Asia-Pacific Economic Review

Volume 2, Number 1, April 1996

The Effects of Trade in Services, Technology Transfer and Delocalisation on Local and Global Income Inequality [1]

Edward E. Leamer

Anderson Graduate School of Management

UCLA

Executive Summary

Income inequality within and between countries is perhaps the most pressing economic problem facing the globe in the 21st century. Income inequality inside the advanced developed countries is being driven partly by technological innovations that are replacing unskilled workers with computers. This technological revolution has been accompanied by an institutional revolution that has "freed" an enormous number of workers in Eastern Europe, in the former Soviet Union, in Mexico, in South America, in China and in India and so on... Because of these two revolutions, workers in the advanced developed countries can look out the north-facing window of their factories and see long lines of robots filling in job applications. Out the south-facing window are truckloads of cheap products made by low-wage foreign workers.

While there may be no escape from the competition with the robots or from the rising tide of imported goods, at least the foreigners have been far enough away that they can't take the jobs in the nontraded service sector. Alas, trade in services is threatening even that refuge.

But is the situation really so alarming? What role does the increased trade in services have in wage determination? To answer this difficult question, we need models of international competition. The mainstay model of international economists is the Heckscher-Ohlin model that points to relative abundance of productive inputs as the source of comparative advantage. A Heckscher-Ohlin model of international comparative advantage allows a high wage equilibrium in the face of low-wage competition if the country is sufficiently abundant in capital that it can concentrate tradables on the most capital-intensive products. Unskilled workers in these high-wage communities produce either capital-intensive tradables (e.g. aircraft) or nontradables (taxi rides). In neither sector are these workers in direct competition with low-wage foreign workers. If, on the other hand, unskilled labour is sufficiently abundant that it has to be absorbed in the labour-intensive tradables sector (e.g. apparel), then even the taxi drivers are exposed to foreign competition through arbitrage conditions first linking wages in the local taxi sector with wages in the local apparel sector and next linking local apparel wages with wages in the foreign apparel sector.

Thus, according to this Heckscher-Ohlin model, it is high demand for local services relative to the supply of unskilled workers that supports a high-wage equilibrium. According to this model, a high wage equilibrium can be threatened by productivity improvements and by the increased tradability of services. The news is not all bad, however. A favourable trend in this century has been the rise of productivity in manufacturing that has supported an increase in the GDP share of services. These trends make a high-wage equilibrium more likely since high productivity in manufacturing allows a moderately capital abundant country to concentrate production on the most capital-intensive goods and satisfy its demands for other tradables strictly from revenues therefrom. Relatively rapid productivity gains in services move in the opposite direction, however, forcing an economy to absorb unskilled workers by diversifying into labour-intensive tradables.

The function of the local nontraded service sector as a buffer between local and foreign workers is obviously can be the buffer between the low-wage is obviously threatened by innovations which allow trade in services. Not to worry. Trade in services will tend to increase wage inequality if traded services use low-skilled workers but have the opposite effect if newly tradable services are capital intensive. This does in fact seem to be the case. Casual observation suggests that most of the increased trade in services is at the high end of the

skill distribution not the low end. Doctors and accountants and programmers are starting to compete globally. Gardeners, waiters, and taxi-drivers are not.

The communications revolution has increased the tradability of some high-end services. It has also facilitated the global flow of corporate assets. US workers once were equipped with superior tools and employed in superior organisations. It seems unsurprising that the superior productivity that comes from superior technology would be shared with workers in the form of high wages. Today, however, the word combination "technology gap" is only a dim memory. Multinational corporations have been one source of technology transfer, but ideas are hidden stowaways that are carried by international commerce, with or without the consent of the owner. Though the flow of technology has been substantial, this need not lower the wages in the high wage countries. The technological flow may mostly raise productivity and wages elsewhere. After all, unless we are direct competitors, I will gain from your improved productivity through a terms of trade effect.

Exporting the services of US knowledge assets via technology transfer poses an uncertain threat to US wages of unskilled workers. But there is one other institutional change that has unambiguous effects. This is delocalisation which is increasing the intensity of global competition among low-skilled workers. Design, parts manufacture and assembly were once done in roughly the same location, but now institutional innovations supported by communications improvements have allowed these production activities to be separated and "delocalised." A very important example is the assembly of autos and consumer electronics in Mexico from parts designed and made in the United States and Japan.

This paper discusses economic theory that can back up the preceding casual remarks. The economist label for the kind of theory here presented is "Heckscher-Ohlin" referring to the two Swedish economists who argued that the source of international comparative advantage is abundance of productive inputs. According to this theory, labour-abundant countries exchange labour-intensive goods (apparel) for capital-intensive goods (machinery) that are sold by capital abundant countries. While this Heckscher-Ohlin framework seems not accurately to explain trade among the advanced developed countries, it seems particularly well suited for studying economic integration among the formerly secluded but now-emerging low-wage countries on the one hand and the advanced high-wage countries on the other.

This paper begins with a review of the simple theory of wage determination that is a familiar part of the Heckscher-Ohlin model. It is shown how demand for local nontraded goods and services can support a high-wage equilibrium that is unthreatened by increased competition from low-wage foreigners. Next the shift in favour of services that has been experienced throughout this century is modelled as an increase in productivity in tradable manufacturing. This increased relative importance of services in GDP may or may not have an isolating effect, but productivity improvements in services as well as increased tradability of services reduces the potential isolating effect of service sector. Next we discuss the international transfer of services of intangible knowledge assets with a model of foreign direct investment. In this model knowledge is treated at a non-excludable input which can be deployed in one location without reducing its deployment elsewhere. It will be shown that this form of technology transfer can be accomplished without putting any pressure on labour markets in the high-wage countries. Last is a discussion of delocalisation which allows design, parts manufacture and assembly operations to be performed at geographically separate locations. The example around which the theory is discussed is the assembly of automobiles in the northern states of Mexico. A provocative conclusion of the discussion of delocalisation is that both US capital and Mexican capital can gain from delocalisation. In the meantime workers in the United States can lose without Mexican workers gaining. This possibility is what drives Ross Perot's metaphor: "Revolving Door Trade."

Figure 1: The Lerner-Pearce Diagram
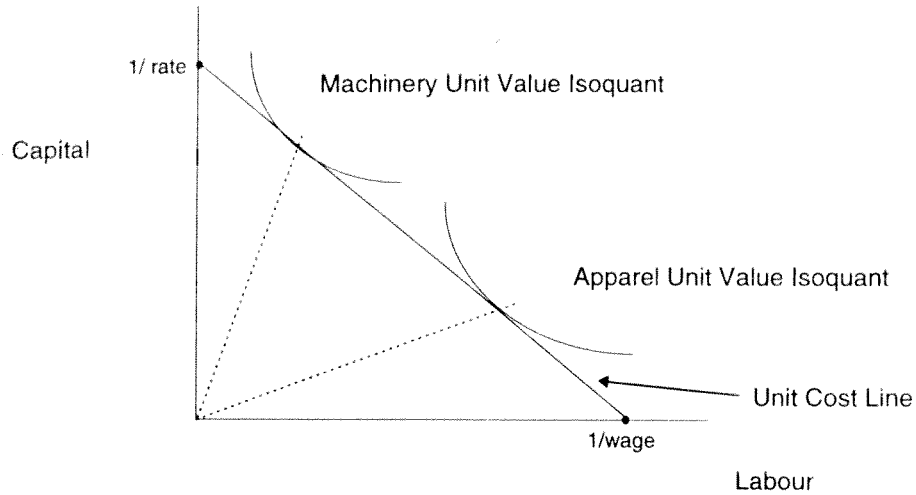
Wage Determination and the Lerner Pearce Diagram

The foundation on which much of our discussion of trade in services rests is the Lerner-Pearce diagram, Figure 1, which is used traditionally to establish the Factor Price Equalisation Theorem and the Stolper-Samuelson Theorem. These results connect factor prices respectively with factor supplies and with product prices. The initial building blocks of this diagram are unit value isoquants for two sectors, labelled here machinery and apparel. These unit value isoquants are combinations of capital and labour needed to produce a unit *value* of output, say one dollar. Against these unit value isoquant rests a unit cost line indicating combinations of capital and labour that can be hired for one dollar. This is the only unit cost line compatible with the production of both of these goods. From the equation of this

unit cost line, 1 = wage × Labour + rate × Capital, one can be solve for the intersection points with the two axes, 1/wage and 1/rate. Without noticing it, perhaps, you have just seen demonstrated the Factor Price Equalisation Theorem, which links externally determined product prices with internal factor prices, without any reference to factor supplies.

From figure 1 it is obvious that factor prices depend on goods prices. This dependence is made explicit in the Stolper-Samuelson Theorem which indicates that a fall in the price of the labour-intensive good leads to a reduction in the wage rate and an increase in the return to capital. This case is illustrated in Figure 2 where the reduction in the price of apparel has shifted outward the apparel unit value isoquant to reflect the fact that it requires more capital and labour to produce a unit value of output.

Figure 2: The Stolper-Samuelson Theorem; Fall in Price of Apparel Lowers the Wage Rate
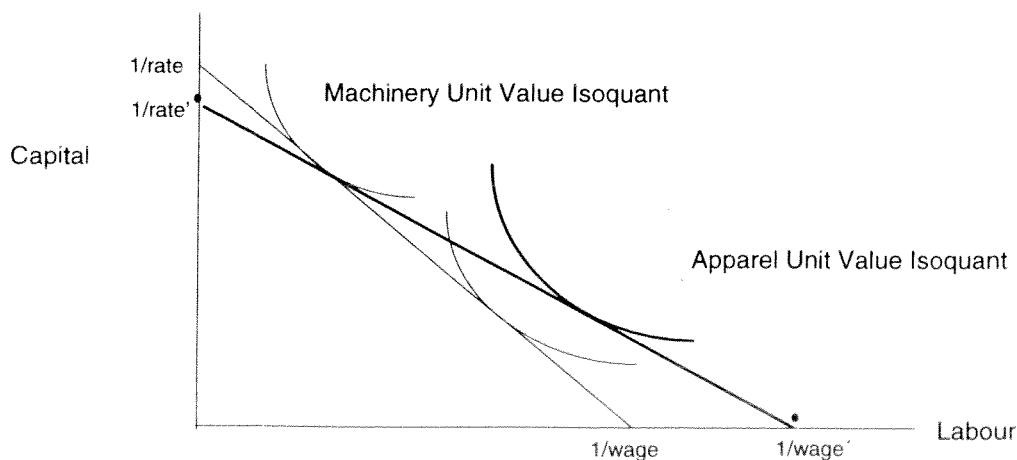
Labour Demand with Nontraded Goods and Services

The factor price equalisation theorem identifies conditions under which factor prices in different countries must be equalised indirectly through arbitrage in the goods market. This theorem is troubling since it raises the spectre of US wages falling to the Chinese level. But by identifying explicitly a set of conditions under which wages in different countries must be equal, the factor price equalisation theorem also implicitly identifies conditions that can support wage differences. One isolating feature is a nontraded sector. Service sector workers do not compete directly with foreign workers, but they can compete indirectly. A chain of arbitrage opportunities links service workers first with domestic workers in manufacturing then with foreign workers in the same industrial sectors and finally with foreign service sector workers. Whether or not US service sector workers are thereby linked with low-wage Asian workers depends on the existence or non-existence of an apparel sector which competes with Asian apparel.

Figure 3 illustrates the possibilities with two traded goods, machinery and apparel, and one labour-intensive nontradable. Two possible equilibria are depicted. In each the allocation of factors to the nontraded sector is indicated by an arrow. The first panel depicts an equilibrium with relatively few nontradables, the full set of tradables; and a relatively low wage. The second panel has more nontradables, no apparel output, and high wages. These differ in terms of the amounts of factors absorbed by the nontraded sector. The low-wage solution leaves the amount L for production of tradables. This factor supply supports the production of both products. The high wage solution in contrast leaves the amount H for tradables, which is too scarce in labour to allow production of apparel. In the low-wage equilibrium the price of nontradables is determined externally through a string of arbitrage relationships. Externally determined product prices are mapped into factor prices via zero profit conditions for the tradables. These factor prices in turn determine the price of nontradables also from a zero profit condition for nontradables. Since these arbitrage conditions fix the price of nontradables, it is up to the supply of nontradables to equilibrate the market. Suppose that the allocation to nontradables indicated by the point L in Figure 3 does not generate enough supply to satisfy the demand at the given price of nontradables. Then the economy must supply more. This it does by shifting toward the point H. If it gets to H without satisfying the demand at the given price of nontradables, then the economy specialises completely in machinery and nontradables. With the fixed input technologies in Figure 3, the outputs of these two goods are then unaffected by further increases in demand for nontradables. Now it is the price, not the output of nontradables that must be adjusted to equilibrate the market. The higher price of nontradables shifts inward the unit value isoquant for nontradables, fully concentrating the economy on machinery and nontradables, and also causing an increase in wages. If the input intensities are not technologically fixed, then the supply side matters as well since a higher relative price of nontradables will precipitate an increase in supply.

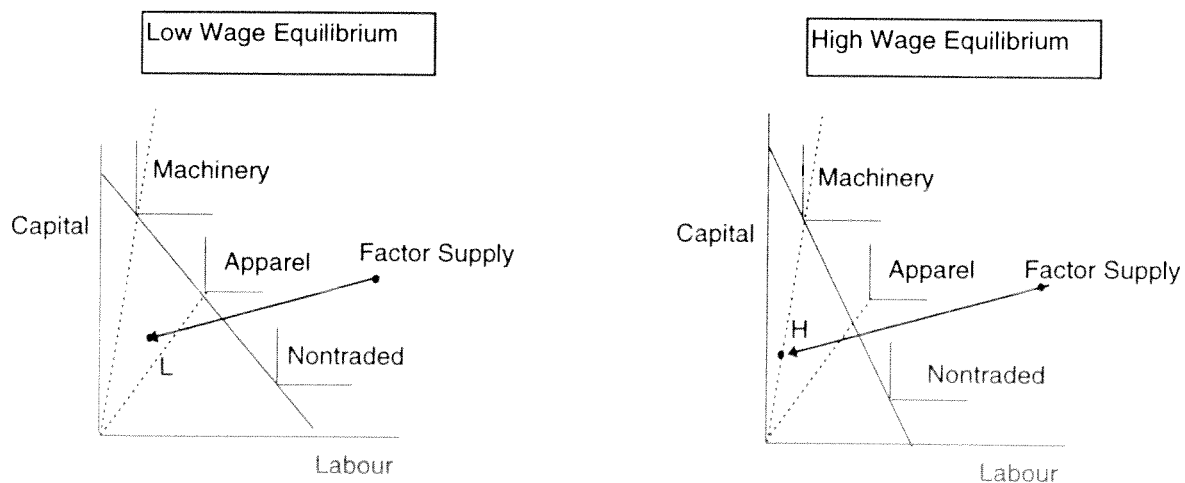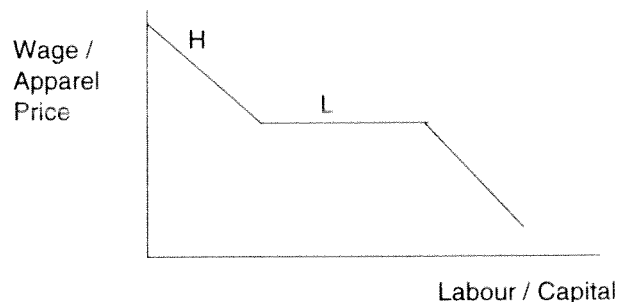**Figure 3: Wage Determination with Nontraded Goods and Services**

Figure 4: Labour Demand For a Small Open Economy

Wage / Apparel Price

Labour / Capital

The message of Figure 3 is probably most clear if it is translated into the labour demand schedule depicted in Figure 4. This labour demand schedule has an infinitely elastic segment corresponding to the L equilibrium. Here the marginal demand for workers is external and infinitely elastic. The potential decline in the marginal productivity of workers that might come from an increased labour supply is completely offset by a shift in output mix in favour of the labour-intensive tradable. This labour demand schedule has also a less-than-perfectly elastic segment labelled H where the marginal demand for workers is in the nontraded service sector. Here an increase in the labour force must be absorbed in nontradables, which can be sold to local consumers only at a lower price. It is this price reduction for the nontradable that causes the decline in marginal labour productivity.

Service Sector Employment and Foreign Competition in Manufacturers

- The relative price of apparel in the US marketplace fell by 30% during the 1970s. This was accompanied by a large increase in imports from Asia.

The first theoretical point of this paper is that demand for local services can decouple a local labour market from the foreign labour markets. According to the theory outlined in Section 1 increased global competition in apparel is communicated to local labour markets through lower apparel prices. As described in the Stolper-Samuelson Theorem, this alters the low-wage equilibrium depicted in Figure 3 since the apparel unit-value isoquant shifts out to reflect the fact that at the lower price it takes more inputs to produce a unit of value of output. This shifting outward of the unit value isoquant carries along the intercept of the unit isocost line.

In words the nominal wage rate falls, by more in percentage terms than the price reduction of apparel. The high-wage equilibrium has a very different reaction to the lower price of apparel. The shift of the apparel unit value isoquant has no obvious effect on the high wage equilibrium, but the improved terms of trade means greater demand for nontradables and consequently higher prices and higher real wages.

These somewhat convoluted arguments can be made transparent if they are translated into the labour demand schedule in Figure 5. Here the lower price of apparel lowers the demand for labour if labour is very abundant and if the marginal demand for workers is external, but the demand curve shifts upward if labour is scarce enough that the marginal worker is employed in the local service sector. An example of a community whose wages might be adversely affected by Chinese competition might be the city of Los Angeles which produces both aerospace and apparel as tradables. This contrasts with the city of Seattle which has only aerospace (and programming) but no apparel sector. Unskilled workers in Seattle thus gain from lower prices of apparel.

Labour Demand and the Shift Toward Services

From 1960 to 1993 the service share in employment of industrial countries rose from 42 percent to 65 percent. In the United States the service share of employment reached 75 percent by 1993.

Over the same time period the GDP share rose from 53% to 61 percent.

All advanced developed countries have experienced a very substantial shift of employment and output away from traded manufactures toward nontraded services. Does the shift of employment and output away from manufacturing

Figure 5: Effect of Lower Apparel Prices on the Demand for Labour
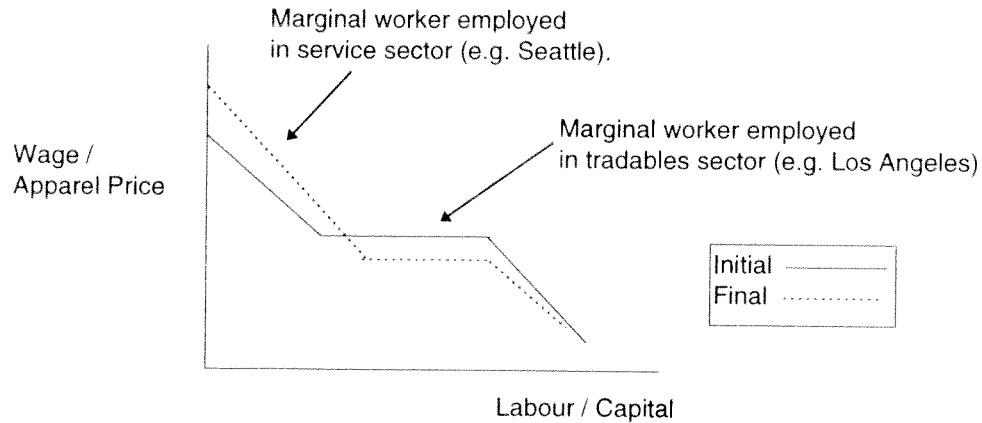
and toward services mean that the workforces in the developed countries are increasingly isolated from competition with low-wage foreign workers? Maybe, but maybe not. The message of the preceding subsection is that economic isolation of a workforce from direct competition with the Chinese can occur if the high-wage country is sufficiently capital abundant after satisfying the demands for factors of production in the nontraded sector. If, as depicted in Figure 3, nontradables are labour-intensive, a high demand for nontradables supports a high wage rate. A shift of demand in favour of nontradables does indeed tend to isolate the economy from foreign competition. However, the principle cause of the shift in favour of services in this century has not been a shift in demand but rather improved productivity in manufacturing which has allowed the

demands for manufactured goods to be satisfied with declining shares of employment devoted to manufacturing. But as far as the isolating effect is concerned, it matters little whether it is a shift toward services from demand changes or a shift away from tradables because of productivity increases.

The effects of productivity improvements in manufacturing can be discussed formally with suitable amendments to Figure 3. These are shown in Figure 6 which uses proportional improvements in productivity in both tradables sectors.

In the diversified low-wage equilibrium, technological improvements affecting productivity in both manufacturing sectors by the same percentage shift inward both unit value isoquants and thus raise by the same proportion both wages

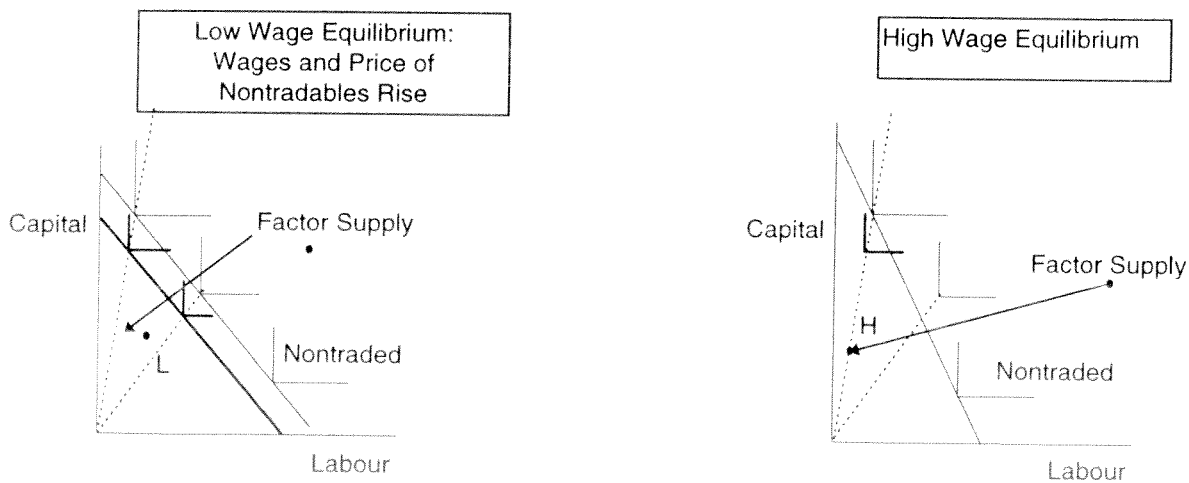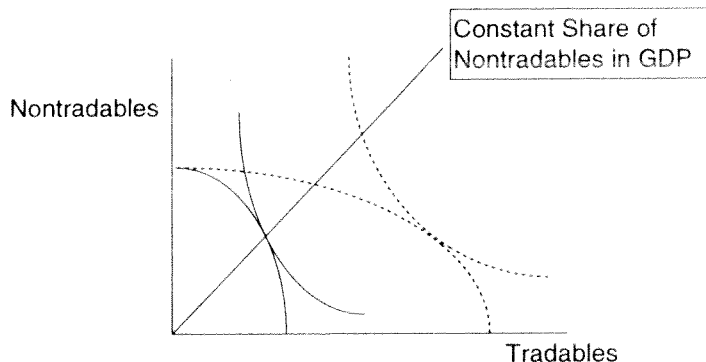**Figure 6: Effects of Productivity Improvements in Tradables Sectors**

Figure 7: Productivity Improvements in Tradables.
Raise the Relative price of Nontradables and Increase the Demand for Both

Nontradables

Constant Share of
Nontradables in GDP

Tradables

and the return to capital. The higher wage means a higher price for nontradables which would tend to reduce demand, but this is offset by the income effect in favour of more nontradables. (The price of nontradables in terms of labour hours or capital hours remains unchanged.) In effect, the consumer is facing lower prices for tradables and the same price for nontradables, wages and rental rate on capital held fix. The amount of nontradables that is consumed depends on whether the income or substitution effect dominates. In order for the share of nontradables to rise, there has to be an income bias in favour of nontradables. Figure 7 shows a production possibilities curve that communicates the point:

The issue here is whether the relative price of nontradables rises in response to improved productivity in tradables. If so, this is accompanied by a wage increase. Figure 7 suggests that indeed this is a likely outcome, but it depends on the demand side. If the income effect in favour of tradables is strong enough, the relative price of tradables could increase. But the data suggest the opposite. The increasing share of nontradables can come only from income effects in favour of nontradables, and therefore even higher nontradable prices and higher wages.

Technological Progress in Selected Service Sectors
Technological innovations in service sectors are replacing some labour-intensive services with capital and skill-intensive activities. For example, today I am typing this manuscript which ten years ago would have been done by a typist.

One important threat to the high-wage equilibrium depicted in Figure 3 is technological change in the service sector. *Neutral* technological progress in services makes the low-wage equilibrium more likely because the service sector

Figure 8: Technological Change in Service Sector. The High-wage Case

Capital

High Wage Equilibrium

Machinery

Apparel
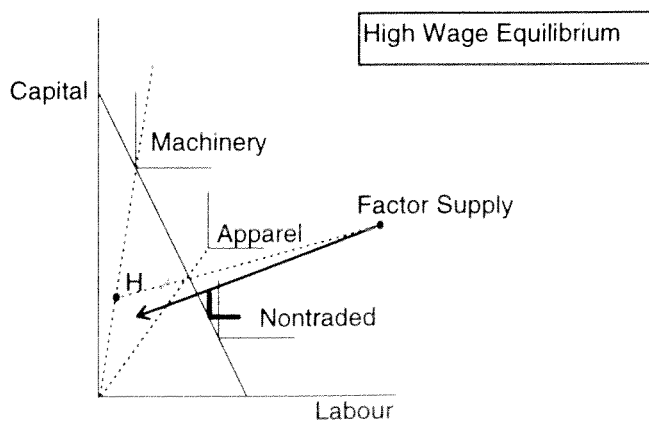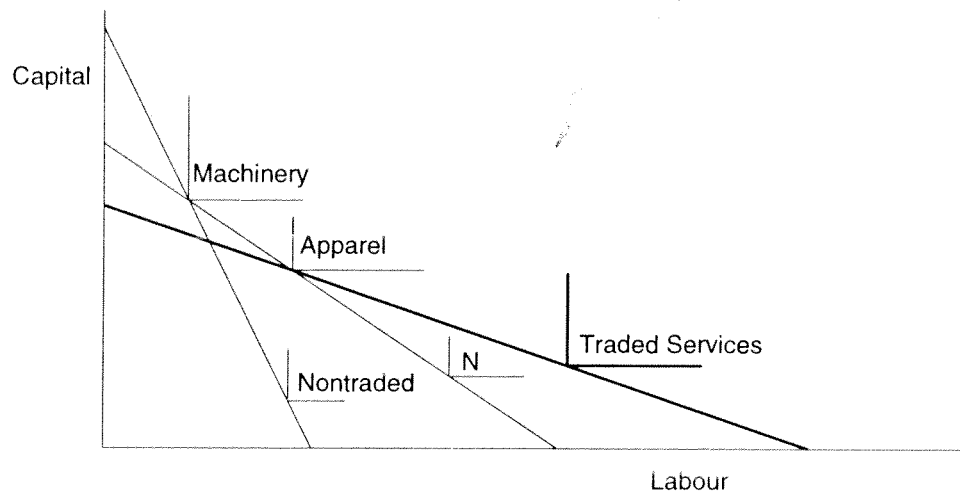
Factor Supply

H.

Nontraded

Labour

Figure 9: Traded and Nontraded Services

demand can be satisfied with smaller amounts of labour thereby leaving more to be absorbed into tradable manufacturing. Innovations that make the service sector more capital intensive are even more threatening to the high-wage solution because relatively less labour is used in the provision of services and more must be absorbed into tradable manufacturing. This is illustrated in Figure 8 which depicts a high-wage initial equilibrium and a new unit value isoquant for services which is more capital intensive than the original isoquant. The vector representing the allocation of factors into the service sector is steeper and shorter, steeper because of the increased capital intensity of the sector and shorter because of the increased productivity. This shorter and steeper vector leaves too much labour relative to capital for the tradables manufacturing sector to absorb with concentrating exclusively on the capital intensive sector. Thus this form of technological change is a force for lower wages.

Internationalisation of Services

The revolution in communication and information technology is allowing many services to be sold internationally.

Data entry services have been exported from China since 1961 (Noble 1986). Software programming (especially Bangalore, India), back-office services , design, research and development, and client service have all become geographically footloose.

Because of improvements in communication and information technology, many nontraded services are becoming traded. The impact of this institutional change on the equilibria in Figure 3 is depicted in the figure below. Here there is a labour-intensive tradable service. This new tradable allows a new labour-intensive cone of diversification, which has labour-abundant countries with low wages producing apparel and the tradable service. The other two cones of diversification stay as before which suggests that this change does not affect wages in the high-wage countries. But in this new equilibrium, it is more demanding in terms of capital abundance to select the high-wage cone since there are fewer nontraded services which can soak up the labour force. Consequently the mix of tradables is likely to be more labour-intensive and wages will be lower. Incidentally, the opposite conclusion emerges if the traded service is capital-intensive. Then there is a new very-high wage cone, and countries are more likely to choose a capital-intensive mix of tradables since less capital is used to produce nontradables. The facts seem to support the second conclusion: tradability of services is helping to maintain high wages in the high-wage countries.

International Transfer of Services of Intangible Assets

- Although roughly 80% of Foreign Direct Investment is located in high-wage countries, from 1989 to 1992 approximately $200 of FDI did flow into low-wage countries. (See Figure 10 on the next page). Some of this FDI is directed at extraction of natural resources, some at local services (e.g. MacDonald's in China) but some of it is a symptom of the transfer of technology to the low-wage developing countries.

Figure 10: FDI 1988-92 and Per Capita Income
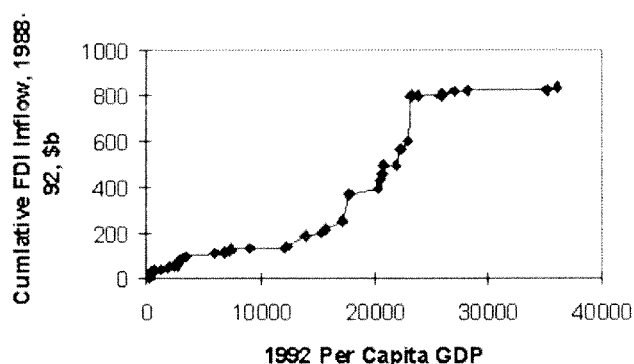
International commerce offers countries two kinds of economic gains. First are the static gains from trade according to comparative advantage. Second are the gains from copying or purchasing the economic innovations that are made in foreign countries. Countries that choose economic isolation miss both kinds of opportunities. With economic liberalisation of formerly isolated countries will come adjustments to take advantage of both kinds of gains. Both advanced and backward countries will specialise according to comparative advantage, which is determined by technology differences as well as relative factor supplies. In addition, some kind of technology transfer will occur. The form of the technology transfer will depend on the adaptability of existing inputs to the new technology and on the supply from foreign sources and domestic sources new inputs suited to the new technology. The effects on the wages in the advanced countries of integration with formerly isolated regions may be much affected by whether there is more specialisation according to comparative advantage or more technology transfer. In the extreme, it seems possible that the formerly secluded regions could costlessly adopt the superior technology and overnight have their wages rise to levels prevailing in the advanced developed countries. If the formerly isolated countries formed an exact economic replica of the advanced countries except for technological backwardness, this could leave the advanced countries completely unaffected by the end to isolationism. On the other hand, technological superiority may be one of the principal props supporting high wages in the advanced countries.

What does this have to do with service trade? Another way to describe technology transfer is the international deployment of the services of intangible assets. The institution of the multinational corporation has as its primary function the deployment to foreign locations of various corporate intangible assets that might otherwise be copied without compensation or that could not in any case be deployed outside the boundaries of the firm. Incidentally, the balance of payments FDI flow data reveal very little about the international deployment of intangible assets. There is the usual reason that it matters little for the flow of the intangible asset where the investment is financed. But in addition, the usual attempt at measurement is based on the premise that the asset is excludable - once deployed in one location it is unavailable in another. An intangible asset like knowledge or goodwill need not have this excludable characteristic.

In this section the Lerner-Pearce diagram is adjusted to analyse both technology transfer and also specialisation according to comparative advantage. To make the discussion concrete, the formerly isolated country is labelled "Mexico" and the advanced high-wage country is the "United States". Figure 11 has two sets of unit value isoquants, one set using more capital and labour and therefore an inferior technology. Because in this figure the technological backwardness has the same proportional affect on productivities in both apparel and machinery, the Mexican wage rate and the Mexican return on capital are lower than the US figure by the same proportion. It seems more likely that the technological backwardness is more extreme in the capital intensive sector in which case the gap in compensation is less for labour than for capital. Indeed it is possible that the wage in the backward country is actually higher than in the advanced country.

Facing a superior rate of return to investments in the United States, there has to be something that keeps Mexican capital from fleeing the country. In Figure 11 this force is labelled a "capital repatriation tax" that more than

Figure 11: Pre-Nafta Equilibrium.
With Immigrant Border Controls, Risk Premium for Multinationals Operating in Mexico
and Mexican Capital Controls to Limit Capital Flight
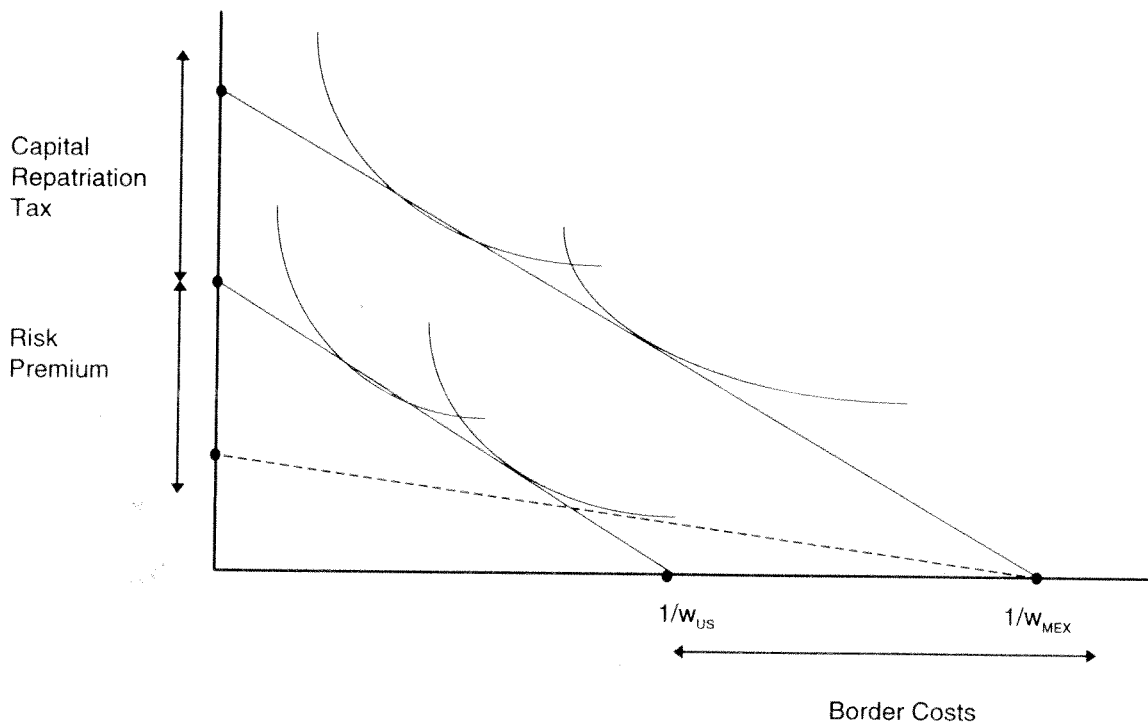
offsets the differential in the rate of return. This is reflected in the figure by a double-sided arrow longer than the difference in the capital intercepts of the two unit cost lines. Likewise, there has to be something that limits the opportunities of Mexican workers to earn the higher US wage rate. This is labelled a "border cost". Incidentally, even without government intervention, there is a home bias for portfolios and for labour services. The words "capital repatriation tax" and "border cost" should therefore be interpreted liberally.

The wage gap between Mexico and the US creates another profit opportunity if US technology can be deployed in Mexico using US capital and cheap Mexican labour. In Figure 11 is a dotted line unit cost line that selects the rate of return to capital deployed in the apparel sector using the superior technology and the low-wage Mexican workers. This investment opportunity is deterred by a "risk premium" exceeding the difference in the realised US rate of return and the higher but hypothetical return to the deployment of US knowledge assets inside Mexico.

Figure 12 depicts a new equilibrium in which the capital repatriation tax has been reduced. The consequent capital flight raises the Mexican rate of return and makes it unprofitable for the Mexicans to operate in the capital

intensive sector. The labour-intensive sector is kept operating by a lowering of Mexican wages. If the border costs are lower than the differential between the US wages and the lower Mexican wages, Mexican labour flees the country as well as Mexican capital.

A symmetric case with reduced border controls is depicted in Figure 13. Here the higher wages in Mexico drive the Mexican labour-intensive sector out of existence. The capital intensive sector continues to operate because it benefits from a lower cost of capital, but if the gap between the rate of return to US assets and the lower Mexican rate exceeds the repatriation tax, then capital joins labour in fleeing the country.

A third possibility is depicted in Figure 14 which has the risk premium lowered (as a result of NAFTA?). This lower risk premium allows US multinationals to deploy US capital and US technology in Mexico. This has the effect of bidding up wages in Mexico, which puts the Mexican apparel sector out of business. The Mexican capital intensive sector benefits from the lower cost of Mexican capital. but if the gap between the rate of return to US assets and the lower Mexican rate exceeds the repatriation tax, Mexican capital

Figure 12: Effect of Reduced Repatriation Tax

1) Capital Flight from Mexico to the US.

2) Wages fall in Mexico

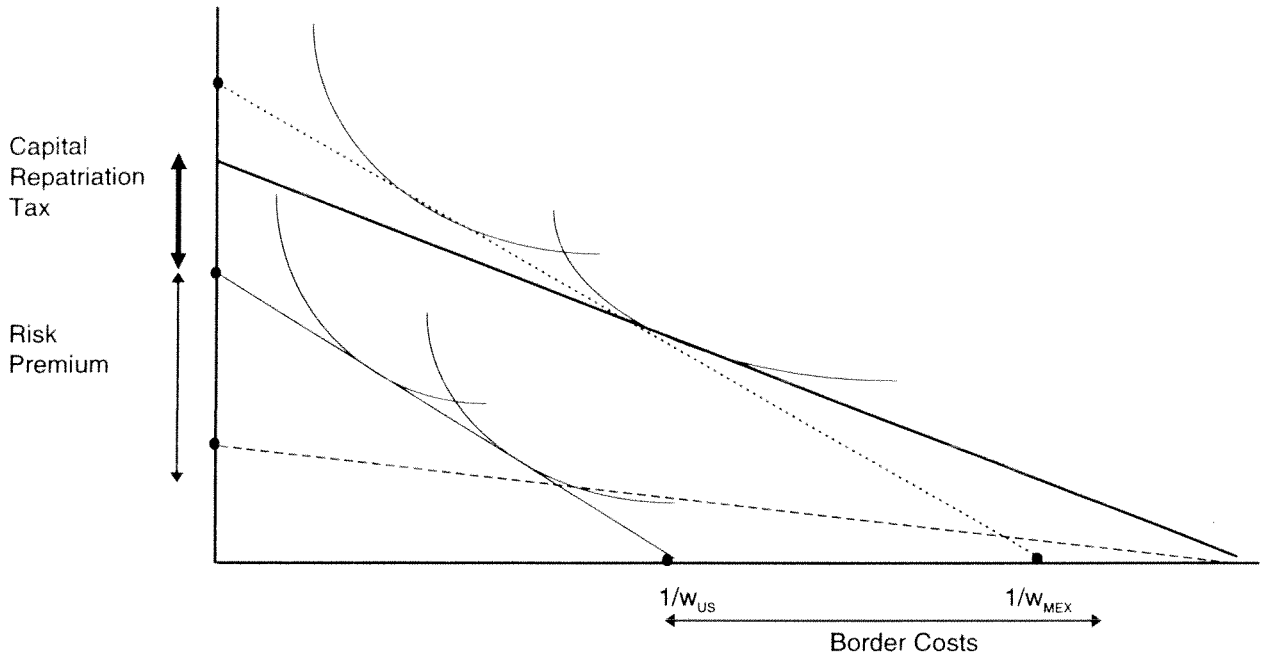3) Production concentrates on the labour-intensive sectors.

Figure 13: Effect of Reduced Border Controls

1) Labour migration forces higher wages in Mexico.

2) Higher wages make the labour-intensive sector unprofitable and all Mexican capital and labour is concentrated in the capital-intensive sector.

3) If the reduction in Border costs is enough, the lower return on Mexican assets causes capital flight, depopulating Mexico both in labour and in capital.
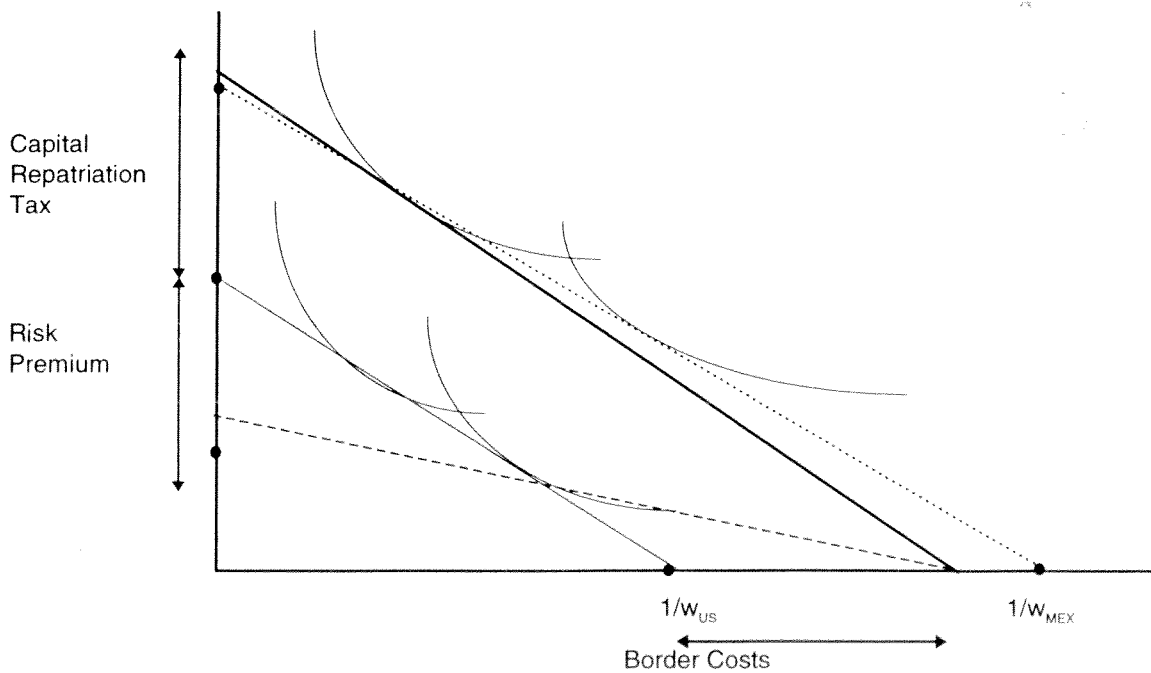
Figure 14: Effect of Reduced Risk Premium for Multinational Investment

1) Multinationals expand into the Mexican labour-intensive sector, and bid up Mexican wages.

2) The higher wages in Mexico force the Mexicans out of the labour-intensive sector. All Mexican assets are deployed in the capital intensive sector, at a lower rate of return.

3) If the risk premium is lowered enough and wages are consequently bid up in Mexico, the return to capital in Mexico can fall enough that it is profitable for Mexico to place assets in US multinationals.
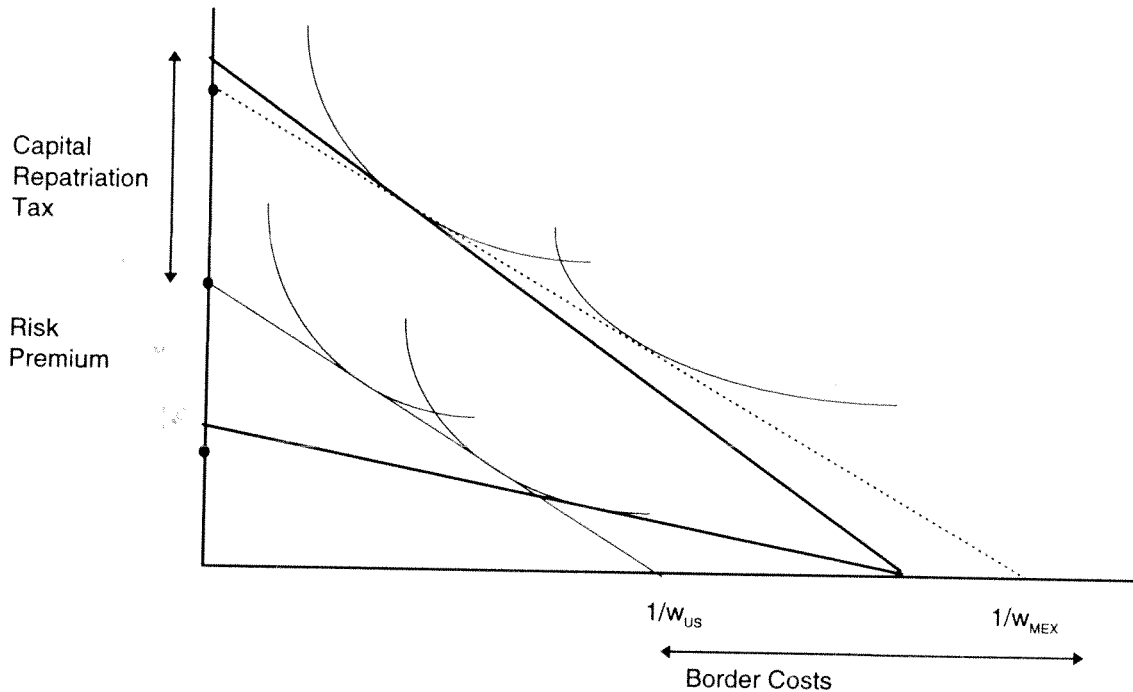
will flee to the United States. In the first case with Mexican capital staying at home, the Mexican economy bifurcates. Mexican firms concentrate in the capital intensive sectors but obtain inferior productivity US multinationals operate in Mexico in the labour-intensive sector. Wages in the US are unaffected provided the transfer of US financial capital to Mexico does not lower the capital abundance in the United States to the point that the US is forced out of its initial cone of diversification. This outcome would not occur if there were an international capital market in which US multinationals could raise funds for Mexican investments. The capital-starving possibility also cannot occur if the Mexican repatriation tax is low and the initial US capital stock is supplemented by and inflow from Mexico. In that circumstance, the capital left in Mexico is only the amount needed to operate the labour-intensive sector using the US technology. From the figure can be seen that the labour-intensity in this sector is greater than the initial labour intensity and consequently the United States has a net gain in capital. This increase in capital is absorbed by a shift in

output mix from apparel into machinery.

In conclusion, technology transfer does not necessarily mean lower wages in the sending country. The primary effects may be improved rates of return to capital at home and higher wages for the receiving country.

Delocalisation

On the northern border of Mexico adjacent to the United States there are approximately 1/2 million Mexicans assembling vehicles and consumer goods destined for the US marketplace.

In the previous section, foreign direct investment was represented as the transfer of nonexcludable intangible corporate assets to foreign locations. This can in principle put the local workforce in jeopardy since after the technology transfer, the foreign worker is equipped with the best technology and may become a more formidable competitor. According to the theory in the previous section, this technology transfer will lower wages at home under two conditions. The first is that it increases the supply of the US

55

labour-intensive product enough to drive down its price. Then the usual Stolper-Samuelson effects become operative. The other route for an effect on US wages is through the financial capital flow that accompanies the transfer of technology. If this flow is great enough it can cause a shift in the mix of US products toward labour-intensive goods produced in lower-wage countries. Offsetting the financial capital flow out of the United States and into Mexico would be a reverse flow in the opposite direction, as Mexicans take advantage of the superior returns to US owned assets. Also, there may be financial capital inflows from third countries into North America. The net of all this is that the risk of lower wages for unskilled workers in the United States coming from the transfer of US intangible knowledge assets to Mexico seems rather small.

The Mexican workforce which is so close to the United States is playing another role in the wage-determination drama. This low-wage workforce is encouraging "delocalisation" of production. Design, parts manufacture and assembly have historically occurred in the same locality. Firms could afford to pay a premium to low-skilled assemblers if that disadvantage were offset by locational advantages in design and parts manufacture. Communication, transportation and organisational innovations are allowing firms now to "delocalise," that is to do the design, the parts manufacture and the assembly in different locations where the costs are lowest. This means moving labour-intensive assembly operations to low-wage developing countries. Although many Asian countries do assembly of electronics, they are too far from the US marketplace to assemble automobiles and trucks destined for the US. Mexico is a very different story, since much of Mexico is geographically close to the markets in the US. As a consequence there is a large and growing presence in northern Mexico of multinational firms from the US, Japan and Korea. Prior to NAFTA these assembly operations were encouraged by two institutions. First was a feature of the US tariff code that allows tariffs to be imposed on foreign value added exclusive of the value of US made parts. Second was the Mexican maquiladora program which allowed parts to be imported into special export zones free of Mexican tariff and nontariff barriers provided the product is reexported. NAFTA has not dramatically improved the attractiveness of these kinds of investments and they continue to accumulate at roughly the same rate.

Delocalisation is one word that has been used to describe the movement of assembly operations to Mexico. Another would be "vertical disintegration." I also like the words "virtual corporation." A "firm" in the 20th Century has been more-or-less synonymous with a collection of buildings that house the management, the workforce and the physical assets in close proximity. The 21st Century may instead have "virtual corporations" consisting primarily of intangible and therefore homeless assets. These intangible assets circumnavigate the globe in search of tangible capital and human inputs at the cheapest possible price relative to productivity.

Also, if you like words, there is Ross Perot's "Revolving Door Trade." Implicit in this metaphor is the idea that there are two kinds of international trade. The good trade is when we ship the product abroad and never see it again. Bad trade, however, occurs when we ship the product abroad and it comes back in the form of assembled products. Is there any economic content in this metaphor??

In this section, I discuss the economic effects of delocalisation. Figure 15 illustrates the welfare gains overall that come from delocalisation. Depicted there are a US production possibilities curve and a Mexican production possibilities curve with finished goods on the vertical axis and parts on the horizontal axis. Unlike a traditional production possibilities curve, these extend into the "second" quadrant in which negative amounts of parts production are combined with positive amounts of final goods. This quadrant is applicable after delocalisation which allows parts to be imported from abroad. If parts cannot be imported, Mexico and the United States select the point on the production possibilities curve corresponding to zero final output of parts, meaning that all parts are put into finished goods that are locally produced. At that choice of output, the shadow price of parts relative to finished goods is high in Mexico and low in the United States. When these prices are equalised following delocalisation, Mexico chooses negative levels of parts, thus importing parts from the US and specialising in assembly. This innovation in the organisation of firms generates consumption gains in both countries. Revolving door trade is just like any other trade: there are gains from exchange.

These consumption gains, however, are not equally divided among capital and labour. In order to discuss the effect of delocalisation on factor earnings we need to be clear about the production process that underlies the production possibilities frontier in Figure 15. Figure 16
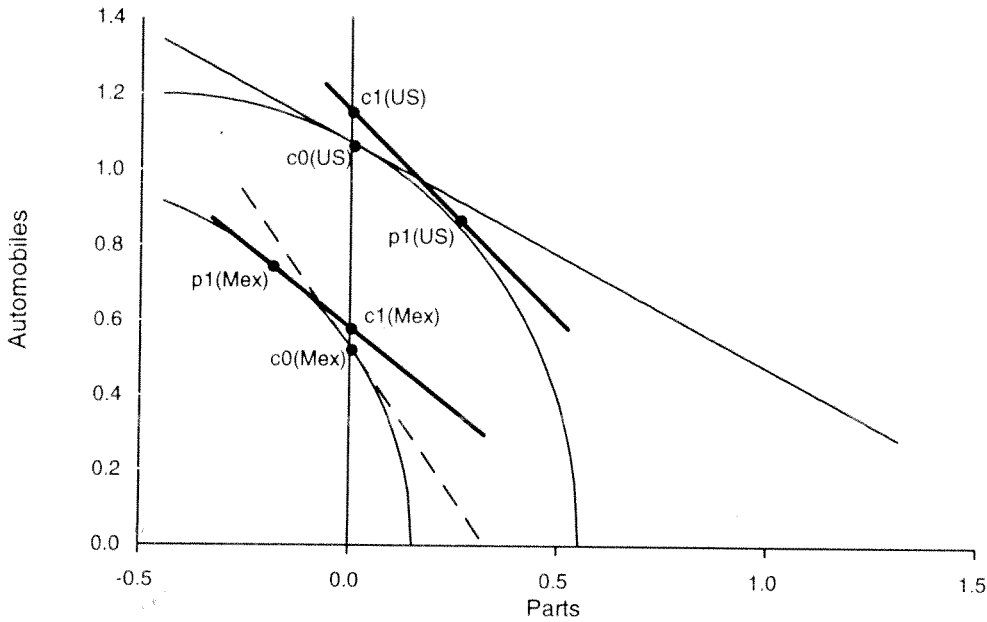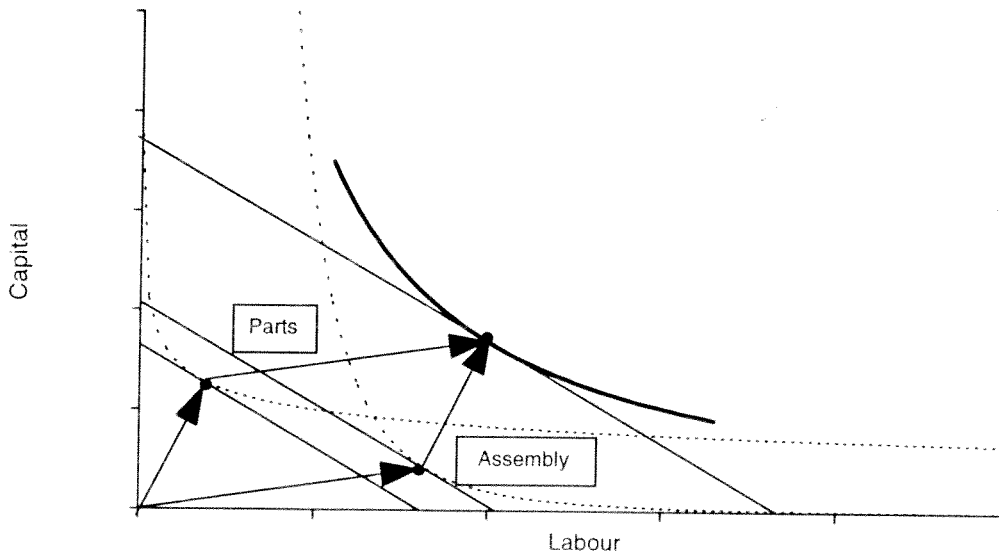
Figure 15: Delocalisation of Assembly

Figure 16: Final Goods Unit Isoquant

indicates how to find a unit isoquant for final goods from the unit isoquants for parts and assembly operations. An implicit assumption is that the ratio of parts to assembly operations in final goods is technologically fixed and the substitutability of capital for labour in final output comes entirely from substitutability in parts manufacture or in assembly operations. In this figure also is an isoquant depicting combinations of capital and labour that are required to produce the parts necessary for one unit of final output. A similar isoquant applies to assembly operations. Also in the figure are isocost lines tangent to these two isoquants as is required for efficient organisation of the firm. These

Figure 17: Initial Equilibrium
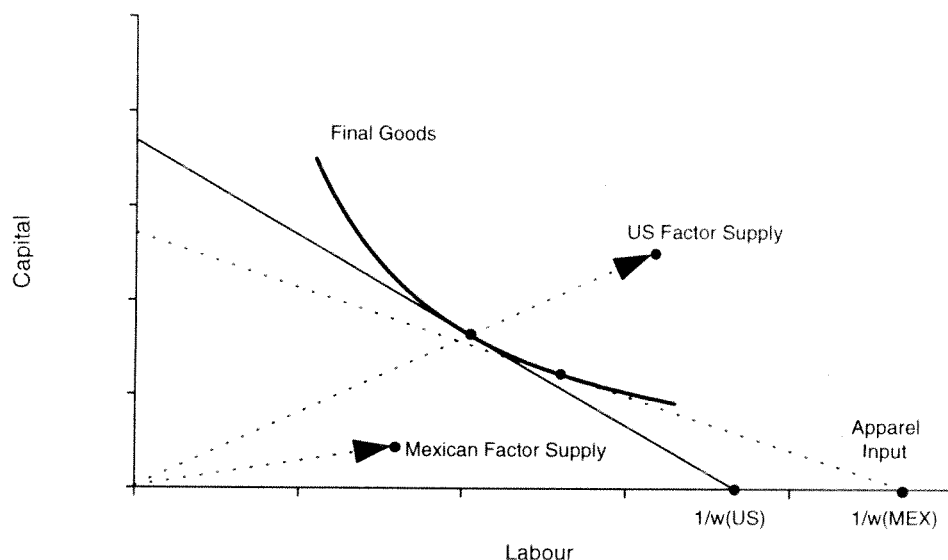
tangency points select a vector of inputs into parts manufacture and a vector of inputs into assembly. Adding these together identifies one point on the unit isoquant for final goods, the heavy curve in the figure. The rest of the isoquant for final goods is traced out by varying the slopes of the isocost lines and repeating the vector addition as depicted. (Incidentally, the slope of the final goods isoquant is inherited from the slopes of the parts and assembly isoquants.)

Figure 17 depicts the initial equilibrium. Here there are two products: final goods and apparel. The apparel point in this diagram is the amount of labour that is needed to produce apparel equal in value to one unit of final goods. In other words, these are two unit value isoquants, with units selected so that the price of final goods is equal to one. The labelling of sectors is somewhat imperfect since apparel is also a final good. It might have been better to call the final goods "complex goods" which are made with geographically adjacent parts manufactures and assembly operations. Then apparel would be "assembly of simple goods" possibly using imported inputs.

In Figure 17 are two isocost lines. The low-wage isocost for Mexico selects a diversified output mix including both apparel and final goods. This is the solution for Mexico provided the Mexican capital/labour ratio is less than the

capital/labour ratio in final goods that is selected by the low-wage isocost line. By assumption, the US factor supply is more capital abundant. The high-wage isocost for the United States is tangent to the final goods isoquant at the US endowment ratio. If it amuses, you can insert into this figure nontraded services in both Mexico and the US as we have done above.

Next, the shadow prices of parts and assembly can be determined from Figure 18. The Mexican and US isocost lines from Figure 17 are imported into this figure and then on each is placed a parts isoquant and an assembly isoquant. In Mexico it takes relatively small amounts of capital and labour to produce a unit value of parts, which means that the shadow price of parts is relatively high. Conversely, the price of assembly is relatively high in the US.

The equilibrium after delocalisation of assembly and parts is depicted in Figure 19 which is not nearly as complex as it initially appears. Here the prices of apparel and final goods are unchanged, since by assumption these are internationally traded products with prices set in a global equilibrium outside of North America. With delocalisation must come an equalisation of parts prices and assembly shadow prices in the US and Mexico. These new prices select the solid unit value isoquants in the figure. With unchanged prices for final goods, this means a higher price

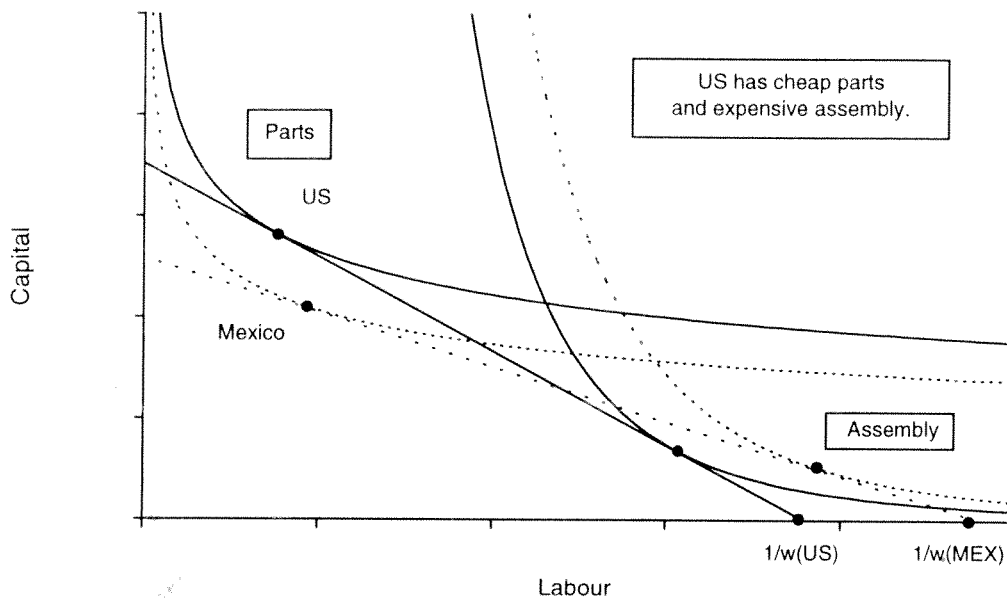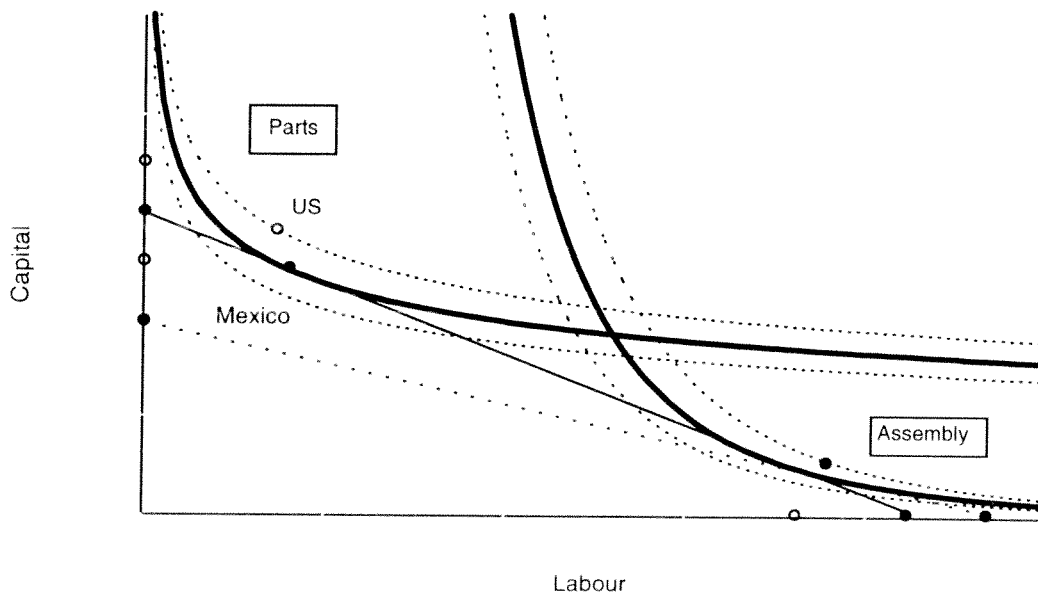**Figure 18: Shadow Price of Parts and Assembly**

Figure 19: Delocalisation of Assembly and Parts

of parts in the US and a lower price in Mexico, and conversely a lower price of assembly operations in the US and a higher price in Mexico. In this new equilibrium, Mexico specialises in apparel and assembly. The US continues to produce parts and to assemble final goods.

The following are the effects of delocalisation:

PRICES: The (shadow) price of parts rises in the US and falls in Mexico. The opposite applies to the (shadow) price of assembly operations, falling in the US and rising in Mexico.

WAGES: Wages stay the same in Mexico since they are determined in the apparel sector.

Wages fall in the United States. This is a consequence of the rise in price of the capital-intensive sector (parts) and a fall in price of the labour-intensive sector (assembly).

RETURNS TO CAPITAL: The return to capital rises in both Mexico and the US.

OUTPUT MIX AND CAPITAL INTENSITY OF PRODUCTION: The lower wages in the US induces a shift of input mix in both parts and assembly toward more labour-intensive techniques. This has the effect of shifting the output mix toward parts and away from assembly. Some assembly is still done in the US. The rest is done in Mexico. Since the US capital/labour ratio supplied to tradables is unchanged, the US capital intensity must remain unchanged, with the shift toward more labour-intensive techniques in parts and assembly offset by a shift away from assembly operations. Mexico loses its parts industry and specialises in assembly and apparel. The higher return to capital with a constant wage rate selects a more labour-intensive technique for assembly operations. This together with the elimination of parts manufacture can cause a large shift of output toward assembly, and away from apparel production.

SHORT RUN CAPITAL REVALUATION: Assets in Mexico that are committed to parts manufacture suffer a capital loss since the price of parts in Mexico falls. In the US, assets in parts manufacturing enjoy a capital gain, from lower wages and higher product prices. The impact of assets specific to assembly is unclear since the potential impact of price reductions are to some extent at least offset by wage reductions.

In conclusion, there is something to be said for Ross Perot's concern about revolving door trade. The problem is not an absence of welfare gains from exchange. The problem is that this kind of exchange can work strongly against the workforce in the high-wage countries and may not benefit much the workers in the low-wage country.

References

Feenstra, Robert C. and Hanson, Gordon (1994), "Foreign Investment, Outsourcing and Relative Wages," Conference on "Political Economy of Trade Policy," Columbia University, November.

Findlay, Ronald (1993), "Wage Dispersion, International Trade and the Services Sector," in *Trade, Growth and Development*, ed. G. Hansson, London and New York: Routledge, 28-40.

Jones, Ronald W. and Kierzkowski, Henryk (1989), "The Role of Services in Production and International Trade: A Theoretical Framework," in *The Political Economy of International Trade*, eds. Ronald W. Jones and Anne O. Krueger, New York: Basil Blackwell.

Leamer, Edward E. (1984), *Sources of International Comparative Advantage: Theory and Evidence*, Cambridge, Mass.: The M.I.T. Press.

————— (1987), "Paths of Development in the Three-Factor N-Good General Equilibrium Model," *Journal of Political Economy*, 95, 961-999.

————— (1993), "Wage Effects of a U.S.-Mexican Free Trade Agreement," in *The Mexico - U.S. Free Trade Agreement*, ed. Peter M. Garber, Cambridge, Mass.: The M.I.T. Press, 57-125.

————— (1994), "Trade, Wages and Revolving Door Ideas," NBER Working Paper No. 4716, April.

Sapir, Andre and Winter, Chantal (1994), "Service Trade," in *Surveys in International Trade*, eds. David Greenaway and L. Alan Winters, New York: Basil Blackwell, 273-302.

Slaughter, Matthew J. (1995), "Multinational Corporations, Outsourcing, and American Wage Divergence," April, 1994; revised March.