<sup>8</sup>

### *Preferential Trade Policy*

Much like traditional trade theory, the customs union literature has also focused on trade in end products. As *NAFTA* (and its predecessor, the maquiladora program) has shown, however, *PTAs* may facilitate trade in components. This section analyzes the implications.

*MFN*-based protection is the starting point in Figure 5.3, where the object is to assess the

welfare effects of a *preferential trade arrangement (PTA)*, which frees trade in both end products and components. It is, of course, well-known that *PTAs* may raise as well as reduce welfare, depending on whether trade-creating elements dominate or fall short of trade-diverting influences. [Figure 5.3 about here]

Production is initially at  $Q$  and consumption at  $C$ . Formation of the trade area is assumed to change the price of  $X$  from  $P_d$  to  $P_{pta}$ . The price change shifts domestic production from  $Q$  to  $Q'$  and imports to the trade partner. The change in the output bundle moves productive resources away from  $X$  toward  $Y$ . In the figure, the outcome represented is welfare-reducing, with consumption now at  $C'$  and thus on a lower indifference curve than  $C$ . We know from the theory of customs unions, however, that welfare improvements are also possible.

If formation of the free trade area is accompanied by intra-product specialization in the  $X$ -sector, then the production possibility curve expands along the  $X$ -axis.<sup>9</sup> The tangency point between  $P_{pta}$  and the new production possibility curve moves down to  $Q''$ . We once again encounter the familiar result of rising  $X$ -output and falling  $Y$ -output. Consumption moves to  $C''$  and hence to a higher indifference curve. Component specialization thus mitigates the negative welfare effects of this free trade agreement. More importantly, whereas component specialization may reduce welfare

when it is introduced into an environment of *MFN* protection, it unambiguously augments welfare in the context of a preferential trade arrangement.

Terms-of-trade effects come into play when country *A* is a large member of the *PTA*, for then the increase in *X*-output in the region (and decrease in *Y*-output) will tend to depress the relative price of *X*, causing the *PTA* price ratio to rotate in a counter-clockwise manner and leading to a further increase in national welfare.

#### *Factor Prices and Factor Proportions*

This section examines the implications for factor prices and factor allocation by referring back to Figure 5.1. Suppose that the initial commodity price ratio, for which isoquants  $X_0$  and  $Y_0$  are defined, is the *MFN* price ratio  $P_d$  of Figure 5.3. Then, introduction of the *PTA* and the resultant change in the price ratio to  $P_{pta}$  shifts the family of *X*-isoquants out from the origin in Figure 5.1, while moving the family of *Y*-isoquants in toward the origin in order to reflect, respectively, reductions in the price of end-product *X* and increases in the price of end-product *Y*. These shifts are not shown in the figure to avoid congestion, but it is clear that outward relocation of *X*-isoquants reduces the wage-rental ratio and inward relocation of *Y*-isoquants reinforces that adjustment.

This, of course, is the well-known Stolper-Samuelson result that a decline in the relative price of a commodity reduces the relative price of the factor used intensively in its production. What is important for present purposes, however, is that this change in factor prices is orthogonal to the effect on factor prices of component specialization in the *X*-industry. The net effect thus depends on the relative strengths of the two tendencies. If the effect of preferential trade liberalization on commodity prices is large relative to the cost-savings of component specialization, then the wage-rental ratio will fall. From the point of view of workers, therefore, component specialization should be a welcome feature of any trade agreement that introduces tougher price competition at the level of end products.

This result is pertinent to the fears of *NAFTA* critics. If introduction of the free trade area brings only a decline in the price of the import-competing end-product, *X*, then wages in the industry will come under pressure and employment and output will decline. To the extent, however, that the free trade area also encourages intra-product specialization in the *X*-industry, wages will fall less or even rise and industry output and employment will fall less or even rise.<sup>10</sup> If the effect of intra-product specialization dominates the terms-of-trade effect, workers will be better off and jobs will be more plentiful in the import-competing end-product industry than before.

If the main effect of a *PTA* with a low-wage country is to introduce component specialization in the import-competing sector, perhaps because the end-product price is governed by trade relations with non-members and thus unaffected by the arrangement, then it will be welfare-enhancing. This consideration may be part of a country's strategic objective in joining a preference area, namely, to capture the cost-saving benefits of cross-border component production for the competitive struggle with non-members in end-product markets.

### III. Repercussions in the partner country

During implementation of the *PTA*, partner country *B* removes tariffs on imports of *Y* from country *A* and as a result the price of *Y* falls in *B*. In Figure 5.4, the price change is reflected in a shift of the unit-value isoquant from  $Y_0$  to  $Y_0'$ . This raises the wage-rental ratio from  $w/r$  to  $(w/r)'$ , with tangencies to the new *Y*-sector isoquant and the original *X*-isoquant at points *a* and *b*, respectively.  
[Figure 5.4 about here]

In addition to the change in the terms of trade, the *PTA* clears the way for component specialization in the *X*-sector. For country *B*, component specialization means that it abandons production of component  $x_l$  in favor of imports from country *A*. Consequently, the *X*-industry's

production technology is now represented by the  $x_2$ -isoquants (which are assumed to include the resource cost of assembling the end product). We assume that the relevant new isoquant is  $X_{2I}$  (which would be tangent to the original factor-price ratio  $(w/r)$  on a lower expansion path than  $ox$ ). Expansion paths for component  $x_I$  have not been drawn in order to avoid cluttering. The new equilibrium factor-price ratio must reflect both the terms-of-trade change and the cost savings of component specialization, that is, it must be tangent to  $Y_0'$  and  $X_{2I}$ . That ratio is  $(w/r)''$ , which causes capital-labor ratios to rise to  $oy'$  and  $ox_2'$ , respectively. Component specialization in the country's export industry clearly reinforces the terms-of-trade effect on the factor-price ratio.<sup>11</sup>

There may, however, be a further effect which works in the opposite direction. It will be recalled from the earlier discussion that  $X$ -output rises in country  $A$ , when that country specializes in component  $x_I$ , while importing component  $x_2$  from country  $B$ . Component specialization in the  $X$ -industries of the two countries thus raises  $X$ -output in the area. If the additional supply of  $X$  coming to markets is large relative to demand shifts, then it will depress the relative price of  $X$  in the  $PTA$ .

While such an event would be beneficial for country  $A$ , it would represent a terms-of-trade deterioration for country  $B$  and would thus undercut the improvement in the wage-rental ratio.

[Figure 5.5 about here]

Figure 5.5 examines the effects of these developments on country *B*'s national welfare. The terms-of-trade effect of the *PTA* is represented by the rotation of the price line from  $P_b$  to  $P_{pta}$ . In the case shown, the *PTA* has been drawn to be trade-diverting for country *B*, with consumption moving to  $C'$  prior to implementation of component specialization. That specialization shifts the production possibility curve out along the  $X$  axis. Production shifts to  $Q''$ , while consumption moves to point  $C''$ .

Thus, while standard inter-product specialization among the members of a preference area may raise or lower national welfare, the effect of intra-product specialization is unambiguously welfare-enhancing. In the case shown, intra-industry specialization of the component type transforms a welfare-reducing *PTA* into a welfare-creating one. In general, *PTAs* which stimulate intra-product specialization among members will be more beneficial than those which do not.

### *Rules of Origin*

When the option of component trade is introduced into an *MFN* system, components will be obtained from the lowest cost source. The bias inherent in preferential trade arrangements, however, has the effect of diverting component trade to the partner country for the same reasons that trade in

end products is diverted. In free trade areas, with their uncoordinated tariff policies, such diversion may be further encouraged by rules of origin. Any tendency for rules of origin to shift sourcing of components from low-cost outsiders to higher-cost partners erodes the cost savings inherent in component specialization. This is an inefficiency which prevents the production possibility curve from shifting out as far as otherwise and thereby reduces the welfare gains. Rules of origin thus keep countries from fully exploiting the benefits of intra-product specialization.

#### IV. Concluding observations

While outsourcing of parts and components has long been a feature of production in many branches of manufacturing, offshore sourcing and, more importantly, offshore production of parts and components appears to have become more prominent and more widely practiced in recent years. This upsurge has doubtless been facilitated by innovations in communications and transportation and by trade liberalization at both multilateral and regional levels.

Under conditions of free trade, extension of the international division of labor to the level of parts and component activities is welfare-creating. If component production is subject to variations in factor intensities, it will affect comparative advantage across countries. Hence, intra-product

specialization will be welfare-enhancing. If component production is subject to economies of scale, then geographic concentration of a component's production will bring further welfare gains.

While this basic principle applies regardless of whether trade is free or not, the welfare effects of intra-product specialization are not independent of the trade regime. In the presence of *MFN* tariffs, for example, introduction of intra-product specialization in the import-competing sector may raise or lower national welfare. When intra-product specialization is introduced in the context of a preferential trade arrangement, on the other hand, national welfare is increased unambiguously. Thus, any tendency for a preference area to generate trade in components increases the likelihood that it will be welfare-improving.

Finally, to the extent that rules of origin and local content requirements force firms to shift sourcing of components from low-cost non-members to higher-cost members, they are welfare-reducing.

## Endnotes

\* I am indebted to Alan Deardorff, Ronald Jones and Henryk Kierzkowski and to conference participants for valuable comments and suggestions.

<sup>1</sup> For examples of that literature, see Ethier (1984), Hazari, Sgro, and Suh (1981), and Sanyal and Jones (1982).

<sup>2</sup> See Arndt (1997, 1998a,b), Deardorff (1998), and Jones and Kierzkowski (1997).

<sup>3</sup> The capital-labor ratio along expansion path  $ox$  is thus the weighted average of the capital-labor ratios of the two component activities.

<sup>4</sup> This assumption makes assembly and production of component  $x_I$  non-separable. If assembly is modeled as a separate activity, then it may also be cheaper offshore.

<sup>5</sup> For additional details, see Arndt (1997, 1998a,b).

<sup>6</sup> For details, see Arndt (1997, 1998a,b). See Johnson (1971) for a classic study of trade and technical progress. See also Hazari et al. (1981) for an example from the earlier literature on

trade in intermediate products. For an application to the economics of multi-plant operations by MNEs, see Markusen (1984).

<sup>7</sup> See Johnson (1967) for a related discussion concerning protection and technical progress.

<sup>8</sup> For a small country, the shift to offshore sourcing does not affect the terms of trade. A large country, on the other hand, may affect global supply conditions when  $X$ -output rises and  $Y$ -output falls and thereby turn the terms of trade in its favor. In that case, the world price line would rotate in a counter-clockwise direction with obvious welfare-enhancing consequences.

<sup>9</sup> It is immaterial in the first instance whether offshore sourcing involves the partner country or the outsider. If the latter is the low-cost producer of the component and there are no discriminatory trade barriers on components, then component imports will originate there. Preferential treatment of component imports from the *PTA* partner, as under rules of origin, is considered below.

<sup>10</sup> In the 2x2 world with completely integrated labor markets and perfectly mobile labor, the effect

on factor prices spreads throughout the economy. In the real world, the spillover will be more limited; it may spread to neighboring industries or regions, but need not affect the entire economy.

<sup>11</sup> The intellectual foundations of the present analytical approach are to be found in the literature on trade and technical progress. That literature finds that output and employment will rise in a sector which enjoys technical progress *except* when that progress is ‘saving’ in the sector’s non-intensive factor, in which case the outcome is ambiguous. Thus, for example, output may rise or fall in the capital-intensive sector if technical progress is labor-saving. It is shown in Arndt (2000) that there is no ambiguity.

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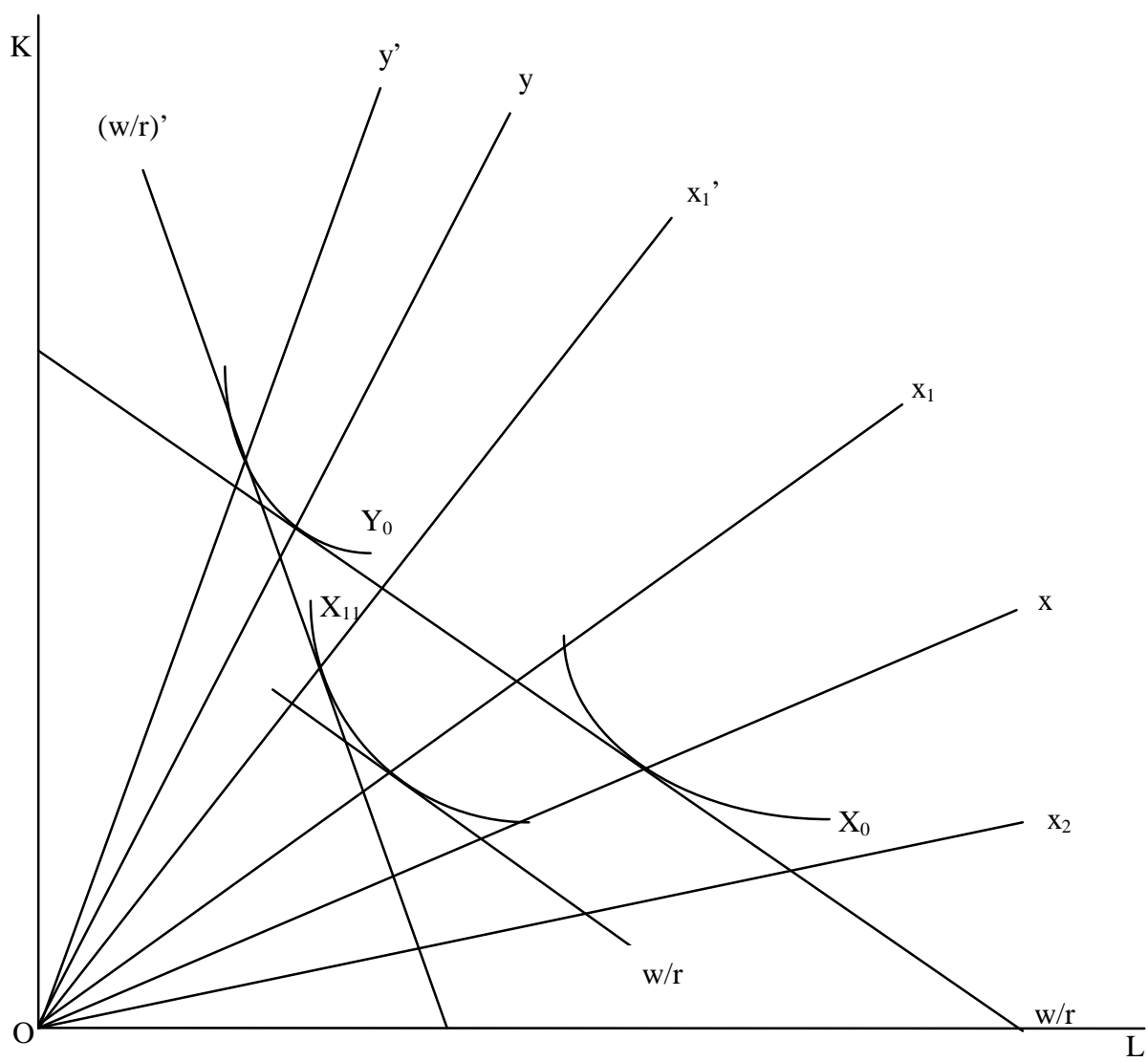


Figure 5.1

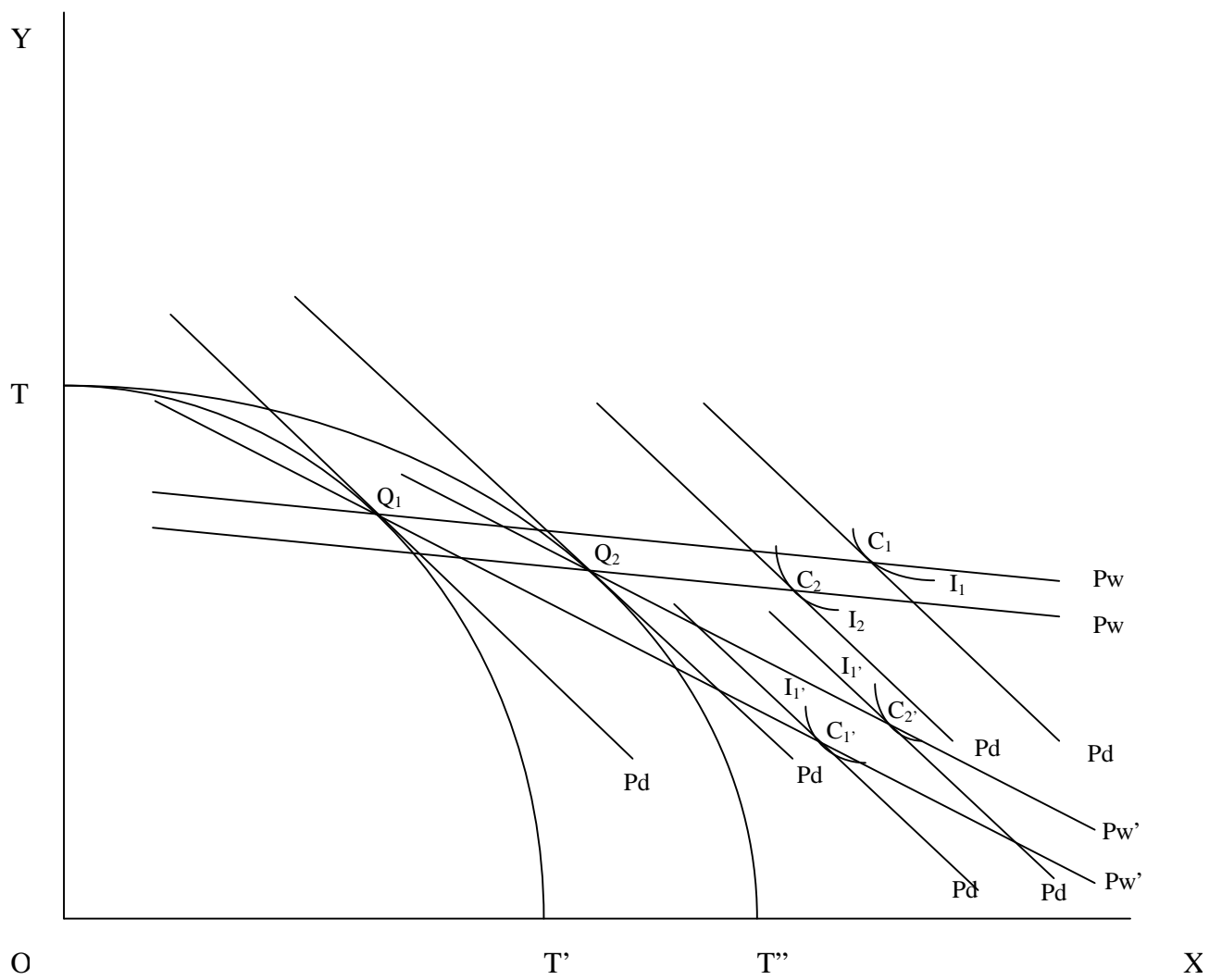


Figure 5.2

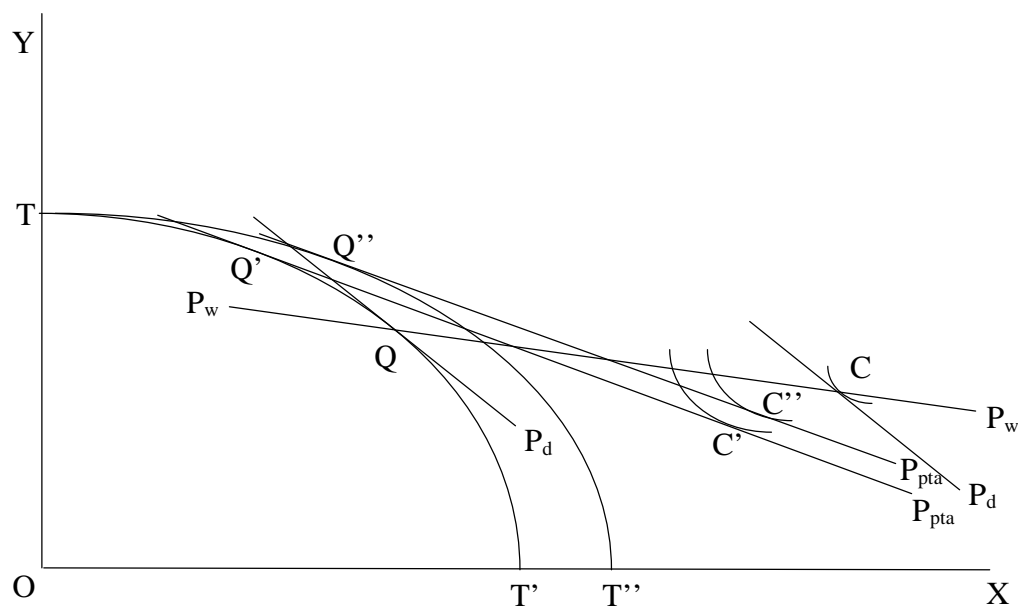


Figure 5.3

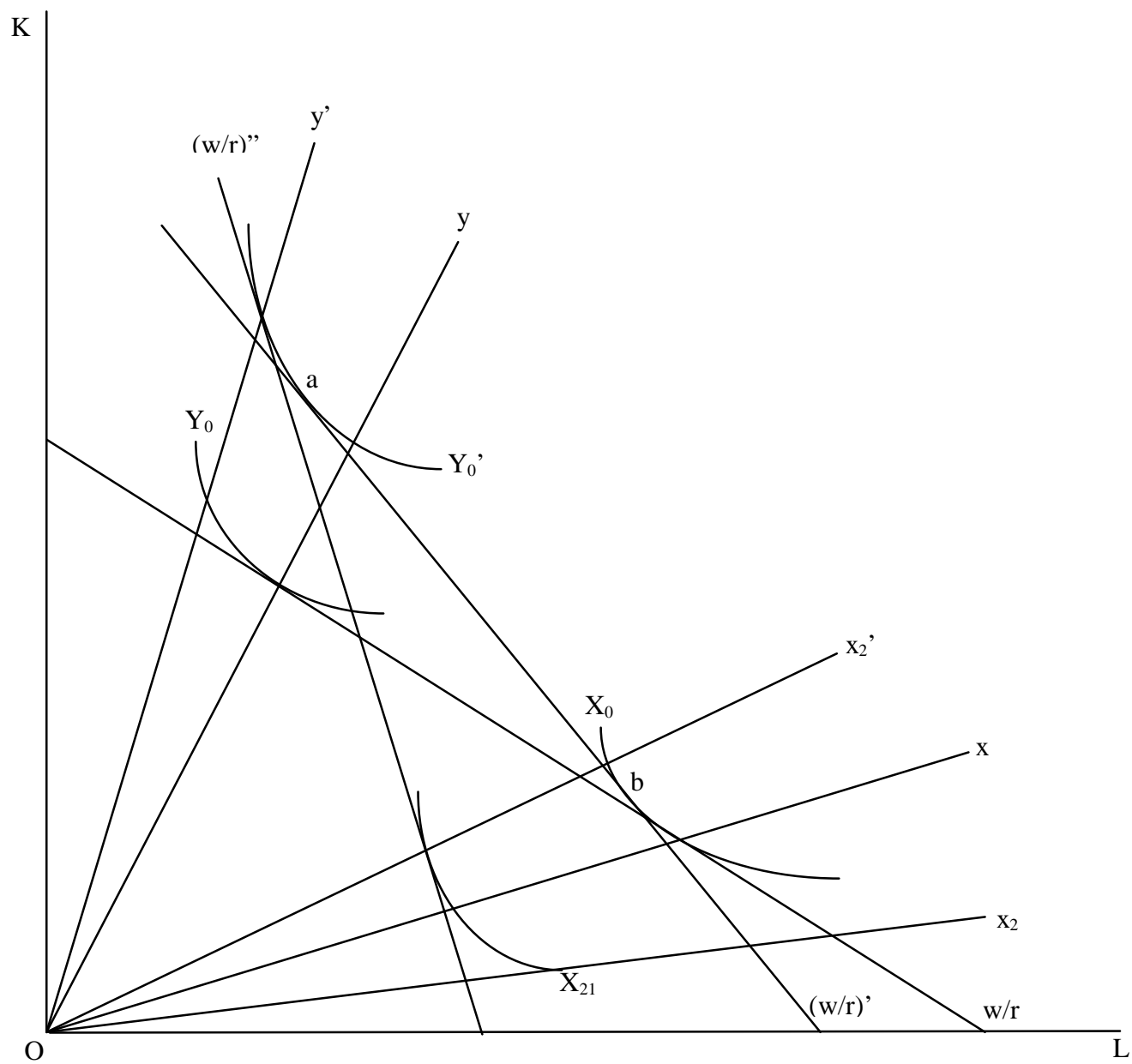


Figure 5.4

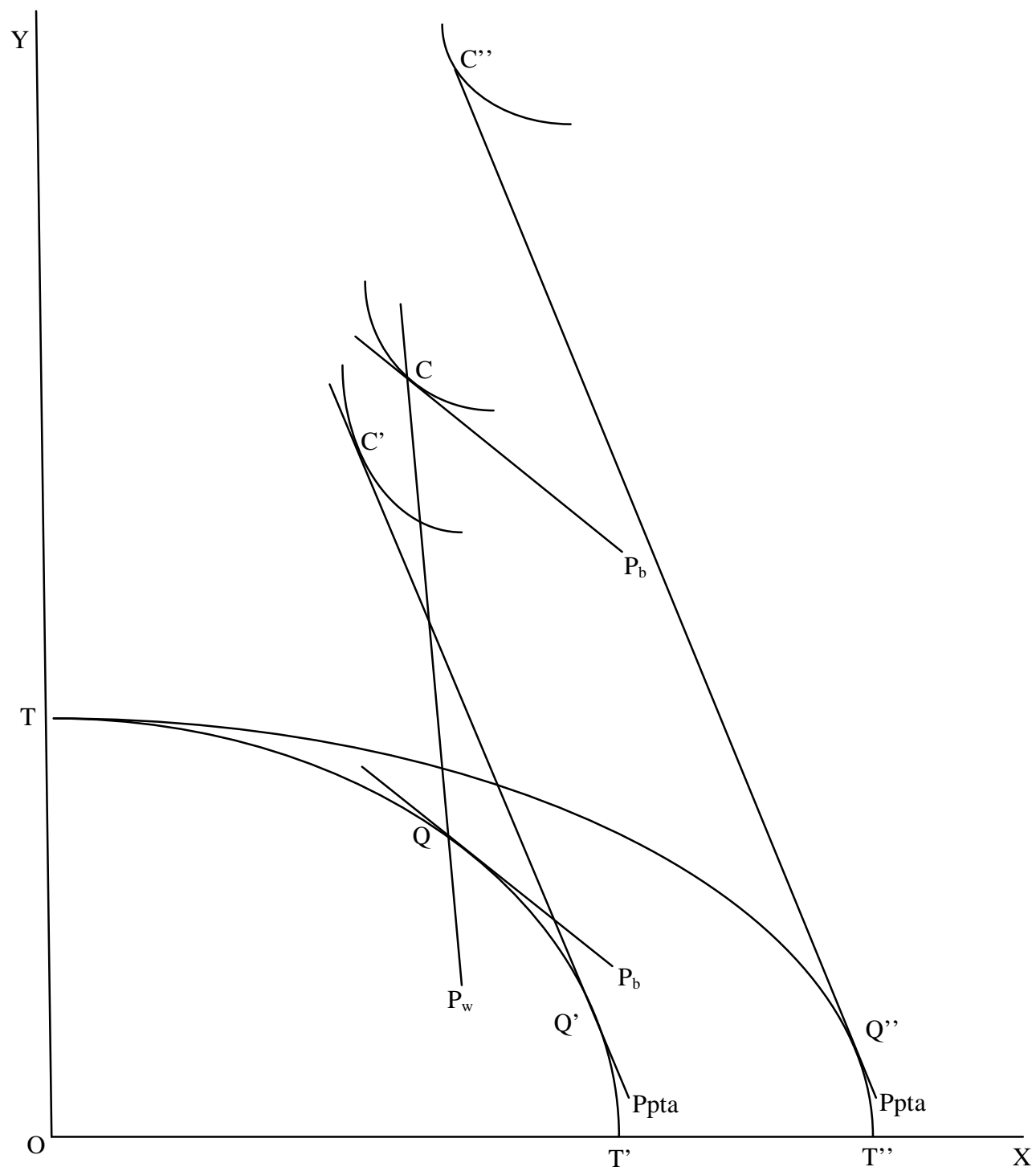


Figure 5.5