4 Multiple Outcomes That Result from Productivity Changes

An economic issue that persistently arouses heated debate is the effect on a nation's well-being of improvements in the productive efficiency and product quality of foreign industries. It is a subject on which business and labor often hold opposing and emotional views and on which the views of the political parties or even successive administrations often diverge. Many times it becomes far more than an abstract discussion about the effect on the nation as a whole. With jobs and the fate of particular industries at stake, the concrete instances in which an industry is threatened by increasingly productive foreign competition become the focus of lobbying and intense political pressure.

Does an increase in the industrial abilities of a trading partner drive down our wages and impoverish our workers? Do our consumers benefit when products that were once made at home become available more cheaply or in better quality from abroad? How do these conflicting consequences balance out? What is the net effect on our country's overall prosperity? These are obviously very real and very practical issues.

We will see that the analysis of our earlier discussion has prepared us to deal with these questions even in the absence of high start-up costs and retainability. These questions are once again about the relative desirability of various equilibria. The question now being asked at the national level is this: Is the equilibrium after our trading partner improves its productivity better or worse for us than the equilibrium we had before?

Our methods for dealing with the various different retainable equilibria carry over with little change to this new issue, and our economic conclusions will also be very similar. We will see once again that improvements in a very undeveloped trading partner are good for both countries, but improvements in the trading partner, once it is beyond

a certain state of development, once more cause conflict in the nations' interests.

4.1 Changing Capabilities

The modern world is characterized not only by high start-up costs and scale economies, that is, by the retainability of many of its industries, but also by substantial and rapid technological and industrial change. Success in industry today is more likely to be acquired than natural. It is more likely to come from manufacturing skill, know-how, low wages, or technical knowledge, or a workable combination of these, than from any gift of nature. The ability to produce and market some good or service depends less on the presence or absence of mineral deposits and more on a superiority of learned abilities or, more accurately, on a level of learned abilities that, coupled with its wage level, makes a country a competitor in a particular industry. While superiority based on natural advantage provides stability in the industries where such advantages exist, industries whose method of operation can be learned and that do not require huge entry costs are subject to rapid changes in their competitive positions as new countries acquire the know-how and become competitors.

We have seen this in Asia. While there has been success in high-tech industries, and Japan, in particular, has entered industries such as autos and semiconductors that are high-tech and have a high cost of entry, much of the Asian success has been based on much more mundane products. Clothing and athletic shoes are not hard to make. Television sets and many other electronic consumer products are not hard to assemble. Once this know-how has been acquired, plants in many Asian countries become competitive because of their generally low labor costs. And knowledge of assembly operations, for example, can be acquired. Often, multinationals, seeking low-cost production sites, will create the plant and also train the workers.

Of course, low wages in Asia or, for that matter, in Mexico, are not new. What is new is the coupling of these low wages with adequate skills, know-how, and physical plant. The motivation for this coupling has been provided by improved market access. This means both better access to the home market via improved transportation and lowered tariff barriers, and access to the foreign market as part of an attitude abroad more favorable to foreign investment.

4.2 Changing Capabilities and Multiple Outcomes

In this chapter we will *not* assume, as we did before, that the industries considered are retainable or offer economies of scale in any form.[1] Here, instead, we deal with the case—on which the classical theory of international trade is based—the complete absence of economies of scale. Nevertheless, because we add to it the changeability of production costs through acquired technology and skills—we will reach conclusions about international trade and its effects on the trading partners that are almost indistinguishable from those that we obtained about retainable industries in chapter 3.

We will assume that production takes a very simple form, the special case often studied by economists, who call it linear production.[2] Production is said to be linear when, if it requires one labor hour to produce 6 units of some good, then two hours will produce 12 units, and three hours will produce 18. In other words, there is one fixed productivity level—6 units of output per labor hour, whatever the scale of production may be. This assumption is plausible for many industries, especially those that are labor intensive. In a simple assembly process more workers mean more production. If the capacity of the work shed is ever exceeded, another can be added at fairly low cost and the process of output expansion can continue. It is output per worker—labor productivity—that counts.

When production is linear there is no entry cost, and there is neither an advantage nor a disadvantage to doing things on a large scale. With linear production it is possible to enter new industries on a small scale and be as productive as a large-scale competitor. This is the key feature of the classical diseconomies case that leads to a single predetermined outcome in international trade, as we saw in chapter 2.

Since linear production is a particular variant of the classical diseconomies case, only one equilibrium outcome is normally possible for any fixed set of productivity levels in two trading countries. But if we consider different alternative productivity levels for the two trading countries, each different choice of productivity levels yields a different equilibrium outcome—the wider the range of different productivity levels, the greater the range of outcomes.

For example, if the United States were to have relatively high productivity levels in wheat and rice production and in making wooden furniture, while China were productive in athletic shoes and electronic assembly, we would get one equilibrium outcome. If, however, some

other productivity levels were to prevail in these industries, the outcome would be different. If productivity in athletic shoes were low enough in China, the U.S. athletic shoe industry would become competitive despite the low Chinese wage, and a different assignment of industries to the countries and a different outcome would result.

Therefore, if we assume linear production, along with the possibility of changes in the productivities of the trading partners, we again have many different possible outcomes. In this way we can return to the questions discussed in the previous chapter. When there are many possible equilibrium outcomes, which are good and which are bad for the various countries? In the scenario of chapter 2 the many different outcomes were attributable to the presence of retainable industries. Here the many different outcomes result from the many different possible levels of productivity.

In chapter 3 we considered all the equilibria that are possible outcomes in a model with retainable industries. Despite the huge number of those equilibria, and therefore of different outcomes, we were able to organize the outcomes into a graph and draw some strong and simple conclusions about conflict in international trade. We will do exactly the same thing here, using linear models. We will consider all possible different productivities for the two trading countries and organize the outcomes from this vast array of possibilities using exactly the same set of graphs.

Remarkably enough, these graphs will show us, just as before, that those outcomes that are good for one country's overall national welfare tend to be bad for the welfare of the other. We will see once again that the very best outcomes for one country are always poor ones for the other. We will see once again, under these new circumstances—without retainablility, but with the possibility of different levels of productivity—that conflicting national interests can arise in international trade.

4.3 Graph for the World Economy

Because our linear production model has the key characteristic that it permits effective entry into an industry on a very small scale, with no disadvantage resulting from the smallness—it gives us for any one combination of productivity levels for the various industries, exactly one equilibrium. This one outcome will be the assignment that most efficiently satisfies the wants of consumers given that particular com-

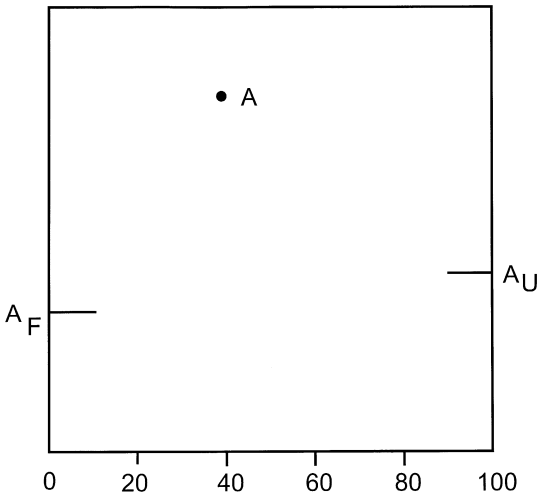

Figure 4.1
Equilibrium point, fixed productivities

bination of productivity levels. Exactly as before, we will plot this outcome as a dot such as point *A* in our graph of world income versus relative national income, with the share (relative income) of one of the countries measured on the horizontal axis and actual national income on the vertical axis (figure 4.1).

Then, if we consider a second set of productivity levels, we obtain a second equilibrium and a new dot in our familiar diagram of equilibrium points. We can go on examining different possible productivity levels and adding dots to the diagram until we have plotted all possible productivity levels.

What limits the possible productivities of these countries, and hence the possible dot locations in our diagrams? Given the state of knowledge and technology at a given time, only a certain range of productivity levels is possible. At one extreme, the floor is the limit. Of course, with sufficient inexperience, ineptitude, or lack of tools and technology, it is possible to obtain productivity levels as close to zero units of output per labor hour as one can want to consider. However, there is also a ceiling. Even with all the experience, skill, tooling and technology in the world it is not possible today to produce one million cars per labor hour.

If we are to confine ourselves to possible productivity levels, we must therefore assume, as is clearly true in reality, that at any given time

there is a limit to how productive any industry in any country can be in supplying a given product. If the industry is a poor producer, it may be well below that limit. If it is doing everything well, it will be very close to that limit. There will always be a limit, and in our analysis pertinence to reality requires that we consider only productivity levels at or below that limit. Some countries do have natural advantages over others, so we will permit the limits in productivity in a given industry to be different from one country to another. Nevertheless, for each country in each industry, we will assume that there is a practical limit.[3]

The fact that there are productivity limits at a given time does have important economic consequences. If, for example, a highly developed country makes a certain good, and makes it in the most efficient possible way, it may for some time be unrivaled as a major producer. If, however, a lower wage country can learn how to achieve the same high productivity level, it can make the same good at lower cost than the highly developed high-wage country, and as a result replace the high-wage country as a major producer. If the highly developed country were not already producing at the limit of what is currently possible for it, it would be able to respond by becoming even more productive, and enhance its productivity advantage sufficiently to overcome the wage difference. But if it is already at or near the limit of what can be achieved, such an increase in productivity is not possible, and it will lose its leadership in that industry.

When, for instance, the textile mills migrated from New England to the lower-wage southern states of the United States, they used the same technology as before but now did so in a lower wage area. The southern textile mills were employing the production methods they had used up north. So there was no way for the remaining New England mills to respond with a leap in productivity and regain their cost advantage. It is this sort of scenario, portraying competition in both productivity levels and wages, that underlies the analysis of this chapter.

4.4 Shape of the World Income Graph: All Outcomes Included

In figure 4.2 we plotted the upper boundary for all the world equilibria that do not exceed the current productivity limits imposed by the current state of technical and industrial knowledge. These equilibria completely fill out the region under the curve shown in figure 4.2.[4] These equilibria represent all the different outcomes

Figure 4.2
Upper boundary for the region of world equilibria

that are possible from all the productivity combinations available to the U.K. and France. Because all productivities up to certain limits are possible, the equilibria are not isolated dots, but rather fill up the entire region under the upper boundary.

Plotting these outcomes has led to exactly the same sort of dome-shaped region that appeared in our discussion of retainable industries. At the extreme right of the diagram the U.K. is the producer of almost everything that is traded in the world, and its share of world output is almost 100 percent. This can only occur when its productivity levels are almost all far greater than those of France. In fact at these equilibria France must be so relatively unproductive that even its low wage rate, which reflects its very small relative national income, does not make up for the very large number of labor hours that it takes French workers to make the various goods. Near the extreme left of the diagram the situation is reversed. A very different set of productivity levels prevails there, and France makes almost everything because its productivity levels are very high relative to those of the U.K. At the outcomes in this part of the graph the U.K. contributes very little to the world economy.

However, if both countries achieve high productivity levels, then at equilibrium both will contribute a good deal to the total output of the world economy and total world output will be much larger. Both countries will have significant shares of this larger world income, so the points representing these equilibria will be located toward the middle of the graph and will be high in the diagram, representing a large world income.

What is different in this graph, as opposed to the retainability case is that in this model it is also possible to find equilibria that are very low. Our diagram, so far, does not contain a band with upper and lower boundaries, but permits any level of low outcomes. These outcomes will occur when the productivities of almost all the actual producers are low, perhaps even extremely so. Even though in each industry a successful producer will have out-competed potential producers in that industry in the other country, its productivity still is low compared to what is possible for it. A low equilibrium point represents a generally low-productivity world, a world in which industry is generally underdeveloped relative to what is possible for it.

4.5 Region of Maximal Productivity

However, such a situation is not likely to persist in the modern world where industrial skills can be acquired. Countries that are actually engaged in the production of some good learn through experience how to do better, so their productivity levels are likely to rise until they approach the productivity limits imposed by the current limits of knowledge and technology.

This improvement process, driven primarily by experience, affects only the country or countries that actually are producers in a given industry. It does not apply to those that have never entered a particular industry or to those that drop out of it. The productivities of these industries, in the country that does not participate in them, are likely to remain at their original low levels. There is no opportunity to learn-by-doing in an industry that does not exist in a country.

This observation, that the actual producers in any industry are likely, in the long run, to approach their highest currently attainable productivity levels, leads us to our next topic: the outcomes that occur when the producers in each industry have attained the highest level of productivity that is currently technologically possible for them. We call such possibilities the *maximum productivity outcomes*.

There are many maximum productivity outcomes. For example, in one of these outcomes the U.K. attains its maximum productivity in the manufacture of, say, electronic pagers, while France is highly productive in other goods but has a very low productivity level in that particular good, one that is near zero and nowhere near its maximum. The U.K. in that situation will be the sole producer of electronic pagers. Another and very different maximal productivity equilibrium will arise if it is France that has the overwhelming productivity advantage in electronic pagers—reaching a productivity level near its upper limit—while the U.K. has a very low productivity level, far below its maximum, perhaps near zero. At this maximum productivity outcome France will be the cheaper producer of electronic pagers and, hence, in the long run, their only producer. All of these possible maximal productivity equilibria lie between the upper and lower boundary curves of figure 4.3 in the region we call the region of maximal productivity.

As time passes, the world economy tends to reach the outcomes in this upper region where maximal productivity is achieved in each producing industry. This is because the firms that survive and are

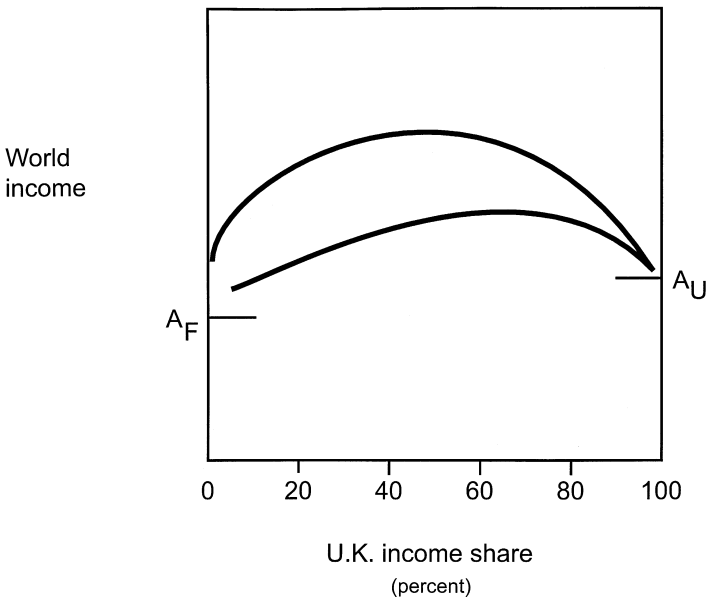

Figure 4.3
Upper and lower world boundaries of the region of maximal productivity

active in an industry tend to learn to use current best practice in that industry. Through this learning-by-doing there is a tendency for the economy to evolve toward outcomes in the region of maximal productivity. For this reason we will focus our discussion on the region of maximal productivity as we turn to the graphs for the individual countries.

4.6 Different Productive Capabilities: Graphs for the Individual Countries and the Combined Graph for the Two Countries

To obtain the graph for the U.K. from figure 4.3 which refers to the entire world, we simply repeat the reasoning we used in chapter 3. The U.K.'s income level is derived from the world income by multiplying world income by the U.K.'s percentage share of the total. If at some particular equilibrium world income is $20 trillion and the U.K.'s share is 75 percent, then the U.K.'s national income must be 20 times 0.75, or $15 trillion. Since the U.K.'s share is near zero at the extreme left and near 100 percent at the extreme right of the diagram, the U.K.'s income will be near zero at the left of the graph (because it equals world income multiplied by the U.K.'s zero share), while toward the right it will obtain nearly all of world income. The result is the hill shape of figure 4.4, with its peak off to the right of the peak of the world income dome.[5]

Repeating the same reasoning, we obtain a diagram for France (figure 4.5) with its peak off to the left of the world peak. Then, combining the two figures, just as we did before, we get the two-country diagram shown in figure 4.6.

These figures are essentially the same as those in our earlier discussions.[6]

4.7 Interpreting the Individual Country Graphs and the Combined Graph

In this chapter we have focused on the multiple equilibria that result from different productivity combinations. In the previous chapter we discussed the different equilibria that result from different assignments of retainable industries to countries. We obtain the same basic diagrams in both cases. What does the hill shape of our basic graph tell us in this situation, where we are dealing with different productivities?

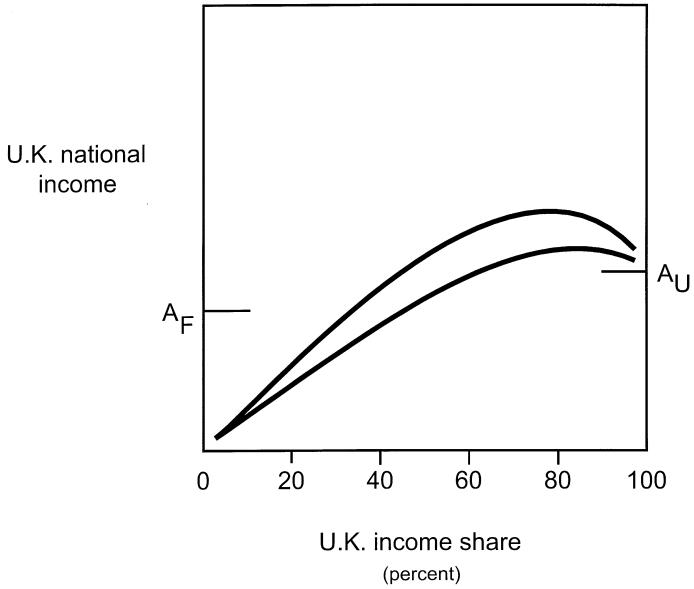

Figure 4.4
Region of maximal productivity for the U.K.

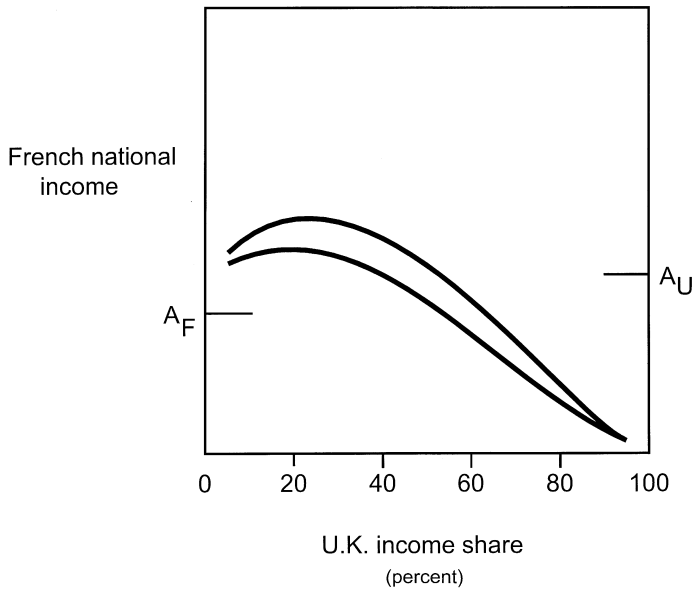

Figure 4.5
Region of maximal productivity for France

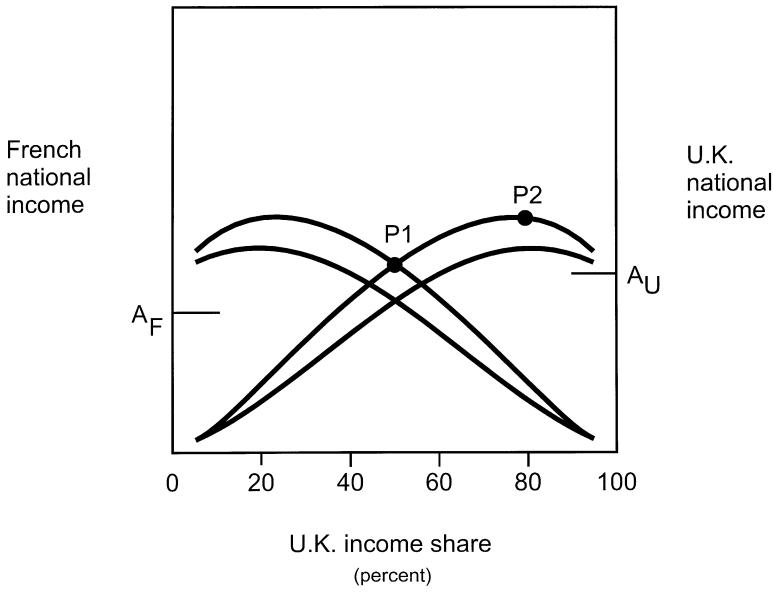

Figure 4.6
Graph for both countries with two important equilibria

The hill shape of the graphs tells us once again that up to a point a country's income, and hence its standard of living, will benefit if it succeeds in acquiring a greater share of world income. Equivalently it tells us that up to a point a country's income, and hence its standard of living, will benefit if it succeeds in changing its productivity levels so as to take industries away from its trading partner. However, once again, the graph shows us that this is a process that can go too far. If a country's *share* becomes too large, its actual national income will decline.

Similarly, if we look at the combined graph for the two countries, we see, as before, that over the range of possible outcomes that are located between the two peaks, the two countries' interests are inherently opposed. In this part of the graph an increase in one country's share brings an increase in its national income but a decrease in the national income of its trading partner. Finally, just as before, there is also a range of outcomes located between the peaks and the ends of the graph where the interests of the countries are not opposed but complementary. For example, an decrease in France's share of world income at the

extreme left of the diagram increases both France's and the U.K.'s national incomes.

We see that our diagrams, applied here to the consequences of unequal productivity growth, bring us back to the main conclusions of chapter 3. Even without retainability of industries there is conflict in international trade.

4.8 Interpreting the Graphs: More Developed and Less Developed Trading Partners

What is the commonsense view that lies behind these graphs and these conclusions? In chapter 3 it was fairly clear that if history brings a country to a prosperous position in which it has a large share of world production and a high national income, it can hold that position despite its high wages. It can maintain its high wages against a low-wage competitor because it is so hard for that competitor to get started in retainable industries. In the circumstances we studied before, all the influences that lead to retainabiliy—the need for special knowledge, manufacturing techniques, knowledge of the market—provided a major advantage to an established industry. This way a country could easily outweigh its wage disadvantage and hold on to an industry. But what is the corresponding explanation here? In the model of this chapter there is no retainability, so new producers can enter an industry on a small scale without being placed at a disadvantaged by that small size. How then can there be outcomes that give a prosperous high-wage country a large share? How can the high-wage country hold on to its industries at such an equilibrium when it can be challenged by low-wage aspirants?

The answer is that this can be achieved by that wealthy nation only if its trading partner is not a fully developed industrial nation. In other words the trading partner cannot have attained its maximal productivity in all industries. If the U.K. is fully developed in most of its industries, while France is not, so that France is not the industrialized partner that the name "France" suggests but is in our hypothetical illustration rather undeveloped, then the U.K. can pay a high wage and still be the dominant producer in most industries. Its high wage coupled with high productivity enables it to out-compete France in most industries because France has not attained its best possible performance in those industries. In those industries France is characterized by low productivity as well as low wages.[7] This mythical "France" resembles many

Asian nations that have attained high levels of productivity in only a few parts of their economies, while combining low wages with low productivity in many other sectors.

In figure 4.6, which deals with two countries whose labor forces and maximum productivities are different but not very different, we draw attention to two outcome points of particular interest. One of them, marked P1 in the figure, is the equilibrium obtained when both countries are fully developed. P1 shows the U.K.'s national income at that equilibrium. The other, marked P2, is the outcome for the U.K. reached when it alone is fully developed and its trading partner's productivity levels permit the U.K. to attain its highest national income. In other words, we can say at this point that France is the U.K.'s ideal trading partner.

A detailed analysis of P2 shows exactly what we should expect from the previous discussion and indicates what makes this particular outcome good for the U.K. The U.K. has a large share of the world pie and large actual national income at equilibrium P2 because at P2 France is not fully developed. It has reached its maximal productivity in only a few industries. Because of its low wage, France captures only those few industries in which it is fully developed. But in the remaining large number of industries France is undeveloped. In these industries it has low productivity, and the U.K., despite its large share, high national income, and high wage, has productive superiority sufficient to make it the cheaper producer, and therefore the actual producer in these industries. In this way it captures a large share of world income. P2 clearly is a very good outcome for the U.K. and a very poor outcome for France.

An example of such an equilibrium state is a country that has a number of developed (though not necessarily high-tech or retainable) industries trading with another country that is mainly agricultural and has only a few export crops. While such situations have existed for long stretches of time in the past, they also can change, and we have seen many such transformations in the past two decades, especially in parts of the "tiger" economies of Asia.

As figure 4.6 shows, if the less developed country (France, in the graph) increases its productivity and starts to move toward fuller development from its state at P2, it ceases being the ideal trading partner. Such development is good for France but bad for its fully developed trading partner. That is, the resulting move to the left in the graph moves France to a higher point on its income curve and moves

the U.K. to a lower point. Thus the common view of many noneconomists, and some leading economists as well, that improvements in productivity in a foreign industry can be damaging to one's own country is, under these circumstances, exactly what our analysis confirms.

4.9 Rapidly Evolving Industries

Our discussion so far makes it seem that there is nothing a country can do to retain an advantageous position. If at some time its trading partner is relatively underdeveloped, it provides an equilibrium near the peak of the home country's hill. But if the trading partner gradually becomes more developed, there appears to be nothing that the home country can do but watch sadly as the trading partner prospers and its own national income declines.

However, this is not always so. In our analysis we assumed that the limits on productivity were fixed, and this is a reasonable assumption for many industries in which there are only small annual increases in productivity that are not large enough to protect against a low wage entrant whose productivity levels grow to somewhere near their maxima. There are nevertheless industries in which the pace of evolution is so rapid that it is difficult for new entrants to reach the rapidly improving maximum productivity levels. The evolution of the biotech industry and of the Internet companies are examples of this sort of rapid change, which can be copied, but in which it is difficult for others to keep up with the rapid pace of improvement.

A country leading in an industry in an area of rapid change can continue to press its advantage and keep ahead even though its trading partner is also learning. If the leading country continues to keep its relative advantage, it can remain the producer even though its trading partner is getting better too.[8] This view provides some basis for the often instinct-based preference for high technology industries. Perhaps a better description of what is needed is rapidly evolving industries, industries in which productivity is rapidly improving.

It is also possible, if history is a guide, for industries going through a period of rapid change and rapid evolution then to enter into a phase of consolidation. They turn from easy entry and rapid change into a collection of much larger survivor companies whose names are known and trusted and whose scale, in a more settled industry, may well give them an advantage. There may well be a long-term payoff to a country

trying to lead in rapidly evolving industries. They will be there when things settle down and those industries become more retainable.

4.10 Concluding Comment

The graphs for different productivity-generated outcomes look the same as those in the previous chapter, where retainability was the issue. Our graphs driven by productivity change have the same basic shapes as the corresponding graphs in chapter 3. They have the same economic implications about the possible conflict of national interests in international trade. We encountered conflict and cross-purposes in the case of retainable industries—industries with substantial scale economies or start-up costs. Now, these same conflicts are also seen to emerge from a model that focuses upon a second crucial attribute of modern industry: rising productivity attributable to technological change, imitation, and the acquisition of skills.

Our graphs show us that the basic message of this chapter is the one that we outlined at the start of chapter 1 and have seen confirmed in chapter 3 where we considered economies of scale and retainable industries. An industrialized country will benefit if an *underdeveloped* trading partner acquires new industries and generally improves its productivity. It will continue to benefit until that partner reaches a level of development that enables it to play a more substantial role in the global marketplace. After this point acquisition of more industries by the newly developing partner *becomes harmful* to the more industrialized country.

Our discussion also suggests that there may be actions that a country can take, even in this case, to improve its situation. The model suggests, for a developed country, a focus on rapidly evolving industries and, for a less developed country, a focus on industries where productivity advances are *not* occurring rapidly.

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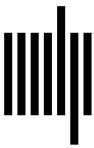

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