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U.S. Trade with Developing Countries and Wage Inequality

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Since the mid-to-late 1970's, wage inequality between low- and highly educated workers has widened markedly. The wage premium to a college education compared with a high-school education has increased by some 20 percentage points (see George J. Borjas and Valerie A. Ramey [1994] for recent estimates). Part of the explanation seems to lie with a slowdown in the growth of supply of highly educated workers in the 1980's. Another part seems to lie with a demand shift toward educated workers.

Two hypotheses have been advanced to account for the alleged demand shift. The first holds that technological change has been biased in favor of high-education workers. The second holds that growing international trade with low-wage countries has shifted labor-market demand in the United States away from low-educated workers, as the United States increasingly imports goods produced by such workers from low-wage countries.

I. Trade–Wage Linkages: Theory

The most popular framework for analyzing the trade–wage linkage is the Heckscher-Ohlin-Samuelson model (HOS), with the celebrated Stolper-Samuelson theorem. Consider two regions (the United States and the developing countries [DC]) and two factors of production (low-skilled and high-skilled workers, or alternatively, low-educated and highly educated workers). High-skilled workers are abundant in the United States; low-skilled workers are abundant in DC. There are two goods, one skill-intensive in production, the other low-skill-intensive. HOS theory predicts that, upon an opening of trade between the United States and DC, either because of an elimination of protectionism or a fall in transport costs, the following will occur: (i) the United States will export the high-skilled-intensive product and import the low-skilled-intensive product; (ii) the relative price of the low-skilled-intensive product will decline in the United States; (iii) the wage of low-skilled labor relative to that of high-skilled labor will decline in the United States; (iv) employment will shift to the high-skilled-intensive output; and (v) firms in both sectors in the United States, in response to the falling relative wage of low-skilled workers, will raise the proportion of low-skilled to high-skilled workers.

The HOS theory underlines the linkage between relative output prices and relative wages. In the simple two-sector, two-skill factor model, without specialization, there is a one-to-one relationship between output prices and factor prices: the relative wage of unskilled labor falls if and only if the relative price of low-skilled-intensive output declines. In more complex models (e.g., more goods than factors, with specialization in production among a strict subset of goods), there is no longer a one-to-one relationship. If the United States has already stopped producing the low-skilled goods imported from the developing countries, further declines in the relative price of those imported goods will not further reduce the relative wage of U.S. low-skilled workers.

There are a number of possible linkages between trade and relative wages that fall outside of the traditional HOS framework. We mention three examples, in which increased trade reduces the relative wage of low-skilled labor *even without reducing the relative price*

of low-skilled-intensive output in the U.S. market (see Sachs and Shatz [1995] for further details).

First, suppose that the low-skilled-intensive product is produced with physical capital that is internationally mobile. The DC liberalize trade and investment regulations to permit U.S. firms to shift physical capital abroad to produce the unskilled-intensive-good in the lower-wage developing country and reexport the product to the U.S. market. The U.S. unskilled-intensive sector shrinks, and low-skilled workers are made unemployed. They push down wages of low-skilled workers in the nontraded-goods sector. Since the total supply of the low-skilled-intensive good remains unchanged in the U.S. market (the rise in foreign-based production substitutes for the fall in domestic-based production), the relative price of the good need not change. The fall in low-skilled wages can take place without any relative output price change.

This kind of model, in which domestic production of the low-skilled good is shifted abroad, is akin to the models of outsourcing stressed by Robert C. Feenstra and Gordon H. Hanson (1996). In their model, each sector of production includes final outputs and intermediate inputs. The intermediate inputs are assumed to be unskilled-intensive. Outsourcing involves the shift from domestic to foreign production of the intermediate input. As a consequence of outsourcing, the skill-intensity of production rises *within* sectors of the economy, since each measured sector is really two sectors: the final output and the intermediate output.

Second, suppose that the low-skilled-intensive sector in the United States is a monopolistic sector, initially facing a domestic competitive fringe. The monopolist engages in limit-pricing, keeping its monopoly price at the maximum level possible that does not encourage the entry of the competitive fringe. Now suppose that the DC, through domestic investment, develop the capacity to export the low-skilled-intensive product to the U.S. market. In some cases, the U.S. monopolist will respond optimally to the increased import competition by lowering its domestic production one-for-one with the increased imports, while keeping the output price at the previous level. The monopolist will cut back on the employment of its low-skilled workers, who once again will drive down wages of unskilled workers in other sectors of the economy. Once again, relative wages change, even though relative output prices do not.

Third, suppose that the skill-intensive export sector can produce with two types of technology. The standard technology employs both high-skilled and low-skilled workers with a constant marginal product. The more roundabout technology requires a fixed investment of high-skilled workers (e.g., engineers) but then permits production with a higher marginal product of labor. As is well known, the resort to the fixed-cost technology will be limited by the scope of the market. In a closed economy, it may not be profitable to introduce the more roundabout technology, since the higher marginal productivity of labor will not compensate for the fixed cost. In a globalized economy, on the other hand, with higher market demand for the output of the skilled-export sector, it may become profitable to produce with the fixed-cost technology. Thus, globalization could change the choice of technology in a skill-biased way, even if the relative output prices do not change.

The moral of these theoretical vignettes is that the trade–wage linkage can occur in many forms: changing relative output prices, which affect relative factor prices as in the HOS theory; capital flows (and outsourcing) to the developing countries from low-skill-intensive sectors; increased import competition for monopolistic sectors; or skill-biased technical changes in response to the growth of the global marketplace for U.S. products.

II. Trade–Wage Linkages: Evidence

There is considerable circumstantial evidence that international trade is playing at least *some* role in the recent widening of wage inequalities. There are several kinds of evidence that are relevant. The first piece of evidence is circumstantial: the timing of expanded U.S.–DC trade in manufactures and the widening of the U.S. wage inequalities are similar, with both trends starting toward the end of the 1970's (see Sachs and Shatz, 1994). The expanded trade in manufactures was occasioned by three

events: an abandonment of protectionist trade and direct investment policies in many developing countries, including most importantly for the United States, China in the early 1980's and much of Latin America in the mid-1980's; a greatly increased manufacturing export capacity in the developing countries, especially in East Asia, as a result of high rates of investment in those countries; and sharply falling transport and communications prices, encouraging trade and multinational investment.

To see the effects of the increased trade, we used the Current Population Survey of the Bureau of Labor Statistics to rank 131 three-digit SIC industries of U.S. manufacturing according to the ratio of highly educated workers (with at least some college) to lower-educated workers (high-school education or less). We then aggregated over the 131 industries to construct 10 deciles of approximately equal employment, ranging from the most skilled-intensive sectors (1) to the least skilled-intensive sectors (10). Here and in what follows, we use the term "skilled-intensive" to denote a high ratio of highly educated to less educated workers.

The top six skilled-intensive deciles were all net exporters to DC in 1979; the four low-skilled-intensive deciles were all net importers. Accordingly, we further aggregated to two manufacturing sectors: a high-skilled-intensive, export sector, and a low-skilled-intensive, import-competing sector. Various key aggregates for these two sectors, denoted as exportables manufacturing and import-competing manufacturing, are shown in the first two columns of Table 1. Aggregates for two service sectors, described later, are shown in the final two columns.

The shifts in U.S. trade and employment are in the direction predicted by the basic theories, which hold that the exportables sector should have expanded while the import-competing sector should have declined. The low-skilled, import-competing manufacturing sector either grew less rapidly, or declined more markedly, than the higher-skilled, exportables sector, according to various measures of inputs and outputs. We see this in Table 1 for overall employment, high-skilled and lower-skilled employment, the capital stock, and real value added. Moreover, *the value-added price of the lower-skilled, import-competing sector fell*

TABLE 1—ECONOMIC CHANGES BY SECTOR, 1979–1990

Measure	Manufacturing sectors		Service sectors	
	(i)	(ii)	(iii)	(iv)
Percentage of high-skilled workers in total employment:				
1979	36.1	19.1	54.2	36.2
1990	47.9	24.6	62.0	43.1
Percentage changes, 1979–1990:				
Total employment	11.2	−14.2	39.2	23.7
High-skilled	34.1	10.5	59.2	47.4
Lower-skilled	−17.5	−20.0	15.5	10.2
Capital stock	30.7	2.3	41.8	55.3
Real value added	25.4	10.7	38.7	28.8
Value-added prices	58.2	32.6	96.8	68.5
Net exports to developing countries, percentage of value added:				
1979	5.3	−5.3	0.2	0.0
1990	2.5	−14.0	0.2	0.0

Notes: The aggregate manufacturing sectors are (i) a high-skilled-intensive export sector and (ii) a low-skilled-intensive import-competing sector. The aggregate service sectors are (iii) tradables services and (iv) nontradables services. Exportables manufacturing includes those industries in the top six skill deciles of manufacturing, as ranked by ratio of high-skilled to lower-skilled workers and then grouped by number of employees, while import-competing manufacturing includes those industries in the bottom four deciles. Tradables services include transportation, communications, and public utilities; finance, insurance, and real estate; business and repair services; entertainment and recreation services; and professional and related services. Nontradables services include construction; wholesale and retail trade; personal services; and public administration.

High-skilled employees have education beyond high school. Lower-skilled employees have a high-school diploma or less. Real value added and value-added prices for manufacturing are based on log annual price changes computed as $(1/Sv)[\delta Po - Se(\delta Pe) - Sm(\delta Pm)]$, where S is the average share of output between time t and $t + 1$, δP is log price change, v is value added, o is output, e is energy cost, and m is materials cost. Sv is computed as the residual of $1 - Se - Sm$. Total price change is the sum of the annual price changes. With 1979 the base year, real value added in 1990 is computed as value added divided by the exponent of the 1979–1990 price change.

Public administration is not included in capital stock. Manufacturing trade listed as 1979 is actually 1978, and value added and value-added prices for exportables manufacturing do not include data for the computer industry (SIC 357).

Data sources are available from the authors upon request.

TABLE 2—WAGES BY SECTOR, 1979 and 1990

	Manufacturing sectors		Service sectors	
Measure	(i)	(ii)	(iii)	(iv)
Wage changes, 1979–1990, percentages:				
Total employment	84.3	63.2	87.3	67.9
High-skilled	88.0	69.4	91.6	72.7
Lower-skilled	63.9	55.1	65.6	56.6
Relative wages, percentages, high-skilled to lower-skilled:				
1979	138.1	143.7	132.9	132.1
1990	158.4	156.9	153.8	145.7
Percentage change	14.7	9.2	15.7	10.3

Notes: The aggregate manufacturing sectors are (i) a high-skilled-intensive export sector and (ii) a low-skilled-intensive import-competing sector. The aggregate service sectors are (iii) tradables services and (iv) nontradables services. Further explanation is provided in the notes to Table 1. Data sources are available from the authors upon request.

sharply relative to the value-added price of the high-skilled, exportables sector, declining by 16 percent in relative terms between 1979 and 1990 (see Sachs and Shatz [1995] for further analysis of these relative price movements). The import-competing sector was hit by sharply higher developing-country imports, which rose from 5.3 percent of value added in 1979 to 14 percent of value added in 1990. U.S. net exports in the exportables sector, relative to the sector's value added, actually declined, but by a much smaller amount, from 5.3 percent of value added in 1979 to 2.5 percent of value added in 1990. Feenstra and Hanson (1996) present evidence that out-sourcing has also increased markedly in U.S. manufacturing sectors in the past two decades.

In the final two columns of Table 1, we also report data for the service sector (plus construction) of the economy. Overall, the service sector is much less engaged in international trade than is manufacturing, but some service subsectors are in fact engaged in international trade. Unfortunately, the reporting of trade in services is still underdeveloped, and there is reason to believe that trade in services is significantly undermeasured in official data. Nonetheless, as a crude approximation, we divide

the service sector into two parts. Large parts of the "tradables" service sector are part of nontradables, but the data are not sufficiently disaggregated to make a finer classification. Interestingly, the tradables services sector grew more rapidly, and with a rise in relative prices, compared to the nontradables services sector. This is consistent with the position of the United States as a significant and growing net exporter of services to the rest of the world.

Recent international evidence (Steven S. Saeger, 1995) supports the view that increased trade between developed and developing countries has caused a fall in the proportion of the developed-country labor force in manufactures, by 1–2 percentage points of the labor force in most OECD economies. Presumably, the workers released from the manufacturing sector find increased employment in nontradables or withdraw from employment. Assuming that the relatively low-skilled workers are leaving manufacturing, this will put downward pressure on low-skilled wages throughout other sectors of the economy, perhaps irrespective of relative output-price changes in manufacturing.

Sketchy data from the side of the developing countries also supports the view that increased trade between the developed and developing countries has reduced the relative price of the goods exported by the developing countries. As Patrick Minford et al. (1995) have noted, the unit-value index of export manufactures of the developing countries has declined markedly relative to the export unit-value index of the developed countries in the past 15 years, especially after 1986. Hong Kong export-price indexes, arguably a good measure of the world prices of developing-country manufacturing exports more generally (in view of Hong Kong's open economy and entrepot function), also show declining relative prices for some key low-skilled-intensive exports. Both pieces of evidence are consistent with the observed trend of declining relative prices of low-skilled-intensive output within the U.S. market.

Because of the partial segmentation of U.S. labor markets, resulting from costs of inter-sectoral mobility and the market power of insiders relative to outsiders, we expect to see

differentials in wages of similarly skilled workers across sectors of the economy. Changes in these relative wages over time would also provide some evidence for the source of shocks in the economy. In Table 2 we show the wage changes between 1979 and 1990 for high-school-educated and college-educated workers in the four major subsectors of the economy. In all four subsectors, the relative wage of college-educated workers rose. Note, however, that both high-school-educated and college-educated workers experienced the *lowest* increase in the import-competing manufacturing sector, and the highest increases in the exportables manufacturing sector and the tradables services sector. While these results are not consistent with strict HOS theory (since wages of each skill class are equalized across sectors in the HOS framework), they are consistent with a shock originating in the decline in the price of the import-competing goods relative to exportables, with labor partially mobile between sectors.

III. Assessment

Despite the range of theory and evidence in support of the trade–wages linkage, some analysts have suggested that trade has played a very small or even insignificant role in the recent widening of wage inequality. Two main arguments have been used. First, despite the fall in the relative wage of low-skilled labor, the ratio of high-skilled to low-skilled workers has risen in almost every manufacturing subsector, suggesting skill-using (or low-skill-saving) technical change. Therefore, the argument goes, trade effects cannot be very important. This line of argument is unsatisfactory. Both technology *and* trade effects can be at play. In fact, the technological change toward high-skilled workers has been a long-term trend; there is only very limited evidence that it has accelerated in the past 15 years, and further empirical analysis is needed to assess a possible acceleration in technical change. Even if ratios of skilled to unskilled workers within some manufacturing sectors have risen more rapidly in the past 15 years than previously, part or all of this could be the result of accelerated outsourcing, rather than accelerated technical change. On the other hand, trade

with developing countries has clearly increased markedly in recent years.

The second line of attack against the trade hypothesis involves price data. Robert Z. Lawrence and Matthew J. Slaughter (1993) maintained that output prices have not moved in the direction suggested by HOS theory, and Jagdish Bhagwati and Vivek H. Dehejia (1994) argued that this finding undermines any purported link of relative wages and trade. This argument is unconvincing. The trade data reported by Lawrence and Slaughter are for a very limited number of sectors and are for gross output prices rather than value-added prices. Much more complete domestic U.S. price data show that the relative value-added prices of low-skilled-intensive products have in fact declined markedly during the period 1979–1990. According to the results of Alan B. Krueger (1995), this trend in relative prices between high-skilled and lower-skilled sectors has continued during 1990–1995, with a continuing relative price decline of the low-skilled-intensive sectors. Moreover, as noted earlier, the manufacturing export price indexes of the developing countries seem to point in the same direction: toward a falling relative price of U.S. manufactured imports from LDC's relative to U.S. exports. In addition, the relative price channel is just one of the ways that increased U.S.–DC trade could increase U.S. wage inequality. It is not a necessary condition for such a linkage.

Given the apparently sizable relative price shifts against low-skilled-intensive sectors in the past 15 years, and the observed shifts in employment and sectoral capital stocks, trade is likely to be playing a role comparable in importance to the other factors. In experiments with a very simple three-sector model of exportables, import-competing goods, and nontradables (available from the authors upon request), shifts of relative prices of 10–15 percent against the import-competing sector, combined with shifts in sectoral capital stock on the observed order, easily produce a widening of wage differentials greater than 5 percentage points, and perhaps much more. Our next step in research is to construct a multisector computable general equilibrium model of trade, capital accumulation, and technical change, adding in considerations of segmented

labor markets and gradual shifts in capital among sectors and between the U.S. and the developing countries, to make more precise quantitative estimates of the contributions of trade and other factors.

IV. Concluding Remarks

There is still no convincing quantitative account of the role of trade in the widening wage inequality, though theory and circumstantial evidence certainly support the linkage of trade and widening inequalities. We emphasize, however, that, even if trade is an important factor in the recent widening of wage inequality, this does not suggest a case for increased trade protection. Theory and evidence both suggest that open trade is likely to be beneficial for the vast majority of the U.S. population. International experience in the postwar era underscores that open trade is a critical spur to long-term growth (see Sachs and Andrew Warner [1995] for cross-country evidence). Moreover, open international trade is vital for the long-term growth prospects of the developing countries. U.S. labor-market experience also teaches that the labor force will respond to the widening of the premium on education by increasing the investment in education, thereby narrowing the gap in inequality in the future (Jacob Mincer, 1995). Increased investment in schooling and job training, possibly combined with compensatory adjustment assistance for workers most hurt by trade shocks, are likely to be the most effective policy responses to recent shifts in the international trading environment.

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