Globalization, Outsourcing, and Wage Inequality

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Since the late 1970's, the wages of less-skilled U.S. workers have fallen dramatically, both in real terms and relative to the wages of more-skilled U.S. workers. There is considerable debate over whether international trade has contributed to the declining economic fortunes of the less skilled (Richard Freeman, 1995; J. David Richardson, 1995). Skeptics about the role of globalization in U.S. wage changes claim that technological innovation is a more plausible explanation for the shift toward skilled labor. While technology is surely an important contributing factor to rising wage inequality in the United States, the current trade-versus-technology debate obscures a more fundamental question about how firms respond to import competition and how these responses, in turn, are transmitted to the labor market.

In previous work, we have argued that outsourcing, by which we mean the import of intermediate inputs by domestic firms, has contributed to an increase in the relative demand for skilled labor in the United States (Feenstra and Hanson, 1996). This feature of globalization—the fragmentation of production into discrete activities which are then allocated across countries—has received little attention in the literature. If firms respond to import competition from low-wage countries by moving non-skill-intensive activities abroad, then trade will shift employment toward skilled workers *within* industries. Most previous studies of the labor-market effects of trade presume that import competition shifts resources across industries, without changing their internal composition. Ignoring outsourcing misses an important channel through which trade affects the demand for labor of different skill types.

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In this paper, we extend our previous work by incorporating new data on manufactured imports. The revised National Bureau of Economic Research (NBER) trade data base (Feenstra, 1996) contains import data for U.S. manufacturing industries over the period 1972–1994. We combine the import data with disaggregated data on input purchases from the *Census of Manufactures* to construct industry-by-industry estimates of outsourcing for the period 1972–1992. We then reexamine whether outsourcing has contributed to an increase in relative demand for skilled labor.

I. Data

As described in Feenstra (1996), the import data were computed by starting with the most disaggregated import figures collected at the border by the U.S. Census for the years 1972–1994. These data were summed according to import-based SIC (MSIC) at the four-digit level. This classification differs from the domestic-based SIC because the latter for some industries depends on the method of processing, which is not known for imports. Accordingly, a concordance between the domestic- and import-based SIC systems was developed by starting with the concordance used by John M. Abowd (1991) and revising it based on various Census sources. This concordance was applied to obtain imports by source country for each four-digit SIC industry for which import data were available (435 in total) for the years 1972–1988. For 1989 and later years, the MSIC codes were revised to follow the 1987 SIC basis rather than the earlier 1972 basis. In order to convert the import totals from the 1987 to the 1972 basis, we computed a "weighting matrix" using 1988 import data from both the four-digit 1972 MSIC and the four-digit 1987 MSIC. For 1989 and later years, we first summed the data according the 1987 MSIC numbers, then multiplied by the weighting matrix, and then

applied our concordance between the 1972 MSIC and 1972 SIC.

Because of the numerous judgments needed to convert the MSIC codes to an SIC basis, our import data differ somewhat from that of Abowd (1991), so that our data should be viewed as a revision of Abowd's beginning in 1972 (or 1974 for imports on a CIF [cost including freight] basis). For example, the total value of manufactured imports from Abowd is about 3-percent higher than our CIF value in 1974, 5-percent higher in 1978, and 15-percent higher in 1985 (the final year in Abowd's data base). These differences can be traced to a very small number of industries, for which it is especially difficult to convert the MSIC codes to an SIC basis. Even in these industries, the import share of consumption is within the range observed for related industries. Studies that have used Abowd's data in *share* form should not be affected to any significant extent by our revision to the import data, as we confirm for the regressions reported below. But the revision is potentially more serious for studies that have relied on the *absolute magnitude* of imports, such as those that estimate the factor-content of imports and its impact on the labor market.

TABLE 1—MANUFACTURED IMPORTS, 1972–1990

	Variable			
Year	Imports	S_M	S_O	S_N
1972	48.77	5.02	5.34	34.24
1979	143.73	6.74	7.69	35.39
1987	355.97	10.53	11.47	41.33
1990	407.02	10.65	11.61	42.44
	Annual changes			
Years		ΔS_M	ΔS_O	ΔS_N
1972–1979		0.250	0.331	0.109
1979–1987		0.585	0.422	0.432
1979–1990		0.436	0.313	0.389

Notes: The sample consists of 450 four-digit SIC manufacturing industries for all variables except S_M, in which case data are available for 435 industries. The share variables are weighted by the industry share of the total manufacturing wage bill. Δ indicates the annual change in the variable. Changes in the share variables are weighted by the average industry share of the manufacturing wage bill in the beginning and ending period.

Variables are defined as follows: Imports = manufacture imports (billions of dollars); S_M = [imports/(imports + shipments)] $\times$ 100; S_O = [(imported inputs)/(total non-energy material purchases)] $\times$ 100; S_N = (nonproduction workers share of the industry wage bill) $\times$ 100. Imported inputs are calculated for each industry as Σ_i(input purchases from industry i) $\times$ (S_M for industry i). Inputs include parts and components and contract work done by others.

Sources: NBER productivity data base (Eric Bartelsman and Wayne Gray, 1994) and NBER trade data base (Feenstra, 1996).

II. Empirical Results

In this section, we examine the impact of outsourcing on the relative demand for skilled labor. We reestimate the regressions reported in Eli Berman et al. (1994) and Feenstra and Hanson (1996), including our measure of outsourcing as an explanatory variable. Following both papers, we use the nonproduction-workers share of the industry wage bill to measure the relative demand for skilled labor, while commenting on the results obtained using relative employment or wages in the concluding section.

A. *Outsourcing: Definition and Measurement*

Table 1 shows total imports and estimated imports of intermediate inputs for U.S. manufacturing industries over the period 1972–1990. We measure outsourcing as the share of imported intermediate inputs in the total purchase of non-energy materials. To construct this measure, we combine the four-digit SIC import data described in Section I with data on material purchases from the *Census of Manufactures*. The census data show the value of intermediate inputs that each four-digit manufacturing industry purchases from every other four-digit manufacturing industry. These are the raw data used to construct input–output tables. We estimate imported intermediate inputs for a given industry as the value of input purchases from each supplier industry times the ratio of imports to total consumption (imports plus shipments) in the supplier industry, summed over all supplier industries. This measure is labeled S_O in Table 1, while S_M denotes the import share of total consumption.

Outsourcing has expanded dramatically over the last two decades. Between 1972 and 1990, imported intermediate inputs increased from 5.3 percent of material purchases to 11.6 percent of materials purchases. The magnitude and timing of this increase are relatively similar to those for overall manufactured imports. In general, industries with large imports of final goods also have large imports of intermediate inputs. The correlation between S_M and S_O (across the 435 industries for which import data are available) rose from 0.15 in 1979 to 0.35 in 1990, and that for ΔS_M and ΔS_O rose from 0.59 in 1979 to 0.72 in 1990. This is consistent with the idea that outsourcing is a response to import competition.

What the aggregate figures hide is that certain industries show a much higher propensity to outsource than others. In footwear, electric and electronic machinery, instruments, and other industries (jewelry, toys, and sports equipment), the share of imported intermediate inputs in material purchases is approximately 1.5–1.75 times higher than that shown in Table 1. These industries, most of which produce semi-durable consumer goods, share two characteristics that make them amenable to outsourcing. First, the production process can be separated into self-contained stages, which facilitates the transport of inputs across space. Manufacturing a personal computer or a pair of shoes involves the production of myriad component parts, which are later assembled into a final good. Second, production stages vary considerably in the relative intensity with which they use labor of different skill types, which creates a rationale for moving non-skill-intensive activities abroad. Product design and development require workers with at least a college education, and the production of components may require skilled technicians. Product assembly, on the other hand, generally requires workers with only rudimentary skills.

It is important to note that the definition of outsourcing we use is more general than that which appears in the literature. Our operational measure, which is based on the *Census of Manufactures* definition of manufactured materials, includes two types of intermediate inputs: (i) parts and components, and (ii) contract work done by others. The second category includes goods that are produced entirely by subcontractors, with the U.S. manufacturer attaching its brand name to a finished product. Contracting a foreign firm to manufacture a good that has been designed by and will be distributed by a U.S. firm is an important type of outsourcing: Nike produces most of its athletic shoes in this manner. A second type of outsourcing also included in "contract work done by others" is the use of foreign plants for product assembly. Assembly services account for a large share of U.S. imports from low-wage countries. For example, imports from offshore assembly plants accounted for 42.2 percent of U.S. imports from Mexico in 1990.

In contrast, Berman et al. (1994) made use of a question asked in the 1987 *Annual Survey of Manufactures* (ASM) that defined outsourcing to include only parts and components purchased from abroad (see note 5 in Feenstra and Hanson [1996]). Using this definition, imported materials amounted to only 8.0 percent of total material purchases in 1987. Berman et al. conclude from this figure that outsourcing cannot be an important factor in the employment shift away from less-skilled workers. The discrepancy between their low figure and our higher figure of 11.5 percent is likely explained by the fact that their measure, taken from the ASM, excludes contract work.

An additional important feature of our definition is that we do not limit outsourcing to mean the foreign activities of multinational corporations. Robert Z. Lawrence (1994) and Matthew J. Slaughter (1995) attempt to measure outsourcing for the United States using the purchase of inputs by U.S. multinationals from foreign subsidiaries. Multinationals do engage in a substantial amount of outsourcing. It is somewhat arbitrary, however, to ignore transactions between U.S. firms and independent foreign suppliers. The Compaq Computer Corporation purchases parts for personal computers from foreign subsidiaries and from foreign suppliers that it does not own. In either case, Compaq imports components that it could have (and in the past may have) produced domestically. Either type of outsourcing will affect the range of activities that Compaq performs in its domestic manufacturing operations.

TABLE 2—REGRESSION RESULTS FOR THE CHANGE IN NONPRODUCTION WAGE SHARE

A. Independent variable	1972–1979 (1a)	1972–1979 (2a)	1979–1990 (3a)	1979–1990 (4a)
$\Delta \ln(K/Y)$		0.045		0.101
		(7.049)		(15.80)
$\Delta \ln(Y)$		0.030		0.046
		(5.588)		(9.584)
ΔS_O	0.070	−0.009	0.637	0.384
	(1.792)	(−0.209)	(16.25)	(8.136)
Constant	0.0002	0.0001	0.0004	0.0003
	(2.431)	(0.139)	(4.834)	(3.989)
R^2:	0.005	0.101	0.369	0.595

B. Independent variable	1972–1979 (1b)	1972–1979 (2b)	1979–1990 (3b)	1979–1990 (4b)
$\Delta \ln(K/Y)$		0.055		0.121
		(8.196)		(19.71)
$\Delta \ln(Y)$		0.041		0.068
		(7.471)		(18.64)
ΔS_M	−0.027	−0.199	0.259	0.156
	(−0.581)	(−4.023)	(6.989)	(5.457)
Constant	0.0003	0.0001	0.0006	0.0003
	(3.190)	(0.465)	(5.609)	(3.735)
R^2:	−0.002	0.132	0.099	0.568

Notes: See notes to Table 1 for sample description and variable definitions. The dependent variable is ΔS_N, the change in nonproduction wage share. $\Delta \ln(K/Y)$ is the change in the log capital/output ratio; $\Delta \ln(Y)$ is the change in log real output. All variables are annual averages and are weighted by the average industry share of the manufacturing wage bill. Numbers in parentheses are t statistics.

B. *Estimation Results*

In Table 2, we show the results from regressing the annual change in the nonproduction wage share on the control variables used by Berman et al. (1994), the change in outsourcing, and the change in the import share of consumption. The regressions with the import share as an explanatory variable update the results in Feenstra and Hanson (1996), using the new import data.

These regressions require some justification. From a theoretical model of trade in final goods, there is little basis for using import quantities to measure the impact of trade: it is relative prices that determine labor demand. Robert E. Baldwin and R. Spence Hilton (1984) and Baldwin and Glen G. Cain (1994) develop an empirical framework based on the general-equilibrium relationship between commodity prices and factor prices, under which changes in commodity prices are regressed on the level of (and changes in) unit input requirements (see also Edward E. Leamer, 1995). The regressions we report can be justified using their approach. When firms outsource, they narrow the range of activities that the domestic industry performs, which can reduce the industry unit demand for less-skilled labor. The regressions we report can be seen as a reduced-form relationship between outsourcing and the unit input requirement for skilled labor, which is one of the explanatory variables in the Baldwin technique. In future work, we plan to incorporate the regressions reported here into that framework.

We show regression results for the change in the nonproduction wage share in two time periods: 1972–1979 and 1979–1990. These periods are chosen as peak-to-peak in the business cycle and follow Berman et al. (1994) in this respect. The regressions for the time period 1972–1979 show, unexpectedly, that the change in outsourcing (ΔS_O) is statistically insignificant in both regressions and that the change in the import share (ΔS_M) enters negatively and is in one case statistically significant. The results for the period 1979–1990 are quite different. Both the change in outsourcing and the change in the import share are positively correlated with the change in the nonproduction wage share and are highly statistically significant.

For the later period, the magnitude of the coefficient estimates on ΔS_O suggests that outsourcing has contributed substantially to the increase in the relative demand for nonproduction labor. Consider the change in the nonproduction wage share over the period 1979–1990 reported in Table 1 (0.389). Multiplying the coefficient estimate on ΔS_O in column (4a) (0.384) times the change in the variable reported in Table 1 (0.313), outsourcing can account for 30.9 percent of the increase in the nonproduction wage share that occurred in the 1980's. Alternatively, if we use the coefficient in column (3a) (0.637), outsourcing can account for fully 51.3 percent of the increase in

the nonproduction wage share. It is instructive to compare this finding to a similar calculation for the import-share variable, which is the measure of outsourcing we used in our previous work. Using coefficient estimates on ΔS_M from columns (3b) and (4b) (0.156 and 0.259), the increase in the import share (0.436) can account for 17.5–29.0 percent of the increase in the nonproduction wage share over the period 1979–1990. Our new measure of outsourcing performs substantially better in accounting for the increase in the relative demand for nonproduction labor. This should not be too surprising, since our new measure of outsourcing is a much more direct estimate of the extent to which industries move production activities offshore.

The contrast between the results for the 1970's and those for the 1980's is somewhat surprising. If our outsourcing hypothesis is correct, an increase in outsourcing should be associated with an increase in the relative demand for skilled labor in all time periods. We interpret outsourcing as an index of the extent to which U.S. firms contract non-skill-intensive production activities to foreigners. So far, we have used U.S. imports from all countries to measure outsourcing. Some portion of outsourcing may in fact be trade in intermediate inputs between the United States and other advanced economies. In our future work we will be able to measure outsourcing, excluding imports from advanced nations. We expect to find that low-wage countries account for much of the increase in outsourcing that occurred in the 1980's, which would explain the discrepancy between the results for the two time periods.

III. Directions for Future Research

While we believe that we have demonstrated the importance of outsourcing for understanding changes in U.S. labor demand in the 1980's, there are several puzzles that remain in the data. In unreported results, we find that during the periods 1972–1979 and 1979–1990 outsourcing is *positively* correlated with the change in the relative employment of nonproduction workers, but weakly *negatively* correlated with the change in relative average annual earnings of nonproduction workers. The negative correlation between outsourcing and relative earnings is surprising. One explanation may be that relative average annual earnings are a poor measure of relative hourly wages, but we feel that a more serious problem is that a regression of relative wages on outsourcing is misspecified. The appropriate framework in which to address the effect of outsourcing on wages is the Baldwin approach, extended to allow for outsourcing. We will pursue this approach in our future work.

A second puzzle, which is not apparent in Table 1, is that the large increase in the nonproduction wage share over the period 1979–1987 is primarily the result of an increase in the relative employment of nonproduction workers that occurred in just two years (1979 and 1981). This feature of the employment shift toward nonproduction labor, to our knowledge, has received little attention. What is special about the years 1979 and 1981 is, of course, that they correspond with a recession in the United States. While the ratio of nonproduction employment to production employment is in general countercyclical, the magnitude of the relative employment change in 1979–1981 appears to be abnormal in comparison with preceding and succeeding recessions. Our results can be interpreted as explaining, in part, why workers who were let go during 1979–1981 were not rehired. But this is an incomplete accounting of the event. The lumpiness of relative employment changes is clearly an issue worthy of further study.

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