"GLOBALIZATION AND THE CONSEQUENCES OF INTERNATIONAL FRAGMENTATION"

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GLOBALIZATION AND THE CONSEQUENCES OF INTERNATIONAL FRAGMENTATION*

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1. Introduction

The dominant paradigm in the pure theory of international trade envisaged trade taking place in final consumer goods (augmented, on occasion, by trade in natural resources). Some forty years ago Robert Mundell (1957) challenged this scenario in the AER by considering a trading world in which real factor mobility provided an alternative to goods trade, one that could be activated by policies such as tariffs which interfere with trade in final commodities. This article opened up the floodgates to a more intensive study of the positive and normative consequences of allowing trade in productive factors and intermediate goods. The present paper fits into this literature by considering the process whereby improvements in transportation, communication, knowledge and technology allow a finer division of labor and a fragmentation of the production process so that previously integrated productive activities can be segmented and spread over an international network. This may involve the creation of multinational enterprises or, instead, be carried out in arms-length transactions where the costs of coordination have been sufficiently reduced to allow a spillover of productive activity abroad. In the past it was international capital mobility which created occasional public fears in exporting and importing countries alike. In the former, concerns were expressed that domestic employment and wages would be adversely affected if local producers invest abroad. In the latter an inflow of investment from abroad was sometimes described as selling the country out to foreigners. Today, globalization often provokes similar reactions.

The term "globalization" has entered everyday usage. It is employed frequently by professionals and the general public but rarely given a precise meaning. At a very basic level, one speaks of globalization of the world economy when the intensity of trade relations between
national economies has reached a certain threshold, such as indicated by a high trade to income ratio. If globalization were only that, then it was already achieved in the 19th century. But globalization means more than the intensification of trade relations. In fact it connotes several different phenomena: While for some countries the trade volume already looked impressive in relation to GNP a century ago, many fruits of human labor could not and would not enter international commerce. The subset of nontradeables was filled with many goods and services, particularly the latter. By contrast, today it would be difficult to find a good that could not in principle be traded. More significantly, services - once a perennial example of nontradedness - have increasingly become a subject of international commerce.

It could be argued that what sets apart current globalization from that which occurred in the aftermath of the Industrial Revolution is the widening of the spectrum of goods and services entering international trade. This process has been a consequence of trade liberalization, increased freedom of establishment and technical innovations allowing long-distance delivery of services. When more goods and services become tradeable, one can speak of extensive growth of international trade. We argue in this paper and elsewhere (1990) that the world economy has also been experiencing intensive growth of international trade. The driving force behind the intensification of international trade is fragmentation of the production process. Integrated technology requiring production of a good to occur in one place and in "one go" is replaced by fragmented technology that breaks down the manufacturing process into separate production blocks. These production blocks need not be produced by one firm, at the same time, in one place. They need not even be produced in the same country.

It can be readily seen how an increased fragmentation of production leads to a finer and
finer division of labor. Services - ranging from transportation and insurance to telecommunications and banking - play a crucial role in the fragmentation process since they connect various production blocks. Fragmentation may well be initially confined to national boundaries of a country as international service links are likely to be more expensive than the domestic ones, and as coordination of production and quality control is more difficult to achieve internationally than domestically. Over time, however, fragmentation is bound to spill over into international markets in response to lowering prices of services, increased tradedness of services and a whole range of technical improvements and innovations that allow geographic de-concentration of production.

New patterns of production and trade may emerge in response to such fragmentation. In a multi-commodity world it takes just one good to capture the benefits of trade. Similarly, having a comparative advantage in a single production stage may suffice to allow a country to branch into international markets without any need at all to be an efficient producer of the entire product. However, the aggregate welfare gains which may arise from globalization (e.g. Arndt, 1996) could well coincide with some factors becoming worse off. As we show in this paper naming the winners and losers is not a trivial task. The effects of globalization on wages have attracted a lot of attention and provoked fears and it is on this issue we focus in the paper. As well we ask about the impact of fragmentation on inter- and intra-sectoral resource allocation. Finally, it may be the case that a country as a whole loses as a consequence of international fragmentation.

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1Innovations in communications have been singled out by some authors as a principle cause of globalization. See for instance R. Harris (1993, 1995).
2. The Framework

The present paper builds on a framework developed in Jones and Kierzkowski (1990). The main motivation behind that effort, undertaken during the period of the Uruguay Round, was to expand the traditional production structure used in trade theory in order to analyze the role of producer services. As a result, new questions could be posed, such as: What impact can liberalization of trade in services be expected to have on trade in manufactured goods? Are less developed countries, often not the most efficient producers of services, justified in their fears of being further marginalized in international trade? Can the international economy become more interdependent as a consequence of liberalization of the rights of establishment and freedom of exchange of services?

The essential element of the framework presented in Jones and Kierzkowski (1990) is the distinction between integrated and fragmented technologies. In the former the process of manufacturing of a good takes place within a single production block. Factors of production and raw materials are brought together and a final good is created through the process described by a production function. Services have some role to play in the process of production based on integrated technology, but their role is rather limited. Economies of scale of the type envisaged as early as Adam Smith may eventually allow the production process to be broken down into two or more stages. Under fragmented technology individual production blocks are arranged in a more or less complicated production sequence, coordinated by a series of producer services. Some of the production blocks may find uses in more than one good, or different models of the same good. Some may even be utilized in a number of industries. Fragmented technology is more complex than an integrated production process in that it requires that individual production
blocks be connected by service links. These links can be best thought of as consisting of bundles of activities - coordination, transportation, telecommunication, administration, insurance, financial services and so on. Efficient production requires that production moves smoothly from one stage to another. For example the so-called just-in-time technology can be seen as a natural outcome of fragmentation of production.

In this paper we put aside issues of increasing returns and focus attention instead on a case in which one final productive activity gets segmented into two (or more) components as a consequence of a reduction in the cost of international service links. This sets the stage for differences in technology or factor skills between countries to realign the location of production according to comparative advantage, with differences in factor proportions and the technology and prices of other goods helping to determine the subsequent trading patterns. Thus both Ricardian and Heckscher-Ohlin characteristics (with the potential in the background for increasing returns to foster the fragmentation process) enter into determining the consequences of international fragmentation. Specifically, a country might gain by such a process even if it loses out, say, in producing the labor intensive segment of a previously integrated process in which it had a comparative advantage. A fear frequently expressed in relatively capital abundant countries is that such a loss of a labor-intensive activity creates difficulty for unskilled labor. We show that this need not be the case - especially for well-to-do countries. Alternatively, international fragmentation may destroy a previous position of comparative advantage in an integrated activity which is based on technical prowess that is relatively high in both (or more) segments, but not high enough to survive a finer application of Ricardian-type specialization. By contrast, a less developed country which was initially frozen out of producing a commodity may,
fragmentation, find that it can now compete successfully in a labor-intensive component. This could improve that country's overall level of income while, at the same time, reduce the wage rate for unskilled workers. Furthermore, just as fragmentation may result in a country's loss of all segments in a process, it is possible that a country might end up specialized in all segments of the fragmented process whereas previously it was producing completely different commodities. A multi-commodity framework is utilized to capture these issues for finite changes in production patterns.

In what follows we consider two productive inputs, capital and labor. But "capital" could as well refer to the human variety so that the consequences of fragmentation for the skilled/unskilled wage differential would provide the focus of attention. The labels are chosen for both analytical and semantic simplification.

3. International Fragmentation

Our focus is on the consequences for the pattern of production, the pattern of trade, aggregate country welfare and the array of factor prices of a technological improvement (e.g. in transportation or communication) that allows components of a production process to be traded on the international market. Prior to the innovation, any country wishing to produce the product in question would have to do so in a vertically integrated process, whereas after the innovation two (or more) components can be separately produced and can enter individually into international trade.

Figure 1 illustrates the situation in which the process of producing commodity 3 in an integrated manner involves inputs of two factors of production, say capital and labor in the amounts shown by 3, ("3 Integrated") to produce $1 worth of this commodity at the given world
price. Points $3_K$ and $3_L$ indicate input bundles which would be required to produce $1$ worth of each of two separate components which could be integrated into commodity 3. Before international fragmentation these components cannot be traded internationally, so that no trade prices are quoted. Instead, points $3_K$ and $3_L$ indicate capital and labor inputs which would be required to produce $1$ worth of the component assuming it is valued at local factor costs. These costs, in turn, depend on the local technology and world prices for other goods which this economy may produce in the pre-fragmentation equilibrium. The factor requirements to produce $1$ of final good 3 in the integrated process is a weighted average of points $3_K$ and $3_L$, with weights showing the distributive value shares of each segment in the integrated technology.

To simplify, we assume throughout that all technology exhibits rigid input-output coefficients (including the quantity of each segment required to produce a unit of final commodity 3). The α-ray in Figure 1 displays the cone of diversification spanned by the technologies for the components.

After improvements in transportation or communication costs allow a de-coupling of these components for commodity 3, world prices for the separate segments emerge. Countries are assumed to differ in their technologies and factor skills, so that a finer division of activities typically allows efficiency gains according to the Ricardian concept of comparative advantage. In Figure 1 this is captured by new combinations of capital and labor to produce $1$ worth of each segment at new world prices. Point 3, for the formerly integrated process is replaced by points 3, and 3, for the separate labor-intensive and capital-intensive segments. If this country
were to attempt to produce both segments (and no separate assembly costs are assumed)\(^2\), it
would take a greater quantity of capital and labor than previously to produce the integrated
product. That is, even though prices for all other commodities are assumed to remain the same,
fragmentation would typically allow a reduction in the final price for commodity 3.

Figure 1 also assumes that the labor-intensive segment, \(3_1\), is *dominated* by the capital-
-intensive segment, \(3_2\) in the sense that less capital and less labor are required to earn $1 at new
world prices producing segment \(3_2\) as opposed to segment \(3_1\). Thus segment \(3_1\) would no longer
be produced at home. Whether segment \(3_2\) survives in this fragmented world depends upon this
country’s technology for other goods relative to given world prices for these goods as well as on
the country’s factor endowment proportions. Both Ricardo and Heckscher-Ohlin have important
roles to play in this analysis of the consequences of international fragmentation.

4. International Trade with Fragmentation

The potential impact of international fragmentation on the pattern of production and
factor prices can be traced through on a diagram showing, for a small price-taking country, the
Hicksian composite unit-value isoquant. In Figure 2 the kind of fragmentation for commodity 3
shown in Figure 1 is illustrated together with unit value isoquants with fixed-coefficient
technology for activities 1, 2, 4, and 5. The original Hicksian convex hull, shown by the broken
solid line, is enhanced by fragmentation and the emergence of activity \(3_2\) instead of \(3_1\), as the
point on the new Hicksian composite unit-value isoquant. The labor-intensive segment, \(3_1\),
would not be produced with trade; nor, for that matter, would any of this segment be imported

\(^2\)This represents a polar stance to that of the “middle-products” approach (Sanyal and
Jones, 1982), in which all final goods are non-tradeables, produced by combining local factors
(labor) with components (or raw materials) available at given prices on world markets.
since we have assumed away a separate process for integrating the components.

Both Figures 1 and 2 suggest that the country is not competitive in producing the labor-intensive component of commodity 3. This is not a question of factor endowments. Rather, the technology and/or skills of local factors do not measure up to those found somewhere else in the world economy. However, the consequences of this for factor prices and the pattern of production do depend upon the economy’s factor endowment proportions. If the endowment capital/labor ratio lies within the cone of diversification (α) for commodity 3, the wage-rental ratio must fall. Furthermore, this is the fate awaiting labor if originally the country was more labor-abundant and produced commodities 2 and 3. Figure 2 also reveals that if the country did not originally produce integrated 3, fragmentation of this activity does not disturb production patterns or factor prices. As will be explained with reference to Figure 3, this result is not robust - technical progress which allows fragmentation of an activity not originally produced may nonetheless allow some segment of this activity to start production, with attendant changes in the distribution of income.

The country's loss of production of more labor-intensive segment 3 may suggest that the resulting fall in the wage/rental ratio is a natural consequence of an increase in the relative supply of labor which cancellation of 3 represents. This, however, is not the logic embedded in Heckscher-Ohlin theory in this two-factor setting. Instead, note that if the country is originally producing integrated 3 and activity 2, fragmentation is akin to experiencing technical progress in the activity which is capital-intensive. Activity 3, has been replaced by the segment 3, which, 3

3If the endowment ray is flatter that 03, cancellation of segment 3 increases the relative supply of capital to the rest of the economy (i.e. to 3 as well as 2). Nonetheless, the wage rate falls (and allocation of labor to labor-intensive commodity 2 increases).
at initial factor prices (shown by the slope of the segment connecting activities 3₁ and 2),
represents a more highly-valued productive activity. But must relative wages fall? Not if the
economy's endowment proportions are sufficiently capital-abundant that after fragmentation it
produces activities 4 and 3₂. In such a case, fragmentation works like an improvement in
technology in the economy's labor-intensive commodity - represented by the move from 3₁ to 3₂
- resulting in a rise in the wage/rental ratio.

This latter possibility is important. Referring again to Figure 2, consider an economy
whose factor proportions lie between the ratios illustrated by activities 4 and 3₂ - a country which
is capital-abundant relative even to the capital-intensive segment of newly-fragmented sector 3.
Fragmentation leads to the country's loss of labor-intensive component 3₁, and yet the
wage/rental ratio rises. Thus the charge that if international trade causes a country to lose a
production activity which is intensive in its use of labor it will cause the wage rate to fall need
not be true - especially for relatively capital abundant countries. And yet these are the very
countries which often express this fear. Furthermore, although the diagrams easily identify what
happens to the wage/rental ratio, the effect on the real wage is in the same direction. The reason
for this is the magnification effect, whereby factor price changes contain commodity price
changes (plus technical progress changes). When segment 3₂ replaces integrated 3₁ and the
relatively capital abundant country also produces commodity 4, the change in the wage rate must
be positive since the price of commodity 4 is unchanged - and the rental on capital must fall.

Figure 3 serves to confirm that if an originally integrated activity becomes fragmented by
trade, laborers in relatively capital-abundant countries which are engaged in this activity gain
and those in relatively labor-abundant countries lose, even if it is the more capital-intensive
segment that gets discarded because it is inefficient by world standards. There are important differences, however, between the situations shown in Figures 2 and 3. Suppose a country’s endowment proportion lies within the cone of diversification (α) of the fragmented segments of commodity 3. The case in which it is the labor-intensive component (3₁) which is lost through inefficiency (Figure 2) is the case in which the real wage declines, whereas the real wage rises if the labor-intensive component is the one which survives world competition. This is analogous to the remark that with technical progress in a Heckscher-Ohlin setting, the bias (i.e. whether labor-saving or capital-saving) may matter in the effect on factor prices for changes of finite size even though, for infinitesimally small changes, bias is unimportant for this question.

One possible consequence of fragmentation with international trade is that a relatively labor-abundant country which proves uncompetitive in the production of an integrated activity may, after fragmentation, be able to produce some labor-intensive segment. This is illustrated in Figure 3 for an economy whose endowment proportions lie between the intensities required to produce commodities 1 and 2. Fragmentation leads such an economy to switch from activity 2 to the more capital-intensive activity 3₁. Nonetheless, such a move reduces the real wage since it is like experiencing technical progress at the capital-intensive end of the productive spectrum.

Fragmentation with international trade has been shown in Figures 2 and 3 to have profound effects on the allocation of resources within the fragmented sector of the economy. But

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4 Note that in Figure 2 the labor-intensive segment of commodity 3 is dominated by the capital-intensive segment; if these segments are internationally traded, there is no way in which the labor-intensive segment could survive. By contrast, in Figure 3 the labor-intensive segment does not dominate; the capital-intensive segment is nonetheless not competitive because a combination of 3₁ and activity 4 proves superior - a reflection in part of the local technology of producing 4 and its world price.

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what can be said about resource allocation between the fragmented sector and the other productive sector? In Figure 2 suppose the endowments allowed an initial production of commodities 2 and 3. Trade knocks out labor-intensive component 3, thus replacing the integrated activity with capital-intensive 3. Employment in sector 3 (all in 3) falls as a consequence. On the other hand, a more capital-abundant economy producing commodity 4 and segment 3 after fragmentation will actually employ more labor in producing 3 than it originally employed in the integrated activity 3.

5. Fragmentation with Both Segments Surviving

Fragmentation need not condemn one of the segments to succumb to international competition. Figures 4 and 5 illustrate a pair of cases in which the post-fragmentation Hicksian composite unit-value isoquant contains both 3 and 3. These figures are drawn to illustrate a case in which the share of the capital-intensive segment is relatively small. This segment might represent "headquarter services," which, with the presumed lowered cost of service links, could be located in one country while still allowing the production block (3,) to be located in another.

When both segments of fragmented sector 3 appear in the convex hull, more attention must be paid to a situation in which the economy's endowment proportions are located within the cone spanned by individual segments 3 and 3. In Figure 4 for endowments within cone α production is concentrated on the two components, but international trade allows them to be produced in proportions different from that of the integrated technology. Our earlier general

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5Suppose the endowment ray allows initial production of commodities 2 and 3 in Figure 2, and let k, k, and k indicate capital/labor ratios in the economy, in sector 2, and in sector 3 respectively. k is the weighted average, \( k = \lambda k_2 + \lambda k_3 \), where \( \lambda \) is the fraction of the labor force employed in sector j. The move from integrated 3 to capital-intensive 3 represents an increase in k, which must (since k exceeds k) be balanced by a matching reduction in k.
results for endowment proportions lying outside cone $\alpha$ remain as before: Capital-abundant countries could see an improvement in real wages, and labor-abundant countries would experience a wage fall. But within diversification cone $\alpha$ these results are completely reversed: Relatively capital-abundant countries suffer a fall in wages and labor-abundant countries experience a wage increase.

To understand this reversal consider, first, an economy which is capital-abundant relative to integrated activity $3_1$, but not so capital-abundant as to lie in cone $\beta$ in Figure 4. For such an economy fragmentation is like experiencing technical progress in its capital-intensive activity as production of $3_2$ replaces activity $4$ and technical regress in its labor activity as $3_1$ replaces integrated activity $3_t$. Hence rents rise and wages fall. However, the situation for an economy whose endowment proportions place it in the $\beta$ cone is different. Note that it originally produces commodities $5$ and $4$, and replaces both of these activities with the two segments of commodity $3$. At the capital-intensive end it replaces activity $5$ with activity $3_2$, which, at original factor prices, is like experiencing technical progress in the capital-intensive good, thus encouraging a fall in wages. At the labor-intensive end it replaces activity $4$ with activity $3_1$, which at its initial factor prices (shown by the slope of segment connecting the isoquant corners for commodities $4$ and $5$) is like technical regress, which would also serve to depress the wage rate. At the other end of cone $\alpha$, labor-intensive activity $2$ is replaced by the superior activity (at initial factor prices) $3_1$, and capital-intensive $3_t$ is replaced by $3_2$ which, at initial factor prices, is like technical regress, hence causing wage rates to rise. In Figures 4 (and 5) note that if the endowment ray lies within the cone of diversification of sector $3$, the new fragmented activity lies at the capital-intensive end of competitive activities for relatively capital-abundant endowments in the cone.
and at the labor-intensive end of the range for relatively labor-abundant countries. This reverses the ordering for economies whose endowment proportions lie outside the cone, and is the basis for the turnaround in results alluded to above: Outside the cone it is relatively capital-abundant countries whose labor has nothing to fear from fragmentation, while inside the cone relatively capital-abundant countries experience declines in real wages.

Figure 5 also illustrates a situation in which both the capital-intensive and labor-intensive segments of the production process for commodity 3 survive the fragmentation process and are potentially competitive on world markets. However, the line segment connecting them is no longer part of the Hicksian convex hull. As a result, an economy whose endowment proportions lie within diversification cone $\alpha$ will produce one segment or the other, but not both. Economies with a capital/labor endowment ratio higher than that used in commodity 4 suffer a loss in wages, while more labor abundant economies within cone $\alpha$ experience a wage increase. Indeed, consider such an economy which originally produces integrated 3, along with more labor-intensive commodity 2. At initial factor prices the switch from producing integrated 3, to commodity 4 is akin to technical regress at the capital-intensive end coupled with a switch from activity 2 to segment 3 (like technical progress) at the labor-intensive end. Once again, for economies whose endowments lie outside diversification cone $\alpha$, if wages are affected they rise for relatively capital-abundant countries and fall for relatively labor-abundant countries.

6. **Fragmentation with No Segment Surviving**

An economy which would successfully compete in producing an integrated activity in a world market might find that fragmentation of this activity drives it completely out of that sector. Figure 6 illustrates this case. Initially if the economy's factor endowments allowed production
of integrated activity 3, it might have been the case that potential rivals in other countries could
have had poor skills in one segment even if superior skills in the other. By contrast, the home
country might have been "second best" in both, so that its average cost of producing 3 made it
competitive. The de-coupling process accompanying fragmentation gives finer possibilities for
countries to specialize in those segments in which productivity is high without being dragged
down by home production in the other segment. The resulting price drops for segments 31 and 32
could lead to both activities lying within the new convex hull in Figure 6. An analogy can be
helpful here. Suppose that the Olympic games consisted of only one discipline - the decathlon
and that one champion dominated the discipline completely. Imagine now that the rules have
been changed and the decathlon has been replaced by ten independent disciplines. Can the old
champion expect to win a large number of gold medals? In fact, he or she may not win even a
single medal.

If this country produced commodity 3 before fragmentation, it now has to spend more
capital and labor to earn $1 on world markets. The new Hicksian convex hull is inferior -
containing the dashed line segment connecting activities 2 and 4. Two further remarks are worth
noting in this case. First, although the convex hull is made less attractive by fragmentation, the
country's net real income might be improved. Suppose the country initially even exported
commodity 3, whose price has deteriorated. Nonetheless, if this price falls sufficiently, the gain
to home consumers might result in a net gain to the community. Secondly, the behavior of the
wage/rent ratio outside cone α is just the opposite from Figures 2 and 3 where the country retains
a productive segment after fragmentation: Relatively capital abundant countries suffer a drop in
wage rates since fragmentation is like technical regress at the labor-intensive end.\(^6\)

7. **Fragmentation with Specific Factors**

A standard characteristic of international trade models is that the effects of technical progress or price changes on the distribution of income are quite sensitive to the specification of the production structure. In particular, in the Heckscher-Ohlin framework of the past sections two productive factors were mobile amongst all sectors. By contrast, some factors may be less mobile and there may be more factors than commodities produced. Such is the case with the specific-factors model. Suppose that in each sector there is a type of capital used only in that sector, whereas labor is mobile and homogeneous in all activities. If all commodities are traded with commodity prices given on world markets, in each sector there would generally be complete specialization to a single commodity or, alternatively, there could be one sector in which two traded commodities are produced.\(^7\) Assume the former case. The first remark that comes to mind is that we must abandon the assumption that technology is rigid and allow for factor substitutability in each sector. Nonetheless, begin the analysis at an initial free-trade equilibrium in which only final goods enter trade, and once again let a single commodity (3) now be fragmented into two segments, with trade permissible in each.

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\(^6\)To be more precise, wages fall if the country originally produced commodity 4 and integrated activity 3.

\(^7\)Details of such a model are provided in Jones and Marjit (1992). There the setting begins with autarky equilibrium in which commodity prices adjust to local demand conditions and in each sector there may be a number of commodities produced using capital specific to that sector. The move to free trade in all commodities then requires that in each sector only one commodity survives competition at given world prices (the small country case), which would correspond with the \((n + 1) \times n\) specific-factors framework, or in one sector two commodities survive in a “nugget”, which corresponds to a form of the Heckscher-Ohlin model made popular in the 3 x 3 version of Gruen and Corden (1970).
We focus on the situation shown in Figure 2, in which it is the capital-intensive component in industry 3 that will survive international fragmentation. Whereas little room exists in the Heckscher-Ohlin model for the importance of factor bias in technical progress (except for finite changes), this is a feature that comes into its own in models with more factors than goods, such as the specific-factors model. Thus fragmentation that knocks out the labor-intensive segment in producing commodity 3 will, at initial factor prices, create an excess supply of labor and, when markets clear, bring about a fall in the wage rate relative to returns on all types of specific capital. By contrast, fragmentation in which it is the capital-intensive segment of producing commodity 3 that gets ruled out in competition would serve to raise the wage rate relative to all rentals. These results correspond more closely to the widely-held view that labor in advanced countries loses out when increases in the extent of world trade lead to losses of labor-intensive sectors.

Although this argument reveals the effects of fragmentation on the ratio of wages to rentals, it does not necessarily expose the effect on the real wage. The analogy to technical progress is once again useful. Technical progress in any sector has two types of effects on wages. To the extent that it saves on the use of labor, the wage rate is depressed. But the wage rate is positively affected by technical progress in any sector. And if the degree of factor substitutability is sufficiently high, the latter effect prevails over the former. For example, in Jones (1996) it is shown that for pure Hicksian labor-saving technical progress of the same extent in each industry, real wages for mobile labor nonetheless rise if on average the elasticity of substitution between labor and capital exceeds the ratio of capital to labor shares (which ratio is usually taken to be around one half).
8. Concluding Remarks

One of the often-referenced facts of economic life is that the volume and value of international trade is increasing, even relative to national incomes. Furthermore, a greater fraction of such trade is taking place in intermediate goods, raw materials, producer goods, and other non-final consumer goods. Aiding and abetting this phenomenon is the decreased cost of the international fragmentation of the production process due to technological advances in transportation and communication, greater knowledge of legal systems in other countries and attendant lowering of risks in co-ordinating production of various segments at locales around the globe, whether within a multinational firm or making use of arms-length transactions. In this paper we concentrate on the consequences of this process for aggregate country national income, the array of factor prices and the inter- and intra-sectoral allocation of employment.

Perhaps the most normal-sounding result of such fragmentation is one that flows from the specific-factors setting of the preceding section, whereby losses of labor-intensive segments of production to international competition increase the relative supply of labor to other sectors and, assuming commodity prices remain constant, lower the wage rate relative to returns to various types of capital. But even here the prognosis for a nation's labor supply need not be gloomy, since such fragmentation tends as well to work like technical progress in raising the returns to all factors. If factor-substitution possibilities are sufficiently large, the real wage can rise even if the return to capital increases by more.

It is in a setting in which all factors of production are internally mobile and trade focusses

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*Globalization can also affect the internal geographic location of industrial activity. For an interesting analysis of this issue for Mexican production see Hanson (1996).*
productive activities to the same number of commodities as factors that a richer variety of outcomes, some rather surprising, can emerge. Here we have severely limited the analysis in two ways - we have considered only the two-factor case and assumed technology allows no factor substitution. Furthermore, we have abstracted from the important costs involved in the act of providing service links to bring together various segments or intermediate goods into a separate assembly operation. Thus a formerly integrated process involving two segments can, as a consequence of background improvements in costs of transport or co-ordination, appear separately in international trade. Both Ricardian and Heckscher-Ohlin elements help to determine new production networks. Inadequate factor skills and/or technology may render one of the segments uncompetitive in that it is dominated by the other segment (as in Figures 1 and 2). Alternatively, the use of different factor intensities may result in one segment lying within, instead of on, the Hicksian convex hull of production possibilities at given world prices (as in Figure 3). The consequences of such fragmentation then depend on the country's factor endowment proportions. Specifically, is the capital/labor ratio greater than either segment of the fragmented process, less than either segment, or does it lie within the cone of diversification of the fragmented process? If a country loses the labor-intensive segment, the wage rate need not fall. The analogy with the way in which technical progress affects factor prices in a Heckscher-Ohlin world provides the clue to explaining the possibilities. Thus if fragmentation takes place in a sector which is capital-intensive relative to the other sector's production requirements, the real wage (as well as the wage-rental ratio) must decline, whether it is the relatively labor-intensive fragment or the capital-intensive fragment in the sector which is lost to competition. However, for a relatively capital-abundant country fragmentation may take place at the labor-
intensive end, and this serves to increase the real wage, even if it is the labor-intensive segment of the fragmented process which gets lost to international competition.

Our entire discussion took place in a setting in which factor prices change in order to clear factor markets so that problems of aggregate unemployment are set aside. Nonetheless, it is possible to enquire about changes in employment levels within and between sectors. Clearly fragmentation can have severe effects on the locale of employment within the fragmented sector - the entire segment can be lost to trade. But inter-sectoral employment flows may more than make up the difference. An example was provided in Figure 2 in which a country could lose the labor-intensive segment of a fragmented process, but end up with a net transfer from its capital-intensive sector (4) so that the now-tradeable capital-intensive segment in the fragmented sector hires more labor than did the entire previous integrated sector. And, the wage rate would rise.

It bears repeating that many questions central to the phenomenon of globalization have not been addressed in this paper. This is deliberate, since the potential consequences of international fragmentation for national resource allocation and income distribution are sufficiently complex as to merit separate attention. It is certainly not the case that the loss to international competition of a labor-intensive process must be harmful to the interests of labor.
REFERENCES


FIGURE 1
FIGURE 3
FIGURE 5
FIGURE 6
Autor: Jones, Ronald Winthrop,
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