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New technology and trade: a threat to low-skilled workers?

Robert Feenstra*

Summary

■ What factors account for the decline in the wages of unskilled workers during the 1980s and 1990s, as observed in the U.S. and other industrial countries? Surprisingly, many researchers in the U.S. feel that import competition from low-wage countries is not the dominant, or even an important, explanation. I present three reasons for this belief, dealing with: the small magnitude of trade; employment shifts within versus between industries; and the behavior of import prices. These reasons have led some to conclude that skilled-biased technological change, such as the increased use of computers, must be the principal explanation for the change in wages. In contrast, I argue that the evidence is consistent with the idea that outsourcing, or trade in intermediate inputs, has been an important cause of the decline in the relative demand for low-skilled workers, and their wages. I briefly examine how my argument stands up for the case of Sweden, which in contrast to the U.S., has not experienced a decline in the relative wages of unskilled workers. Possible policy options are considered at the end of the paper. ■

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One of the most widely discussed public-policy issues in the U.S. and many other industrial countries is the decline in the wages of unskilled workers during the 1980s and 1990s, both in real terms and relative to the wages of white-collar workers. The question is what factors account for this wage gap. One of the first explanations that would come to mind is the increased competition from lower-wage countries. But surprisingly, many American economists researching this issue have come to the conclusion that trade is *not* the dominant—or even an important—explanation for the shift in wages. Instead, they have looked to the massive influx of computers into the workplace and other forms of technological change as the explanation.

This paper presents a contrary point of view, and I argue that international trade is indeed an important explanation for the increase in the wage gap. My argument rests on the idea that an increasing amount of international trade takes the form of trade in intermediate inputs. This is sometimes called *global sourcing* by the companies involved, or simply *outsourcing*. Trade of this type affects labor demand in import-competing industries, but also affects labor demand in the industries that use the inputs. For this reason, trade in intermediate inputs can have an impact on wages and employment that is much greater than for trade in final consumer goods.

Feenstra (1998) presents evidence on the extent of outsourcing and its welfare implications. Drawing on that analysis, this paper discusses these issues in each section:

1. I present three reasons why some researchers believe that import competition does not explain the movement in wages. The first is that the trade relative to GDP is not that much larger now than it was 100 years ago. The second reason is that much of the shift in employment within the U.S. has been *within* rather than *between* industries. The third is that change in industry prices seems to

contradict the movement in wages that one would expect from the Stolper-Samuelson theorem.

2. These three reasons have led some to believe that the change in wages are due to *skill-biased technological change,* such as the increased use of computers. But I argue that it is equally plausible that the change in wages is due to *outsourcing* activities. In particular, outsourcing has a qualitatively similar effect on reducing the demand for unskilled relative to skilled labor within an industry as does the increased use of computers.
3. I then briefly examine how my argument stands up for the case of Sweden, which in contrast to the U.S., did not experience a decline in the relative wages of unskilled workers in the 1980s. It is argued that this is consistent with what we know about the outsourcing activities of Swedish multinationals.
4. At the end of the paper, I consider possible policy options. Despite my belief that trade—through outsourcing—has a significant impact on the wages, it does not necessarily follow that restrictions on trade will be in the interest of workers generally. On the contrary, I suggest that under global sourcing of inputs, trade restrictions can have an even greater cost to countries than we normally believe.

1. Changes in wages and employment

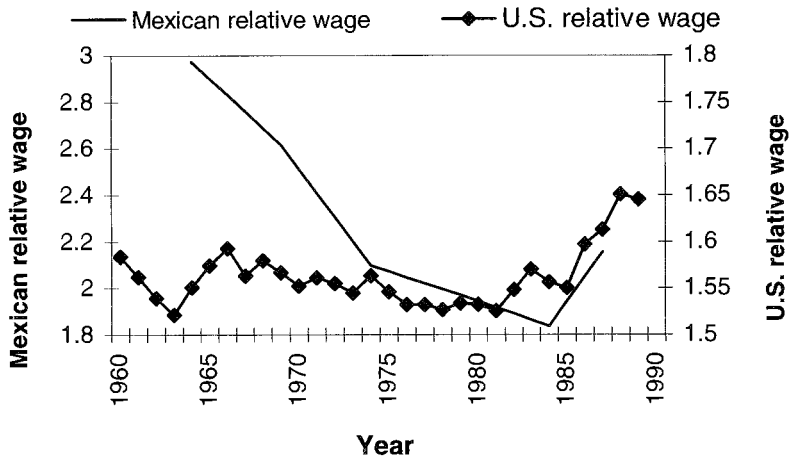
The basic facts concerning the movements in wages in the U.S. are fairly well understood. Between 1979 and 1989, the real wages of young men with 12 or less years of education *fell* by 20% in the U.S.[1] During the same period, the real wages of professional workers were rising, so that the wage gap between blue-collar and white-collar workers increased dramatically. Figure 1 shows this trend, where the bold line graphs the wages of non-production relative to production workers in the U.S. manufacturing sector. The breakdown of workers according to whether or not they are engaged in production activity is made in the U.S. *Census of Manufactures* and is used as a proxy for the occupational class or skill level of workers. For example, in 1990 about three-quarters of non-production workers were in white-collar occupations, and a slightly larger fraction of production workers were in blue-collar occupations.[2] Looking at the educational background,

[1] Freeman and Katz (1994), p. 33, from the Current Population Survey.
[2] Berman, Machin, and Bound (1994), p. 10.

about two-thirds of non-production workers had at least some college education, and nearly the same fraction of production workers had only a high school education. So while the distinction between non-production and production workers is admittedly imperfect, it is frequently used as a measure of the skill-level of workers, and I follow this practice.

Returning to Figure 1, we see that wages of non-production relative to production workers in the U.S. moved erratically during the 1960s and 1970s, but then shows a substantial increase during the 1980s. The same ratio of wages is also shown for Mexican manufacturing and displays a decline from 1965 to 1985, which reflects the entry of more highly educated, professional workers into the workforce. But the decline in their relative wages is reversed after 1985, and in the following years, the relative wages of production or blue-collar workers have declined. This mirrors the pattern in the U.S. The same decline in the wages of blue-collar workers, especially during the 1980s, can be found for the UK, Japan and several other industrialized countries.

Figure 1. Relative wages of non-production/production workers.



Source: Feenstra and Hanson (1996)

1.1. The magnitude of trade

There are three major reasons why some researchers believe that import competition does not explain the movement in wages. The first

is that the trade relative to GDP in the U.S., and other industrial countries, is not that much larger now than it was 100 years ago. At the turn of the century, the world was in a *golden age* of trade and investment, which was broken by World War I and the Great Depression.

Table 1 compares the ratio of merchandise trade to GDP prevailing today with that in 1890 and 1913. For most industrial countries shown there, the ratio of trade to GDP in 1913 was not obtained again until the late 1960s or 1970s, and some countries (Australia, Denmark, Japan, and the UK) still have not reached it.

Table 1. Ratios of merchandise trade to GDP (percent)

Country	1890	1913	1960	1970	1980	1990
Australia	15.7	21.0	13.0	11.5	13.6	13.4
Canada	12.8	17.0	14.5	18.0	24.1	22.0
Denmark	24.0	30.7	26.9	23.3	26.8	24.3
France	14.2	15.5	9.9	11.9	16.7	17.1
Germany	15.9	19.9	14.5	16.5	21.6	24.0
Italy	9.7	14.4	10.0	12.8	19.3	15.9
Japan[a]	5.1	12.5	8.8	8.3	11.8	8.4
Norway	21.8	25.5	24.9	27.6	30.8	28.8
Sweden	23.6	21.2	18.8	19.7	25.0	23.5
UK	27.3	29.8	15.3	16.5	20.3	20.6
U.S.[b]	5.6	6.1	3.4	4.1	8.8	8.0

Notes: Merchandise trade is measured as the average of imports and exports, expect as noted below.

[a] Data for 1890-1913 use three-year averages.

[b] Data recorded under 1890 are for 1889, and along with that in 1913, measure the ratio of merchandise exports to GNP.

Source: Feenstra (1998)

Paul Krugman (1995, p. 331) uses numbers like these to conclude that: "...it would be hard to argue that the sheer volume of trade is now at a level that marks a qualitative difference from previous experience."

But the figures in Table 1 do not tell the whole story. The comparisons there are for industrial countries that have had increasing shares of their economies devoted to services rather than merchandise (that is, manufacturing, mining, and agriculture). Two factors usually explain the rising share of services: services are a luxury good,

whose share rises as per capita income does, and services have slower productivity growth than manufacturing, so that with an elasticity of substitution between these of less than unity, the rising relative price of services also increases its share.

To these explanations we can add a third, advanced by Rodrik (1997): as the openness of an economy increases, so does government expenditures, which are needed to offset the external risks from trade. For all these reasons, the merchandise component of GDP is shrinking. But the vast majority of internationally traded products are merchandise goods rather than services. This means that the ratio of trade to GDP is pulled *downward* by the steady shift toward service economies.

To make a better comparison of trade with overall production, I measure merchandise goods in both the numerator and the denominator. Table 2 displays information of this type for various industrial countries, which shows the ratio of merchandise trade to value-added.

Table 2. Ratios of merchandise trade to merchandise value-added (percent)

Country	1890	1913	1960[a]	1970	1980	1990[b]
Australia	27.2	35.6	24.4	25.6	32.4	38.7
Canada	29.7	39.4	37.6	50.5	65.6	69.8
Denmark	47.4	66.2	60.2	65.9	90.0	85.9
France	18.5	23.3	16.8	25.7	44.0	53.5
Germany	22.7	29.2	24.6	31.3	48.5	57.8
Italy	14.4	21.9	19.2	26.0	43.1	43.9
Japan	10.2	23.9	15.3	15.7	25.8	18.9
Norway	46.2	55.2	60.0	73.2	70.9	74.8
Sweden	42.5	37.5	39.7	48.8	72.9	73.1
UK	61.5	76.3	33.8	40.7	52.6	62.8
U.S.[c]	14.3	13.2	9.6	13.7	30.9	35.8

Notes: Merchandise trade is measured as the average of imports and exports, expect as noted below. Merchandise value-added combines agriculture, mining, and manufacturing for the U.S. and these sectors plus construction and public utilities for most other countries.

[a] Value for Australia refers to 1962 and for Canada, refers to 1961.

[b] Value for Canada refers to 1988, for Germany to 1989, and for the U.K. to 1987.

[c] Data recorded under 1890 are for 1889, and along with that in 1913, measures the ratio of merchandise exports to merchandise value-added.

Source: Feenstra (1998)

There are still two countries for which this ratio was larger in 1913 than in 1990 (Japan and the UK) and one other for which this ratio changed little (Australia). But all others countries have experienced substantial growth in trade relative to merchandise value-added since 1913: this ratio has increased by about one-third for Denmark and Norway; by three-quarters for Canada; has doubled for France, Germany, Italy, and Sweden; and has nearly tripled for the U.S. We conclude that merchandise trade has indeed grown substantially relative to the production of these commodities in many countries.

1.2. Employment changes *within* and *between* industries

The second reason why some researchers do not believe that trade has had an impact on labor comes from decomposing the shifts in the relative employment of unskilled workers into those occurring *within* industries and those occurring *between* industries. According to this line of reasoning, international trade should have the effect of moving workers between sectors, as industries expand or contract in response to foreign competition. In contrast, technological changes, such as the increased use of computers, would have the effect of changing the ratio of skilled to unskilled workers employed within each sector. Table 3 shows some evidence on this *within-versus-between* industry distinction, which is taken from the work of Berman, Bound, and Griliches (1994), and Bernard and Jensen (1997).

The top of Table 3 decomposes the change in the relative employment and relative wages of non-production workers into those that occurred within industries and between industries. We can see that in the 1979-1987 period, the average relative employment of non-production workers increased by slightly more than one-half of one percent per year, with about two-thirds of that explained by within-industry movements. On the wages side, the average relative wages of non-production workers increased by about seven-tenths of a percentage point per year; within-industry movements explained more than half of that change. Berman, Bound, and Griliches suggested the conclusion that trade cannot be a dominant explanation for the wage and employment shifts, because the between-industries movements are smaller than the within-industry movements.

But that conclusion seems to beg the question of what is occurring within these industries, and whether that shift could itself be related to international trade. Bernard and Jensen have obtained some

Table 3. Decomposition of the change in the share of employment and wages of non-production workers, 1973-79 and 1979-87

A. Industry-level decomposition

Year	Employment		Wages	
	Between	Within	Between	Within
1973-79	.121	.199	.119	.212
Total	.320		.381	
1979-1987	.184	.362	.309	.410
Total	.546		.719	

B. Plant-level decomposition

Year	Employment		Wages	
	Between	Within	Between	Within
1973-79	.101	.170	.140	.134
Total	.271		.274	
1979-1987	.177	.215	.315	.221
Total	.392		.536	

Notes: Numbers are percentage changes between years. *Between* numbers represent shifts across 4-digit SIC industries in part A, and shifts across plants in part B. *Within* numbers represent changes within industries in part A, and within plants in part B. All calculations have been annualized.

Sources: Part A from Berman, Bound, and Griliches (1993) and part B from Bernard and Jensen (1997).

suggestive evidence on this point, by doing the same decomposition but using *plant-level* data rather than *industry-level* data. The lower half of Table 3 shows this. Looking again at the 1979-1987 period, we can see that nearly one-half of the relative increase in the employment of non-production workers occurred due to shifts between plants, and movements between manufacturing plants also explain more than one-half (about 60%) of the increase in the relative wage of non-production workers. Furthermore, Bernard and Jensen found that the plants that experience the greatest shifts in relative employment and wages are precisely those that are engaged in export activity.

While the results of Bernard and Jensen are suggestive, they still do not give us a clear idea of what has been happening within industries in the U.S. and whether that might be related to international trade. In my work with Hanson (1996), we have been investigating

the outsourcing activities of U.S. firms. We like to think of an industry as composed of a whole range of different activities, which use varying amounts of skilled and unskilled labor.

As globalization proceeds, the U.S. firms can find it profitable to shed the most unskilled, labor-intensive activities to overseas production. In doing so, the remaining activities in the U.S. would become more skill-intensive on average, so this will increase the relative demand for skilled workers and their wage. Moreover, we can expect the *same* trends to occur in Mexico (or whatever other location is used for the outsourcing). The reason is that the activities that are sent overseas are unskilled labor-intensive compared to those done in the U.S., but are probably quite skill-intensive compared to those done in Mexico. So outsourcing can be expected to also increase the relative demand for skilled workers in *both* the U.S. and Mexico, along with their wage, which fits the pattern in Figure 1.

A quantitative measure of outsourcing can be obtained by estimating the imported intermediate inputs used in each industry. Hanson and I (1997) perform this calculation for manufacturing industries in the U.S. and find that imported inputs have increased from 6% of total intermediate purchases in 1972 to 8.5% in 1979, and 14% in 1990. Jose Campa and Linda Goldberg (1997) make the same calculation for Canada, Japan, the UK, and the U.S. Table 4 displays their results.

The U.S. shows a doubling of the share of imported inputs between 1975 and 1995 for all manufacturing, though it is still at a low level compared to Canada and the UK, where more than 20% of inputs were purchased from abroad in 1993. The UK, especially, shows a large absolute increase in foreign outsourcing. For individual industries, the chemical industry has a lower share of imported inputs than overall, whereas machinery (non-electric and electric) and transportation equipment have higher shares in these three countries.

The machinery and transportation industries have especially rapid growth in imported inputs, with the shares doubling or even tripling between 1974 and 1993. Japan is the exception to these observations,

Table 4. Share of imported to total intermediate inputs (percent)

Country	1974	1984	1993
	All manufacturing industries		
Canada	15.9	14.4	20.2
Japan	8.2	7.3	4.1
UK	13.4	19.0	21.6
U.S.	4.1	6.2	8.2
	Chemical and allied products		
Canada	9.0	8.8	15.1
Japan	5.2	4.8	2.6
UK	13.1	20.6	22.5
U.S.	3.0	4.5	6.3
	Industrial machinery (non-electrical)		
Canada	17.7	21.9	26.6
Japan	2.1	1.9	1.8
UK	16.1	24.9	31.3
U.S.	4.1	7.2	11.0
	Electrical equipment and machinery		
Canada	13.2	17.1	30.9
Japan	3.1	3.4	2.9
UK	14.9	23.6	34.6
U.S.	4.5	6.7	11.6
	Transportation equipment		
Canada	29.1	37.0	49.7
Japan	1.8	2.4	2.8
UK	14.3	25.0	32.2
U.S.	6.4	10.7	15.7

Note: U.S. estimates are for 1975, 1985, and 1995.

Source: Campa and Goldberg (1997, tables 1,3,5,7).

where the share of imports in these heavy industries is lower than in overall manufacturing, and has generally been falling.

Imported intermediate inputs have also been computed for nine OECD countries by Hummels, Rapoport, and Yi (1997). They use the term *vertical specialization* to describe the specialization of a country in particular segments of the value chain. When inputs are imported, then processed, and the resulting product is exported, the total value of exports reflects more than just the value-added in that country. Their measure of vertical specialization equals the fraction of the total value of trade accounted for by inputs that are both imported and embodied in exports.[3] This measure lies between zero (when imported inputs are not used in the production of exports) and unity (when all imports are re-exported, with minimal value-added). Table 5 shows the values of vertical specialization between about 1970 and 1990.

We can see that vertical specialization in trade has increased between the first and last years available for nearly all countries, except Japan. The extent of vertical specialization varies a good deal across countries, being above 30% for the Netherlands; above 20% for Canada and Denmark; between 10 and 20% for Germany, France and the UK; and less than 10% for Australia, Japan, and the U.S. For the sample of nine countries overall, vertical specialization-based trade increases from about 12% to 15% of total trade during the two decades, though these numbers would be higher if Japan were excluded. Considering the contribution to the growth in exports for each country, Hummels, Rapoport, and Yi (1997) report that *more than half* of this growth is due to vertical specialization-based trade in Denmark and the Netherlands; about *one-third* for France, Canada and the UK; and smaller amounts for the U.S., Australia, and Japan. We conclude that the increased use of imported inputs, and narrowing of production activities within each country, is a characteristic feature of many OECD countries over the past two decades.

[3] On the import side, the imported intermediates that are used in the production of exports are measured by (imported intermediates)*(fraction of gross production that is exported). On the export side, the factor content of exports coming from imported intermediates is measured by (exports)*(fraction of gross production that is imported intermediates). Vertical specialization in trade equals the sum of these two terms, but because they are equal in value, it is equivalently measured as twice the value of either one.

Table 5. Vertical specialization in trade

	Approximate years[a]				
Country	**1970**	**Mid-1970**	**1980**	**Mid-1980**	**1990**
Australia	5.5	6.8	NA	7.3	7.4
Canada	17.3	18.1	19.3	24.7	23.2
Denmark	21.2	21.7	24.5	25.7	25.2
France	13.9	17.4	19.1	20.9	18.7
Germany	NA	NA	14.2	16.4	16.3
Japan	7.3	8.0	7.9	7.2	6.6
Netherlands	30.4	34.3	41.5	34.7	NA
UK	14.3	NA	19.2	18.8	19.1
U.S.	3.9	5.1	5.6	5.4	7.4

Notes: Vertical specialization is defined in Footnote 3.

[a] The actual years are:

Australia	1968, 1974, 1986, 1989
Canada	1971, 1976, 1981, 1986, 1990
Denmark	1972, 1977, 1980, 1985, 1990
France	1972, 1977, 1980, 1985, 1990
Germany	1978, 1986, 1990
Japan	1970, 1975, 1980, 1985, 1990
Netherlands	1972, 1977, 1981, 1986
UK	1968, 1979, 1984, 1990
U.S.	1972, 1977, 1982, 1985, 1990

Source: Hummels, Rapoport, and Yi (1997, Figure 10).

1.3. Changes in import prices

The third reason why some authors have argued that international trade is not a significant factor in explaining the movement in wages has to do with the behavior of import and export prices. In widely cited work, Lawrence and Slaughter (1993) have shown that the movement of prices across industries seems to contradict the movement of relative wages. In order for international competition to be the cause of the fall in the relative wage of unskilled workers, we should see that the price of the most unskilled, labor-intensive goods, such as apparel, have fallen relative to other goods. But on average, this has not occurred in the U.S. Table 6, which is taken from the work of Lawrence and Slaughter (1993) and Lawrence (1994), shows this. For each country, the first row is a weighted average of the change in prices over the 1980s, where the weights are the industry's share of total manufacturing employment of *non-production* workers.

The second row is again the weighted average of the change in industry prices over the 1980s, but now using the industry's share of employment of *production* workers.

Table 6. Employment—weighted percentage changes in domestic and import prices

U.S. (1980-89)	**Domestic prices**	**Import prices**
All manufacturing industries		
Non-production labor weights	33.1	26.0
Production labor weights	32.3	28.1
Japan (1980-90)		
All manufacturing industries		
Non-production labor weights	-5.60	-18.23
Production labor weights	-3.90	-17.29
• Without office machines		
Non-production labor weights	-7.09	-18.69
Production labor weights	-4.72	-17.50
• Also without petroleum products		
Non-production labor weights	-6.98	-18.45
Production labor weights	-4.66	-17.39
Germany (1980-90)		
All manufacturing industries		
Non-manual labor weights	23.98	15.24
Manual labor weights	26.03	17.07
• Without office machines		
Non-manual labor weights	24.79	15.38
Manual labor weights	26.21	17.11
• Also without petroleum products		
Non-manual labor weights	24.97	15.70
Manual labor weights	26.28	17.24

Notes: The averages shown weigh each industry's price change by that industry's share of total manufacturing employment or non-production and non-manual workers, or production and manual workers. Industries are defined at the 3-digit SIC level for the U.S., and generally correspond to the 2-digit level for Japan and Germany.

Sources: Lawrence and Slaughter (1993, tables 3 and 4) and Lawrence (1994, table 4).

For U.S. import prices, for example, we can see that when we weight the industries by their production workers, the average price increase is *higher* than when we weight by non-production workers. The same pattern can be seen by comparing the rows for other industrial

countries. This means that some of the industries that use the most production—or unskilled—workers are those with the highest price increases. This finding led Lawrence and Slaughter (1993) to conclude that the price movements, due to international competition, could not explain the wage movements.

But if you believe that industries are engaged in increasing amounts of outsourcing, that suggests a different way to look at the price data. Rather than comparing prices *across* different industries, depending on their skill-intensity, it now makes sense to compare import and domestic prices within each industry. With the U.S. activities in each industry being more skill-intensive than those used abroad, and with an increase in the relative wage of skilled workers, the theoretical prediction from my work with Hanson (1996) is that U.S. prices within each industry should be rising relative to import prices. In terms of Table 6, we should be comparing the price changes across columns rather than across rows. We see that for the U.S. during the 1980s, it is indeed the case that domestic prices rose faster than import prices, and the same is true for Japan and Germany. These price movements are entirely consistent with a model of outsourcing where the industrial countries have the most skill-intensive activities within each industry. Using this framework, the price evidence is actually quite consistent with the wage movements.

2. Technological change versus outsourcing

Summarizing my argument so far, the decision of companies to source their production overseas will most certainly affect their employment at home and can be expected to differentially affect skilled versus unskilled workers. With firms in industrial countries facing a higher relative wage for unskilled labor than that found abroad, the activities that are outsourced would be those that use a large amount of unskilled labor, such as assembly of components and other repetitive tasks. Moving these activities overseas will reduce the relative demand for unskilled labor in the industrial country, in much the same way as replacing these workers with automated production. *This means that outsourcing has a qualitatively similar effect on reducing the relative demand for unskilled relative to skilled labor within an industry as does the increased use of computers.*

This result has several important implications. First, we *should not* assess the proximate cause of the decline in employment and wages

of unskilled workers by attributing all within industry shifts in labor demand to technology and allowing trade to operate only via between industry shifts. This was the approach taken by Lawrence and Slaughter (1993) and Berman, Bound, and Griliches (1994), both of whom were thinking only of trade in final goods. In that context, it is correct that international trade must affect labor demand through inter-industry shifts. But as soon as trade in intermediate inputs is permitted, as with outsourcing, then changes in the demand for labor within each industry occurs due to trade, and these are observationally equivalent to the shifts resulting from skill-biased technical change.

Second, the whole distinction between *trade* versus *technology* becomes suspect when we think of corporations shifting activities overseas. The increase in outsourcing activity during the 1980s was in part related to improvements in communication technology and the speed with which product quality and design can be monitored. This was in turn related to the use of computers. A good example of this is the retailing revolution that has occurred during the 1980s. Consumers in the U.S. are familiar with the development of large-scale discount stores such as Walmart and Target. It is generally believed that the failure to incorporate these discount stores has led to an upward bias in the consumer price index. But the ability of these stores to offer lower prices has depended on an extensive system of outsourcing to low-wage countries, with new inventory methods and rapid communication allowing for design changes that are frequently needed in apparel. This illustrates that trade (through outsourcing) and technology (through computerized communication and inventories) are complementary rather than competing explanations for the change in wages.

Given that the synergy between trade and technology is more important than their individual contributions, it is perhaps not surprising that attempts to measure the impact of trade on employment and wages have led to quite modest estimates, and my own work is no exception. At the same time, attempts to directly measure the impact of computers (as opposed to treating the technology variable as a residual) have also found that this variable can explain only a fraction of the increase in employment and wages.[4] Indeed, a peculiar but

[4] Feenstra and Hanson (1997) find that outsourcing accounts for 20% of the shift in relative employment toward skilled (that is, non-production) workers in U.S.

persistent finding has been that the increased use of computers do not appear to have had the positive impact on total factor productivity (TFP) that we would expect. In attempting to explain this anomaly, Robert Gordon (1996, p. 267) has argued that: "part of the reason that electronic computers have thus far failed to produce a TFP revolution is that they still represent a very small fraction of the capital stock." Of course, much the same has been said about trade being a very small fraction of GDP! In these respects, trade and technology are on equal footing as being only partial explanations for rising wage inequality.

Given that we cannot fully explain empirically the increase in wage inequality, it is important to think conceptually about these issues. There are several models that can be used to understand the impact of globalization on wages. Markusen and Venables (1995, 1996a,b) consider a model where low-skilled labor is used in production, and high-skilled labor is used in headquarter services, while multinational firms choose their location of production. They find that the movement of multinationals increases the skilled-unskilled wage gap in the high-income country and possibly in the low-income country as well.

Krugman and Venables (1995) analyze an economic geography model with trade in intermediate inputs, subject to transportation costs. At medium levels of transport costs (low enough to promote trade but high enough to prevent factor price equalization), a core-periphery pattern emerges: countries in the core will have manufacturing agglomerated in them, while those in the periphery suffer from a lack of industry and low wages. At lower levels of transport costs, the agglomeration of manufacturing in the core areas disappears, leading to a fall in wage inequality across regions. These results suggest that continual advances in transportation and communication technologies, along with free trade, will eventually move the world toward factor price equalization.[5]

Davis (1996a,b,c) has considered the implication of globalization in a model that contrasts the flexible wages of the U.S. with the fixed

manufacturing during 1979-1990. In comparison, the increased use of computers and other high-technology equipment accounted for 30% of that shift.

[5] Kiminori Matsuyama (1996) also demonstrates a similar pattern of agglomeration and uneven incomes across countries. Gao (1997) has extended this type of model to allow for multinational firms, and found that agglomeration breaks down more quickly (at higher levels of transport costs) due to these firms, leading to more equal incomes across countries.

wages of Europe. In this setting, it turns out that the impact of globalization—such as the entry of the newly industrialized countries—is very different than if wages are uniformly flexible. In particular, the brunt of the new supplying countries is borne by European unemployment when those wages are fixed and does not affect American wages, as would occur if both regions had flexible wages. These results highlight that the labor market institution of one country can have spillovers effects (for better or worse) on the position of labor in its trading partners.

3. The case of Sweden

Sweden presents a challenge to the principal argument of this paper, that outsourcing from the industrial countries causes a decline in the relative demand for and wage of unskilled workers. These features did not really arise in Sweden during the 1980s, despite the presence of an extensive number of multinational corporations engaged in outsourcing activities. There was some increase in wage inequality in the second-half of the 1980s (see Edin and Holmlund, 1995, and Hibbs and Locking, 1996), but this is generally attributed to a breakdown of collective bargaining in 1983, and the extent of wage inequality remains small by comparison with the U.S. Employment of low-skilled workers did not suffer, at least not until the recession of 1992-93. Björklund and Freeman (1997) argue that the public sector played some role in maintaining demand for low-skilled workers, as well as high prices for some labor-intensive, non-traded goods. So what, if any, has been the role of international trade and outsourcing in affecting the prospects of low-skilled workers?

The evidence suggests that Sweden and the U.S. have quite different responses of employment to outsourcing activity. Blomström, Fors, and Lipsey (1997) analyze how an increase in the foreign activities of U.S. and Swedish multinationals affects their demand for labor at home. For U.S. multinationals, they find that increased foreign sales *reduces* employment at home, while controlling for sales of the parent firm. This result supports the hypothesis that the U.S. multinationals are sending abroad the more labor-intensive activities. Consistent with this, the negative impact on home employment shows up more strongly for affiliate production in developing rather than industrial countries.

But for Swedish multinationals, the results are quite different. Blomström, Fors, and Lipsey (1997, pp. 11-12) find that:

> Swedish parents, on the other hand, employ more labor at home given the size of home production, when they invest more abroad, and this effect is particularly large for production in developing countries. It, thus, appears that there is little allocation of labor-intensive production to low wage countries within the Swedish firms, and that the labor effect we observe reflects the need for supervisory and other auxiliary employment within the parent associated with production abroad, especially in developing countries.

In other words, production abroad is *complementary* with employment of workers at home, and this result shows up more strongly for the employment of blue-collar workers in Sweden than for white-collar workers. One reason for this is that the overseas activities of Swedish multinationals are principally in other industrial countries, such as the U.S. and Europe, where blue-collar labor is expensive. Thus, there is little incentive to allocation these production activities overseas. More speculatively, we could conjecture that the high, marginal tax rates in Sweden may make it difficult to fully compensate highly skilled executives, so that there could be an incentive to shift these activities out of the country. In any case, it appears that outsourcing poses much less of a threat to blue-collar workers in Sweden than we have argued is the case for the U.S.

4. Policy options

I have argued that the world has become increasingly integrated through trade and that the structure of trade has shifted toward more outsourcing, or vertical specialization. Along the way, I have stressed the need to use a conceptual framework where firms allocate their production activities worldwide. Several prominent researchers have referred to the idea that production occurs internationally: Bhagwati and Dehejia (1994) call this *kaleidoscope comparative advantage*, as firms shift location quickly. Krugman (1995) uses the phrase *slicing the value chain*. Leamer (1996) prefers *delocalization*. Arndt (1997, 1998a,b) uses *intra-product specialization*, and Antweiler and Trefler (1997) introduce *intra-mediate trade*. But the vast majority of research to date relies on a conceptual model that allows only trade in final goods, thereby com-

pletely ignoring the importance of outsourcing. The empirical evidence supports a much more prominent role for the optimal decisions of firms to allocate production worldwide, that needs to be incorporated into our theoretical framework. To conclude, I would like to speculate on the implications of such a model, and the directions that world trade might take in the years ahead.

From the viewpoint of an economic historian looking back on the late 20th and early 21st centuries, surely one of the most important events affecting trade will be the integration of China into the world economy. With one-fifth of the world's population, currently earning a tiny fraction of wages in the industrial countries, it would be surprisingly indeed if the opening of this market did not have an impact on factor prices worldwide. The logic of factor price equalization is certainly not affected by outsourcing, and if anything, is strengthened by this feature. Evidence from the integration of other countries in recent times strongly supports the idea that trade moves factor prices toward equality (Ben-David, 1993, 1996). So while we can expect wages in China to rise rapidly, and this is already happening in the coastal provinces, we should also expect some spillover on reduced wages outside of China.

In light of this, what would be the consequences of a policy action against this integration, such as the *social tariff* discussed during the U.S. presidential campaign of 1996? With firms being major purchasers of imports through outsourcing, I would speculate that protection could very well backfire and would be detrimental to many workers in the U.S., including production workers. To justify this viewpoint, I need to put the issue of trade and wages in a global context.

Some products produced in China are labor-intensive consumer goods, such as toys, which are not produced to any significant extent in the U.S. or Europe. But other activities involve the labor-intensive components of quite sophisticated products, such as the assembly of circuit boards for computers. When these activities are shifted to China from parent companies in Taiwan, Korea, or Japan, then the overall costs of production are lowered. Furthermore, these sophisticated products compete directly with American- or European-made goods on world markets. So the cost advantage obtained by outsourcing from the industrialized countries of Asia, to mainland China, translates into increased competition for American and European firms on world markets.

Faced with this increased competition, what are the options for American and European firms? It seems to me that to protect both their profits and their employment, there is no choice but to join the global trend toward the outsourcing of labor-intensive activities. This outsourcing may occur in China, but American firms have the special advantage of proximity to Mexico, while European firms can take advantage of locations in Eastern Europe. It can be hoped that outsourcing to these locations will allow U.S. and European exporters to face the competitive challenge posed by the availability of the Chinese workforce to other countries in Asia. By giving U.S. companies free access to the workforce in Mexico, the North American Free Trade Agreement helps these companies to retain or expand their international market share. Despite the potentially adverse consequences of this outsourcing on the relative demand for unskilled labor, the consequences could be even worse if the competitive challenge from outsourcing within Asia is not responded to.

This raises the question of whether it is even possible to redistribute income toward low-skilled workers, who have seen their relative incomes decline in recent years. Researchers in international trade know surprisingly little about redistribution schemes, other than that they often fail. The problem in theory is that obtaining the necessary information (who to compensate and how much) creates severe disincentives. But there is one suggestion that has been made in several quite different contexts and is worth repeating. Dixit and Norman (1986) have shown that a system of tax/subsidies on all goods and factors, combined with a poll subsidy, can be used to obtain Pareto gains from trade, without requiring a mechanism for revelation of private information. Provided that production moves in an efficient direction, then this policy is self-financing.[6] Exactly this type of proposal was made in the context of German unification by Akerlof, Rose, Yellen, and Hessenius (1991), who argued that a wage subsidy to workers in East Germany would prevent them from experiencing losses and would pay for itself through savings in unemployment insurance. More recently, Phelps (1997) has argued that a wage subsidy, directed at the lowest paid workers, ought to be considered in the

[6] Feenstra and Lewis (1994) have extended the Dixit-Norman result to a setting where labor and other factors have small adjustment costs and have shown that the tax/subsidies reduce to a set of prohibitive tariffs. They propose that trade adjustment assistance be used to move factors in an efficient direction. See also the other contributions to the May 1994 *Journal of International Economics*.

U.S. The scheme he proposes has a budgetary cost of about $125 billion in 1997, but he suggests that much of this would be recouped through increased tax revenues and reduced social expenditures as employment rose. It is striking that much the same proposal has been made in these different contexts. If we want to move beyond the possibility of Pareto gains to making actual compensation, then wage subsidies to low-skilled workers is one option that ought to be seriously considered.

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