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Abstract

Using firm-level data collected by the U.S. Bureau of Economic Analysis, we estimate the impact on U.S. manufacturing employment of changes in foreign affiliate wages. We show that the motive for offshoring and, consequently, the location of offshore activity, significantly affects the impact of offshoring on parent employment. In general, offshoring to low-wage countries substitutes for domestic employment. However, for firms that do significantly different tasks at home and abroad, foreign and domestic employment are complements. These offsetting effects may be combined to show that offshoring by U.S.-based multinationals is associated with a quantitatively small decline in manufacturing employment.

Disciplines

Business Administration, Management, and Operations | Economics | International Business

OFFSHORING JOBS? MULTINATIONALS AND U.S. MANUFACTURING EMPLOYMENT

Ann Harrison and Margaret McMillan*

Abstract—Using firm-level data collected by the U.S. Bureau of Economic Analysis, we estimate the impact on U.S. manufacturing employment of changes in foreign affiliate wages. We show that the motive for offshoring and, consequently, the location of offshore activity, significantly affects the impact of offshoring on parent employment. In general, offshoring to low-wage countries substitutes for domestic employment. However, for firms that do significantly different tasks at home and abroad, foreign and domestic employment are complements. These offsetting effects may be combined to show that offshoring by U.S.-based multinationals is associated with a quantitatively small decline in manufacturing employment.

I. Introduction

DURING the past three decades, domestic manufacturing employment of U.S.-based multinationals has fallen steadily (table 1). Between 1982 and 1999, affiliate foreign employment as a share of total employment of these U.S. multinationals increased, climbing from 30% to nearly 44% of their labor force. These parallel developments have led critics of globalization to conclude that U.S. firms are cutting employment at home and shifting employment abroad. Concerns about offshoring have intensified as newly released data indicate a further decline in manufacturing employment by both U.S.-based multinationals and for the U.S. economy as a whole.

Why are the employment consequences of offshoring so important? After all, most trade models predict that the factor reallocations resulting from globalization are associated with net gains in aggregate welfare. First, there are likely to be short-run costs of adjustment as workers may not quickly leave one type of employment for another. These types of costs have been formalized in trade models where factors are specific to the production of certain types of goods. To the extent that unskilled workers are more likely to suffer transitional losses, these are important distributional consequences and need to be carefully identified and understood.

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Second, these short-run costs could lead to an erosion of support for free trade, as discussed by the chair of the Federal Reserve (Bernanke, 2006). And finally, understanding the magnitude of these changes is important for the design of social safety nets. For example, on October 22, 2004, the U.S. Congress passed the American Jobs Creation Act of 2004. The act contains a provision to encourage profit repatriation back to the United States by multinationals—explicitly for the purpose of job creation at home. Yet the evidence linking offshore activities to falling domestic labor demand is in fact unclear. Bernanke (2006) emphasizes the need to identify losers and compensate them for the costs of increasing competition as a way to ensure that support for free trade continues.

In this paper, we use a standard labor demand equation to identify the effect of offshoring on home employment. We allow different degrees of substitution (or complementarity) depending on the motive for offshoring and whether offshoring takes place in high- or low-income affiliate locations. We differentiate between the motives for offshoring using the following measures of vertical integration between parents and their affiliates: imports from foreign affiliates, exports for further processing, exports for resale, and export platform offshoring. At the same time, we control for other confounding changes, such as other factor price changes, demand shocks, and technological change. To address the possibility that methodological differences might be driving the conflicting results described above, we also estimate wage elasticities using a translog specification and a constant elasticity of substitution specification.

We find that the insights derived from trade theory go a long way toward explaining the apparently contradictory evidence on the relationship between offshoring and domestic manufacturing employment. Before controlling for the degree of vertical integration, we find that affiliate employment in low-income countries substitutes for domestic employment: a 10 percentage point reduction in wages in low-income countries is associated with a 1% reduction in U.S. parent employment. However, for parents that export significant amounts of goods to low-income countries for further processing, foreign wage reductions are associated with an increase in domestic employment. Conversely, for parents that export significant amounts of goods to high-income countries for further processing, foreign wage reductions are associated with decreases in parent employment. Using data on affiliate employment composition in the computers and electronics sector, the sector with the highest share of exports for further processing, we show that the results differ across high- and low-income affiliate locations, in part because the tasks performed in these locations are very different. Tasks performed by affiliates in

TABLE 1.—EMPLOYMENT BY U.S. MULTINATIONALS, 1982–1999

	1982	1989	1994	1999
<i>Parent employment</i>				
BEA manufacturing ^a	11,758	10,706	9,622	7,954
Our sample ^b	10,689	9,668	9,104	7,564
<i>Affiliates</i>				
Employment in high-income countries	2,595	3,171	3,048	2,903
Employment share of total in high-income countries	18%	22%	22%	24%
Employment in low-income countries	1,064	1,405	1,584	1,868
Employment share in low income countries	7%	10%	12%	15%
Total affiliate employment	3,659	4,576	4,632	4,772
Employment share of all affiliates	26%	32%	34%	39%

^aMataloni (1995) and Mataloni and Yorgason (2006). Employment is industry of parent and includes petroleum extraction.

^bOur totals differ and/or R&D

high-income locations are similar to those performed in the United States, while tasks performed in low-income locations are significantly different or complementary to those performed in the United States.

We also find that imports from foreign affiliates do not affect the relationship between domestic employment and affiliate wages. This is true regardless of whether the imports come from high- or low- income countries. This is possibly due to data limitations, which we discuss in the text. We find some evidence that exports for resale are complementary with domestic employment. Finally, we show that export platform offshoring is a prominent feature of almost all industries and firms. Thus, we are unable to separately detect a significant effect of export platform offshoring on domestic employment.

By combining our point estimates with changes in variable means, we show that offshoring is not the primary driver of declining domestic employment of U.S. manufacturing multinationals between 1977 and 1999. Declining domestic employment of U.S. multinationals is primarily due to falling prices of investment goods such as computers, which substitute for labor. Other contributing factors include rising domestic wages and increasing import competition. Our research highlights both the importance of heterogeneous firm responses to opportunities for direct investment abroad and the need to account for other avenues through which international competition affects U.S. labor demand.

Our results are consistent with the literature that focuses on the impact of international trade on U.S. jobs. Revenga (1992) finds a negative impact of changes in import prices on U.S. employment growth. Katz and Murphy (1992) also find that increased import competition negatively affected relative labor demand in the United States, particularly in the 1980s with the increase in the U.S. trade deficit. Borjas, Freeman, and Katz (1997) find that increased trade with developing countries depresses wages at the bottom of the income distribution. Bernard, Jensen, and Schott (2006) examine the impact of U.S. imports on both the survival and employment of U.S. manufacturing firms. They find that imports harm U.S. manufacturing employment only when those imports are from low-wage countries.

This paper also helps to clarify the reasons for the discrepancies in results across previous papers on this topic. First,

previous studies have asked different questions. For example, Brainard and Riker (2001) use a factor demand approach to show that labor employed by affiliates overseas substitutes at the margins for labor employed by parents at home, but they emphasize that the results differ depending on geographic location. In particular, they emphasize strong substitution between workers at affiliates in developing countries, with workers in countries like Mexico and China competing for jobs with each other. Borgia (2005) and Desai Foley, and Hines (2009) ask a different set of questions. Borgia (2005) examines simple correlations between measures of offshoring and parent employment and makes no attempt to disentangle the relative importance of offshoring compared to other factors that determine domestic employment. Desai et al. (2009) focus on the correlation between expansion in activity at home and abroad. They show a positive association between growth in domestic investment, assets, employment, and total compensation for multinational parents and their foreign affiliates.

Second, previous studies have used a variety of different methods. While Desai et al. (2009) adopt an instrumental variable approach to estimate the association between growth in employment at home and abroad for U.S. multinationals, Muendler and Becker (2009) and Brainard and Riker (1997) estimate translog factor share equations. Using German multinational data, Muendler and Becker (2009) also explore the importance of selection into affiliate locations for the consistency of their estimates.

Third, previous empirical studies on employment and offshoring have not distinguished the differing motivations for foreign investment. Theoretical models of trade and foreign investment imply that different types of foreign investments will be associated with different kinds of effects on domestic labor demand. There is currently no agreement in the theoretical literature on whether horizontally integrated foreign investment (H-FDI) or vertically integrated foreign investment (V-FDI) is more likely to lead to domestic job losses.

An early version of the V-FDI model is presented in Helpman (1984). In the Helpman framework, there is an equilibrium where the parent (the headquarters) imports low-wage goods and exports headquarters services. In such a world, domestic demand for labor to produce the homoge-

neous good in the headquarters country would fall, and wages would continue to decline until factor price equalization is eventually achieved. Such a framework implies that under some initial relative endowments, V-FDI can be associated with intrafirm imports of low-wage goods, largely invisible exports from headquarters of intangibles such as management skills and knowledge arising from product-specific R&D conducted at home, falling domestic demand for unskilled labor, and falling domestic wages.

Markusen (1989) presents an alternative model in which V-FDI is associated with rising labor demand at home. In Markusen, domestic and foreign specialized inputs are complements by design, and trade generates welfare gains by increasing the number of specialized inputs (which are produced under increasing returns to scale technology) available. There are also models that focus on the implications for labor demand of V-FDI versus H-FDI. Markusen and Maskus (2001) show how different incentives for foreign investment lead to different organizational structures, which should produce different degrees of substitution between employment at home and abroad. Horizontal multinationals, defined as firms that produce the same products in different locations, are primarily motivated by trade costs to locate abroad.¹ For H-FDI, investment abroad substitutes for parent exports, and foreign affiliate employment should substitute for home employment. In their framework, V-FDI leads to complementarity between trade and foreign investment. Vertically integrated enterprises are motivated by factor endowment differences (and, consequently, factor price differences in a world where there is no factor price equalization) to locate different components of production in different locations. As Brainard and Riker (1997) pointed out, one implication of this type of modeling approach is complementarity between parent and affiliate employment.

The remainder of this paper is organized as follows. In section II, we describe the Bureau of Economic Analysis data on outward direct investment and our choice of sample. Section III describes the empirical framework and discusses econometric issues. Section IV presents the results, and section V concludes.

II. The BEA Data

We analyze firm-level surveys on U.S. direct investment abroad, collected each year by the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce. The BEA collects confidential data on the activities of U.S.-based multinationals, defined as the combination of a single U.S. entity that has made the direct investment, called the parent, and at least one foreign business enterprise, called the foreign affiliate. We use the data collected on majority-owned, nonbank foreign affiliates and nonbank U.S. parents for the benchmark years from 1982 and 1999. These bench-

mark years (1982, 1989, 1994, and 1999) include more comprehensive information than the annual surveys do.²

Creating a panel using the benchmark years of the BEA survey data is a nontrivial task for several reasons. First, not all firms are required to report to the BEA, and reporting requirements vary across years. Second, we must consider the implications of the changes to the Standard Industrial Classification (SIC) codes in 1972 and 1987 and the switch from SIC codes to the North American Industrial Classification System (NAICS) codes in 1997. The fact that parents are allowed to consolidate information for several affiliates in one country on a single form calls for special care in the aggregation and interpretation of affiliate-level data.

All foreign affiliates with sales, assets, or net income in excess of a certain amount in absolute value must report their data to the BEA. This amount was \$3 million in 1982, 1989, and 1994 and rose to \$7 million in 1999. In addition, a new reporting requirement was imposed on parents in 1999. Parents whose sales, assets, or net income exceeded \$100 million (in absolute value) were required to provide more extensive information than parents whose sales, assets, or net income fell below that level.³ To determine whether the changes in reporting requirements made small firms overrepresented in our sample in the early years, we imposed a double filter on the data using the uniform cutoff for affiliates (based on the strictest reporting requirement of \$100 million in 1999) of \$5.59 million in 1982 U.S. dollars and \$79.87 in 1982 U.S. dollars for parents. As it turns out, the reporting requirements were large enough that imposing the filter on the data makes little difference on our initial results. Therefore, we use all of the available data.

Finally, we face selection issues with our sample of manufacturing firms.⁴ We keep those parents whose primary

² While the BEA collects annual data on U.S. direct investment abroad, these data do not include all the variables we need and can find in the benchmark years.

³ Parents that do not meet this cutoff but have affiliates that meet the \$7 million cutoff are still required to provide extensive information for affiliates.

⁴ To document what has happened within industries in manufacturing over time, we created a concordance that allows us to assign SIC codes to NAICS codes. This was necessary because in 1999, the BEA collected data on NAICS codes and not SIC codes. We chose to convert SIC codes to NAICS codes since all future information will be collected on the basis of NAICS codes. For example, data for the benchmark year 2004 will be available shortly and firms report based on NAICS codes. The 1977 and 1982 benchmark years are based on the 1972 SIC codes. The 1989 and 1994 benchmark years are based on the 1987 SIC codes. The 1999 benchmark data are based on the 1997 NAICS codes. In addition to the fact that the industry codes are not directly comparable across all benchmark years, the BEA industry codes have been slightly modified to reflect the fact that these are enterprise data and are called, respectively, SIC-ISI and NAICS-ISI. Working with these codes, we created a program (available on request) that assigns the SIC-ISI codes for the years 1977 to 1994 to NAICS-ISI codes. Both parents and affiliates are classified into their primary industry of sales using the following algorithm, which tracks the algorithm used by the BEA: the top five industries by parent or affiliate sales are used to assign to each parent or affiliate one of the 22 aggregates. Sales are collapsed into the top five industries of sales, and then the maximum sale by industry is identified. A parent or affiliate is classified as being in manufacturing if its maximum sales across the top five industries of sales is in manufacturing.

¹ For simplicity, we will occasionally refer to horizontally integrated firms as horizontal firms and vertically integrated firms as vertical.

industry of sales is manufacturing, since our goal is to determine whether manufacturing jobs at home are being replaced by manufacturing jobs abroad. However, some parents were reclassified from manufacturing to wholesale trade and services. To account for this, we keep all parents that were ever classified in manufacturing and their affiliates.⁵

Table 1 reports the number of manufacturing employees of U.S. manufacturing parents in both the United States and foreign affiliate locations. U.S. employment of manufacturing parents declined from nearly 12 million in 1982 to slightly below 8 million in 1999. The second row of table 1 shows the employment coverage of our sample after we performed the cleaning procedures described above. The sample size remains almost the same, particularly in the later years. Almost all of the increase in foreign affiliate employment occurred in low-income affiliate locations.

The share of U.S. multinational employment concentrated in affiliates increased from 26% in 1982 to 39% in 1999. Although total affiliate employment increased by more than 1 million employees, the foreign employment gains did not fully offset the domestic losses. This suggests other important determinants of falling domestic employment for U.S. multinationals. Alternative explanations, which we incorporate into our empirical framework, include changing prices of capital, labor-saving technical change, and increased import competition.

Manufacturing multinationals reporting to the BEA accounted for the majority of economic activity in U.S. manufacturing during the sample period. Table A1 reports the coverage of the BEA data for benchmark years 1982 through 1999. In 1982, gross product by these enterprises accounted for over 80% of total manufacturing and 77% of manufactured exports in the United States. By 1999, the BEA's coverage had declined slightly: these enterprises accounted for only 63% of U.S. exports and about half of manufacturing employment. These firms also accounted for more than 80% of total private U.S. research and development expenditures throughout the sample period (Mataloni & Fahim-Nader, 1996). Table A1 also shows that the proportion of services that firms accounted for by the BEA sample is extremely small. During the sample period, the BEA sample accounted for only between 6% and 8% of total gross product in services. Consequently, we restrict our analysis to manufacturing, which we believe provides a more representative sample.

⁵ A number of parents have been reclassified from manufacturing to wholesale trade and services. For example, several firms were in manufacturing but are now classified in wholesale trade because almost all of their manufacturing is done overseas, not in the United States. To account for this, we chose our sample in two different ways. First, we included parents that were either classified in manufacturing or had previously been classified in manufacturing and their affiliates. Next, we included only parents that were currently in manufacturing in any given year and their affiliates. Since the results are not sensitive to this distinction, we use the larger of the two samples, keeping all parents that were ever classified in manufacturing and all of their affiliates.

How reliable are these data? These are the only data officially collected by a U.S. government agency on affiliate activity abroad. We have initiated a number of data checks to analyze the reliability of the coverage.⁶ We were able to cross-check the employment numbers for U.S. affiliate activity reported by the BEA with data on inward foreign investment reported by the official statistical agencies in Germany and Sweden. These checks are reported in Table A2. We report total employment in both countries as indicated by the BEA database and show that it is quite close to the numbers collected by the national statistical agencies. Although there are some discrepancies between BEA and German and Swedish data, this may be at least partially accounted for by variation in reporting based on fiscal year versus calendar year. The BEA classifies a firm in 1999 if its fiscal year ends in 1999—this could be for any month in 1999. Although most firms have their fiscal year ending in December, enough have earlier end dates that some of the 1999 BEA employment figures correspond to a mix of the 1998 and 1999 employment figures reported by the statistical bureaus for Sweden and Germany.

III. Empirical Framework

Previous work has used very different econometric models to specify the impact of foreign affiliate activity on labor demand at home, making it difficult to identify whether the conflicting results stem from different approaches or different data sets and time periods. Brainard and Riker (1997) estimate labor demand as a function of wages in different locations, Desai et al. (2009) estimate a reduced-form equation with growth in log labor at home as a function of log labor abroad, and Brainard and Riker (2001), Hanson, Slaughter, and Mataloni (2001), and Muendler and Becker (2009) use a short-run translog cost function approach to derive factor shares as a function of wages in different locations. Katz and Murphy (1992) and Card (2001), focusing on the effects of immigration and trade, both use a CES functional form to derive an equilibrium relationship between the ratio of employment at home to employment abroad and the ratio of wages at home to wages abroad.

We chose to derive labor demand from a generalized cost function as our primary specification. Our preferred approach is attractive for several reasons. It puts minimal restrictions on the nature of the production function, unlike the CES specification, which imposes a constant elasticity of substitution across different factor inputs. Our approach is also more flexible than previous approaches in the

⁶ We are particularly grateful to Marc Muendler and Karolina Eckholm for helping us do this cross-checking. They provided the data on the activities of U.S. multinational affiliates in Germany and Sweden. We also contacted Statistics Canada to check whether they record information on affiliates of U.S. multinationals in Canada, which would allow us to cross-check U.S. data on foreign affiliates there with Canadian data on inward foreign investment. Statistics Canada informed us that they do not gather data on affiliates because it is too difficult to define a foreign affiliate and referred us to the BEA.

offshoring literature that have imposed a short-run cost function and kept capital inputs fixed. In the translog approach, we worry that identifying elasticities of substitution or complementarity and calculating standard errors is a less transparent process (depending, among other things, on the choice of factor shares) than estimating a labor demand equation. However, for completeness, we also derive estimating equations using a generalized translog and CES function approach. We shall see that the implied elasticities of complementarity (or substitution) are remarkably robust across these different specifications.

Modifying Hamermesh (1993), let us consider a firm using N domestic factors and N^* foreign factors of production $X_1, \dots, X_N, X_{1^*}, \dots, X_{N^*}$. We begin by assuming there are only two locations (domestic and foreign) but will generalize to j locations in the empirical specification that follows. Let the production function for a U.S. multinational firm i producing total aggregate worldwide output Y_i and using N domestic and N^* foreign inputs X_i and X_{i^*} be

$$Y_i = f(X_{1i}, \dots, X_{Ni}, X_{1i^*}, \dots, X_{Ni^*}). \quad (1)$$

Output Y can include production at home and abroad, and production could be exported or sold on domestic markets. Then the associated cost function, based on the demands for X_1 through X_N and X_{1^*} through X_{N^*} is given by

$$C_i = g(w_{1i}, \dots, w_{Ni}, w_{1i^*}, \dots, w_{Ni^*}, Y_i), \quad (2)$$

where the w_i 's and w_{i^*} 's are the N and N^* input prices at home and in the foreign affiliate location. One can use Shepard's lemma to derive the factor demand for the n th input for U.S. multinational firm i :

$$X_{ni} = X_{ni}^d(w_{1i}, \dots, w_{Ni}, w_{1i^*}, \dots, w_{Ni^*}, Y_i), \quad (3)$$

$$n = 1, \dots, N, n^* = 1, \dots, N^*.$$

Our first approach will be to estimate a log-linear version of equation (3), focusing on U.S. labor demand and extending this equation to allow three locations. With three locations, there are three types of labor inputs: home labor, foreign labor in low-income affiliates, and foreign labor in high-income affiliates. This framework is flexible enough to allow a range of production technologies, including Brainard and Riker's (1997) assumption that production is vertically decomposed across high-wage and low-wage regions. We also allow two other types of inputs, making the total number of inputs N in each location equal to three: labor, physical capital, and research and development inputs. As with wages, we allow physical capital and research and development inputs to be separately identified depending on location.

One estimation issue that arises is that global output Y for firm i is jointly determined with domestic U.S. employment. If we were to estimate equation (3) directly, we

would have a significant simultaneity problem. We solve this by assuming that aggregate worldwide output Y for firm i is a function of domestic and foreign prices:

$$Y_i = Y(P, P^*).$$

Substituting this into equation (3) yields

$$X_{ni} = X_{ni}^d(w_{1i}, \dots, w_{Ni}, w_{1i^*}, \dots, w_{Ni^*}, P, P^*), \quad (4)$$

$$n = 1, \dots, N, n^* = 1, \dots, N^*.$$

Our first set of estimating equations is based on log-linearization of equation (4), generalizing to j locations, and takes the following form:

$$\ln L_{iht} = \beta_0 + \sum_j \alpha_j \ln P_{jt} + \sum_j \eta_j w_{ijt} \quad (5)$$

$$+ \sum_j \omega_j r_{ijt} + \sum_j \chi_j t_{ijt} + d_t + f_i + \varepsilon_{ijt}.$$

The dependent variable $\ln L$ is the natural logarithm of net annual employment by the U.S. parent in the United States, the P 's are final goods prices, w is the wage in location j and time t , r is the price of capital in location j and time t , and t is the price of research and development goods. We allow for time effects d and a firm-specific (common to the parent and its affiliate) fixed effect f_i , which takes into account both firm-specific productivity differences and other nonvarying firm characteristics, while j indexes location and t indexes time.

A. Identifying the Motives for Offshoring

Markusen and Maskus (2001), in their comprehensive survey of general equilibrium approaches to the multinational firm, define horizontal multinationals as "firms that produce the same product in multiple plants, serving local markets by local production." This definition of horizontal integration implies that intrafirm trade will be low, since foreign investment substitutes for U.S. exports. Vertical firms are defined as "firms that fragment the production process into stages based on factor intensities and locate activities according to international differences in factor prices." An important finding of Markusen and Maskus is that foreign investment replaces trade in the case of horizontal multinationals but is positively correlated with trade in the case of vertical foreign investment. Although we cannot directly test the motivation for foreign investment with our data, our data set is rich enough that we can construct credible proxies to help us distinguish between different motives for offshoring.

Conceptually, there is a clear distinction between horizontal FDI (H-FDI) and vertical FDI (V-FDI). In practice though, firms often do both simultaneously. And within the class of V-FDI, there is a range of activities, including resales FDI and export platform FDI. To get at these nuances empirically, we compute a variety of measures of

TABLE 2.—DEFINING HORIZONTAL AND VERTICAL FOREIGN DIRECT INVESTMENT

Measures of Vertical Integration as Share of Parent Sales: Coefficient Estimates from Regression of Measure of Vertical Integration on Industry Dummies				
Industry (97 NAICS code)	Imports from Foreign Affiliates	Exports for Further Processing	Exports for Resale	Share Affiliate Production Exported
Textiles and Apparel	0.007**	−0.006	−0.019	0.321**
Food	0.005	−0.006	−0.021	0.044
Beverages and Tobacco	0.018**	−0.011**	−0.021	0.195**
Leather Products	0.002	−0.014**	0.001	0.152
Wood Products	0.041**	0.005	−0.019	0.149**
Paper	−0.004	−0.006	−0.021	0.144**
Chemicals	0.009**	0.029**	−0.005	0.071**
Plastics and Rubber	0.001	0.012**	−0.017	0.066*
Nonmetallic Minerals	0.009**	−0.000	−0.021	0.198**
Primary Metals	0.009**	0.004	−0.018	0.134**
Fabricated Metals	0.005	0.009**	0.007	0.061*
Machinery	0.015**	0.035**	0.000	0.111**
Computer and Electronics	0.034**	0.097**	0.027	0.131**
Electrical Equipment	0.013**	0.017**	−0.007	0.031
Transportation Equipment	0.019**	0.011**	−0.016	0.122**
Toys, Dolls & Miscellaneous	0.015**	0.042**	0.001	0.076**
Constant	0.009**	0.022**	0.019**	0.265**
Number of observations	4,338	4,338	4,338	4,338
R ²	0.049	0.189	0.025	0.027

The constant term is the mean for Petroleum and Coal since it is the omitted industry. **Indicates that the within-industry mean is statistically significantly different from the constant term at the 1% level. For a detailed description of which industries are included in Miscellaneous, see <http://www.census.gov/eped/naics/NAICS33C.HTM#N339>.

vertical integration at the firm level and interact these firm-level measures of vertical integration with our wage variables in our estimating equations. The firm-specific measures of vertical integration are calculated as the mean of the measure of vertical integration over the entire sample period so as to avoid the endogeneity problem associated with including measures of intrafirm trade as explanatory variables. The alternatives to defining vertical integration at the firm level are to define vertical integration as the beginning-of-period level or to define it at the industry level. Both of these approaches have significant drawbacks. The first ignores changes over time in vertical integration, and the second masks significant within-sector firm heterogeneity. Thus, our preferred measure is the firm-level measure of vertical integration.

To get a sense for what determines the various types of vertical integration, we regress each of our measures of vertical integration on a set of industry dummies clustering the standard errors at the industry level. Table 2 presents the coefficient estimates from this regression. Petroleum and Coal Products is the omitted industry so that the constant term is the mean of the dependent variable for firms in the Petroleum and Coal Products industry. All of the other coefficients should be interpreted relative to the constant term. For example, over the entire sample period, the mean of imports from foreign affiliates as a share of parent sales in Textiles and Apparel is 0.009 plus 0.007 or 0.016 and is significantly greater than the mean for Petroleum and Coal Products at the 99% level. Each column represents a different measure of vertical integration: the dependent variable in column 1 is total imports from foreign affiliates, the depen-

dent variable in column 2 is exports to foreign affiliates for further processing, the dependent variable in column 3 is exports to affiliates for resale, and the dependent variable in column 4 is the share of affiliate production that is exported.

Only one industry stands out as notable for the share of affiliate production exported: textiles and apparel. In textiles and apparel, the mean share of affiliate production exported is 58.6%. This is reassuring in that it is consistent with what we know about the textile and apparel industry. We omit the results for total exports to foreign affiliates because they closely resemble the results in column 2, indicating that the cross-industry variation in exports to foreign affiliates is driven by the variation in exports for further processing. Exports for resale vary little across industries.

Like Hanson, Mataloni, and Slaughter (2005), our preferred measure of the type of vertical integration characterized by a fragmentation of the production process across various locations in response to factor cost differences is exports for further processing. Unfortunately, the BEA does not record information on whether imports from foreign affiliates are final goods imports or imports of intermediate goods, making it difficult to interpret these numbers. Nevertheless, we report both sets of statistics for the sake of completeness. Grossman and Rossi-Hansberg (2007) also use intrafirm trade to quantify the increase in vertical activities of multinationals, pointing out that intrafirm trade “mostly reflects the international division of labor within multinational enterprises.” By this measure of vertical integration, the computer and electronics industry clearly stands out as the most vertically integrated industry with exports to affiliates for further processing at roughly 12% of sales.

Finally, much horizontal FDI is motivated by trade barriers (such as tariffs or quotas). Textiles and apparel and beverages and tobacco are typically the most protected sectors in both industrial and developing countries. Evidence to support this for developing countries can be found in Harrison and Hanson (1999). Tariffs in the United States are currently at very low levels. However, prior to trade liberalization (1979, for example), trade frictions for the United States followed the same pattern. They were highest for textiles and apparel, beverages and tobacco, leather, and nonmetallic minerals (cement). These patterns imply that firms in highly protected sectors (textiles and apparel) or in sectors with high costs of transportation (cement) must frequently engage in horizontal investments in order to access domestic foreign markets.

B. Data and Estimation Issues

To estimate equation (5), we need data on U.S. employment, capital prices, wages, final goods prices, and research and development prices. We also need factor prices and output prices for each of the j locations in which the multinational firm has operations. We measure U.S. employment as the (log) number of individuals employed by the parent in the United States, since hours or even employment broken down by skill levels are not collected for U.S. parents. Domestic prices of investment are defined at the disaggregated industry level and are taken from the NBER's manufacturing database. Domestic U.S. wages are computed at the industry level using both the BEA and UNIDO data sets (see the discussion below). And finally, domestic final goods prices are captured by the log of industry sales deflated by the producer price index.

While in principle there could be as many factor and final goods prices as there are countries in the BEA database, in practice the number of j locations is limited by data availability and the need for parsimony in estimation. We restrict our j locations to three: domestic (U.S.) activity, high-income locations, and low-income locations. One problem is that many firms, especially small enterprises, do not have any operations in low-income countries. To permit us to include these firms in the estimation, we set wages for these firms equal to 0 and add a dummy variable indicating whether the firm has a missing observation for low-income affiliates.

Our proxy for final goods prices abroad is the log of affiliate sales deflated by the foreign price index. Our measure of foreign investment prices comes from the Penn World Tables. While in principle all foreign factor prices should be broken down into low-income foreign and high-income foreign affiliate locations, collinearity in investment and consumption prices has led us to aggregate these prices across foreign affiliate locations. Because both capital and goods are significantly more mobile than individuals, the factor price differentials across high- and low-income affiliate locations are much larger for labor inputs.

To control for exposure to international competition, we use data on import penetration made available at the four-digit ISIC level by Bernard et al. (2006). We also include a measure of import penetration from low-wage countries, also computed by these authors. These measures of import competition include imports of final goods as well as imported intermediate inputs. To the best of our knowledge, no time-series data are available for the period 1982 to 1999 that separately identify final goods imports from imported intermediate inputs. However, even if there were, existing evidence suggests that it would be very difficult to disentangle the two effects. This is because the aggregate trends over time in the two series are highly correlated both over time and across industries. (See figures 4 and 5 of Ebenstein, et al., 2009, for the time-series correlation.) Our own calculations show that for the period 1997 to 2005, the correlation in the two measures across industries is 0.85.

We do not have adequate measures of prices for research and development goods. However, we believe that these are important inputs into production and could account for a significant impact on manufacturing employment, particularly if research and development inputs are associated with labor-saving technical change. Consequently, we proxy for prices of research and development goods with research and development spending as a share of parent sales. Though there are other ways to measure R&D (for example, R&D spending per R&D employee by country), none are well suited to our analysis because they severely limit sample size.

Since wages are calculated at the country level using BEA aggregates of the firm-level measures, we assume that wages are exogenously determined. However, we also test for the validity of this assumption by using wages collected by UNIDO. Following Hanson et al. (2005), wages are employment-weighted averages of wages in high- and low-income affiliates, where the weights are given by the competitor's share of employment within countries belonging to each high- and low-income category. We use competitor's wages to avoid the endogeneity problems associated with using the parent's own employment choices. Affiliate country locations are defined as either high or low income based on the World Bank's country classifications (see table A8).

IV. Results

We report sample means in table 3. Consistent with the trends in table 1, parent employment fell over the sample period by 20%. Real wages in the sample went up in the United States by 11.6% and in high-income affiliate locations by 22.9% but fell by 21.5% in low-income affiliate locations. Table A8 shows that the annual average changes in wages and employment in the manufacturing sector reported by UNIDO are similar to what we find using the BEA data. Apart from East Asia, the numbers in table A4 show real wage declines in low-income countries of between 1% and 2% per year and employment gains of

TABLE 3.—SUMMARY STATISTICS

Variable	No. of Observations	Mean	Standard Deviation	Change in Mean, 1982–1999
Log U.S. Employment	3,946	7.558	1.673	−0.204
Log U.S. Manufacturing Wages, BEA	3,946	3.331	0.398	0.116
Log High-Income Affiliate Wages	3,946	3.158	0.487	0.229
Log Low-Income Affiliate Wages	3,946	2.044	0.794	−0.215
Log U.S. Price of Investment, NBER Manufacturing Database	3,946	0.698	0.067	−0.276
Log Foreign Price of Investment, Penn World Tables (PWT)	3,946	0.629	0.318	−0.099
U.S. R&D Expenditure (% Sales)	3,946	0.037	0.052	0.011
High-Income Affiliate R&D Expenditure (% Sales)	3,946	0.006	0.018	0.004
Low-Income Affiliate R&D Expenditure (% Sales)	3,946	0.001	0.004	0.000
Import Penetration, Bernard et al. (2006)	3,946	0.174	0.118	0.121
Import Penetration from Low-Income Countries, Bernard et al. (2006)	3,946	0.059	0.065	0.059
Log Parent Sales by Industry	3,946	12.286	0.923	0.109
Log Affiliate Sales by Industry	3,946	9.363	0.557	0.314
Imports from Foreign Affiliates (% Sales)	3,946	0.027	0.069	0.021
Exports for Foreign Affiliates (% Sales)	3,946	0.051	0.158	0.023
Exports for Further Processing (% Sales)	3,946	0.031	0.111	0.022
Exports for Resale (% Sales)	3,946	0.021	0.105	0.006
Share of Affiliate Production Exported	3,946	0.366	0.331	−0.005

between 2% and 9% per year over the sample period. Similar to the BEA numbers, the UNIDO statistics for high-income countries show average real wage increases of .41% per year and average employment declines of .68% per year.

Research and development expenditure as a share of parent sales averaged 3.7% for U.S. parents, .6% for affiliates in high-income countries, and .1% for affiliates in low-income countries. R&D spending as a share of sales rose significantly in the United States and in high-income affiliate locations but changed very little in low-income affiliate locations.

Average import penetration in the four-digit SIC sector over the period was 17.4% and increased by 12.1 percentage points over the sample period. Average import penetration from low-wage countries increased by 5.9 percentage points over the sample period. The real price of investment fell by 27.9 percentage points over the period in the United States and 9.9 percentage points abroad. These price declines reflect in part the importance of falling computer-related costs for these firms. Industry sales in the United States increased by 10.9% in the United States and by 31.4% abroad, reflecting the growing importance of overseas markets for U.S. multinationals.

A. Fixed Effect Results for Labor Demand

We report the results of estimating equation (5) in table 4. The log of U.S. employment is our dependent variable, and we use a within transformation of the data to eliminate firm fixed effects. All specifications include time dummies to control for year-specific shocks. Column 1 of table 4 reports coefficient estimates without controlling for the motives for offshoring. In each of columns 2 through 5, we interact different measures of vertical integration with our wage variables to test whether the motive for offshoring

affects the impact of offshoring on domestic employment. Our measures of vertical integration between parents and affiliates are imports from foreign affiliates (column 2), exports to affiliates for further processing (column 3a), exports to foreign affiliates for further processing by destination (column 3b), exports to foreign affiliates for resale (column 4) and affiliate exports as a share of affiliate sales (column 5).

The results in column 1 indicate that employees in low-income affiliates are substitutes for U.S. employees. The point estimate of 0.097 on low-income affiliate wages indicates that a 1% fall in foreign wages would lead to a 0.097% fall in U.S. parent employment. The point estimate on high-income affiliate wages suggests the opposite: a 1% fall in high-income affiliate wage increases would be associated with a 0.006% increase in parent employment. However, the point estimate on wages in high-income countries is statistically insignificant. In columns 2 through 5, we allow the slope coefficients on our foreign wage variables to vary according to degrees of vertical integration as defined in table 2.

The coefficients on the interaction terms differ substantially depending on the definition of vertical integration. In columns 2, 4, and 5, the coefficients on the interaction terms are not significant. Thus, differentiating parents on the basis of total imports from foreign affiliates, exports for resale as a share of sales or the share of affiliate production exported provides no additional information regarding the degree of substitutability between domestic and foreign labor. By contrast, the results in columns 3a and 3b indicate that exports for further processing play an important role in determining margins of multinational labor substitution. The point estimate on low-income affiliate wages interacted with exports for further processing equals -3.127 and jumps to -3.915 when low-income affiliate wages are interacted with exports for further processing to low-income

TABLE 4.—WITHIN ESTIMATES OF LABOR DEMAND: U.S. PARENTS

	(1)	(2)	(3a)	(3b)	(4)	(5)
	Pooled	Imports from Affiliates	Exports for Processing	Exports for Processing	Exports for Resale	Export Platform FDI
Log U.S. Industrial Wages	−0.359 [0.042]**	−0.332 [0.045]**	−0.401 [0.047]**	−0.350 [0.041]**	−0.386 [0.045]**	−0.466 [0.114]**
Log Industrial Wages High-Income Countries	−0.006 [0.035]	−0.015 [0.038]	−0.036 [0.041]	−0.048 [0.049]	0.026 [0.038]	0.051 [0.086]
Log Industrial Wages Low-Income Countries	0.097 [0.016]**	0.097 [0.018]**	0.126 [0.019]**	0.104 [0.017]**	0.098 [0.018]**	0.057 [0.046]
Log Industrial Wages High-Income Countries × Vertical		0.316 [0.544]	1.185 [0.788]	1.741 [0.876]**	−1.803 [0.806]**	−0.098 [0.128]
Log Industrial Wages Low Income Countries × Vertical		−0.004 [0.392]	−3.127 [0.945]**	−3.915 [0.744]**	−0.043 [0.272]	0.064 [0.069]
Log of the U.S. Price of Capital	0.403 [0.175]**	0.393 [0.175]**	0.389 [0.175]**	0.589 [0.195]**	0.330 [0.184]**	0.398 [0.175]**
Log of the Foreign Price of Capital	0.187 [0.071]**	0.190 [0.071]**	0.172 [0.071]*	0.162 [0.061]*	0.185 [0.071]**	0.193 [0.071]**
Import Penetration	−0.232 [0.096]**	−0.232 [0.096]**	−0.232 [0.095]**	−0.192 [0.077]**	−0.237 [0.096]**	−0.232 [0.096]**
Import Penetration from Low-Wage Countries	0.081 [0.338]	0.094 [0.339]	0.112 [0.337]	0.181 [0.488]	0.053 [0.339]	0.076 [0.339]
R&D (% Sales)	0.834 [0.447]*	0.846 [0.447]*	0.896 [0.447]*	0.737 [0.311]*	0.791 [0.448]*	0.843 [0.448]*
R&D (% Sales) in High-Income Countries	1.516 [0.695]*	1.529 [0.695]*	1.453 [0.693]*	1.449 [0.599]*	1.488 [0.694]*	1.558 [0.695]*
R&D (% Sales) in Low-Income Countries	4.985 [2.413]*	5.046 [2.418]*	4.795 [2.406]*	4.949 [2.427]*	4.957 [2.413]*	4.956 [2.414]*
Log of Industry Sales	0.153 [0.029]**	0.154 [0.029]**	0.152 [0.029]**	0.142 [0.029]**	0.153 [0.029]**	0.153 [0.029]**
Log Affiliate Sales by Industry	−0.051 [0.041]	−0.049 [0.041]	−0.053 [0.041]	−0.033 [0.041]	−0.050 [0.041]	−0.049 [0.041]
Time dummy 1989	−0.028 [0.043]	−0.029 [0.043]	−0.034 [0.043]	−0.055 [0.044]	−0.033 [0.043]	−0.028 [0.043]
Time dummy 1994	−0.024 [0.060]	−0.026 [0.060]	−0.032 [0.060]	0.009 [0.061]	−0.034 [0.060]	−0.024 [0.060]
Time dummy 1999	0.080 [0.078]	0.075 [0.078]	0.068 [0.078]	0.115 [0.079]	0.064 [0.079]	0.079 [0.078]
Observations	3,946	3,946	3,946	3,946	3,946	3,946
R ²	0.09	0.09	0.09	0.09	0.09	0.09

Standard errors corrected for arbitrary heteroskedasticity are in brackets. *Significant at 5%, **Significant at 1%. Each of columns 2–5 includes an interaction term between the wage measures and vertical integration defined at the firm level as the mean of the variable in the column heading over the entire sample period. In column 3b, exports for further processing are broken down by location: exports to high-income countries are interacted with Wages in high-income countries, and exports to low-income countries are interacted with low-income country wages.

countries. These point estimates imply that for parents that export significant amounts of goods to low-income countries for further processing, domestic and foreign labor are complements. The point estimate on high-income affiliate wages interacted with exports for further processing is 1.185 but statistically insignificant in column 3a, but increases to 1.741 and becomes significant when interacted with exports for further processing to high-income countries. The implication of this last result is that workers in high-income affiliates substitute for U.S. workers in companies that export significant amounts of goods to high-income countries for further processing.

The own-wage elasticity, which varies between −0.33 and −0.47 across columns 1 through 5, suggests that a 1% increase in the domestic U.S. manufacturing wage reduces labor demand by 0.33% to 0.47%. The magnitude is in line with the dozens of studies cited in Hamermesh (1993), who reports that most studies find that the own-wage elasticity for labor lies between 0.3 and 0.7. The coefficient on the

industry-specific home price of investment is positive across all specifications, indicating that reductions in the price of domestic investment goods reduce domestic labor demand. The coefficient on investment abroad is similarly positive. These coefficient estimates imply that capital and labor are generally substitutes. This is consistent with a story in which less skilled workers are being replaced by capital (computers) and consistent with previous labor demand studies on capital-labor substitution cited in Hamermesh (1993).

Negative employment effects are also associated with increases in import penetration (arm's-length trade). The point estimates range from −0.192 to −0.237 across specifications, indicating that a 1 percentage point increase in import penetration during the sample period would imply a decline in U.S. manufacturing employment of 0.192 to 0.237 percentage points.

Positive employment effects are associated with our proxies for the prices of technology inputs, the share of

research and development expenditure in parent sales. The results indicate that a 1 percentage point increase in the parent research and development expenditure shares would be associated with employment increases between 0.737 and 0.896 percentage points. For affiliates in high-income locations, a 1 percentage point increase in the affiliate research and development share is associated with employment increases between 1.449 and 1.558 percentage points. For affiliates in low-income locations, a 1 percentage point increase in the affiliate research and development share is associated with employment increases between 4.795 and 5.046 percentage points. In spite of the very large point estimates on affiliate research and development expenditure shares, the changes in means in table 4 make it clear that R&D activities in affiliates have not had an economically significant impact on U.S. parent employment.

Positive employment effects are also associated with our proxies for final goods prices in the United States, the log of the real value of industry sales. The results indicate that a 1 percentage point increase in final goods prices would be associated with employment increases between 0.142 and 0.152 percentage points. Negative but statistically and economically insignificant employment effects are associated with increases in final goods prices abroad: a 1 percentage point increase in our proxy for final goods prices abroad is associated with employment declines of between -0.033 and -0.053 percentage points.

The net effect of vertical integration as measured by exports for further processing is equal to the coefficient on low- (high-) income affiliate wages plus the coefficient on the interaction between low- (high-) income affiliate wages multiplied by the value of vertical integration at different points in the distribution. The net effect of offshoring to low-wage countries is nonmonotonic and turns positive only for the last two quartiles of the distribution. Thus, the employment effects of offshoring to low-wage countries are positive only for firms that export significant amounts of goods to low-wage countries for further processing. Column 2 of table 2 shows that, on average, these firms are most likely to be in the computers and electronics industry.

The opposite signs on the interaction between wages and exports for further processing imply that employees of affiliates in high- and low-income countries must be performing different tasks. To check this, we use information on employee type for the computer and electronics industry for the four countries that received more than 80% of the share of exports for further processing in 1999: Canada, Mexico, China, and Brazil. Unlike parent employment, affiliate employment is recorded for the following categories: production workers, nonproduction workers, and research and development employees. Using this information, we computed for each country the share of production employees, nonproduction employees and research and development employees. The results in table 5 show that roughly two-thirds of all employees in the developing countries are production employees. By contrast, only around a

TABLE 5.—COMPOSITION OF EMPLOYMENT IN THE COMPUTER INDUSTRY, BY COUNTRY, 1999

	Canada	Mexico	China	Brazil
Production employees	39.10%	65.70%	62.60%	66.66%
Nonproduction employees	57.20	33.60	36.50	33.05
R&D employees	3.70	0.70	0.90	0.29
Total	100.00%	100.00%	100.00%	100.00%

third of the workforce in Canada is made up of production employees. Though we do not have the data to prove it directly, these results strongly suggest that employees in the computer and electronics industry in Canada perform tasks that are more similar to those of U.S. employees, while employees in Mexico, Brazil, and China perform tasks that are significantly different from the tasks that U.S. workers perform.

The critical parameters of interest in table 4 are the coefficients on affiliate wages and affiliate wages interacted with our measures of vertical integration, which indicate whether affiliate employment substitutes for or is complementary with home employment. In column 2 of table 6, we report results using an alternative definition of affiliate wages. Instead of constructing country-level wages from the BEA sample, we use country wages reported by UNIDO. Wages are calculated based on surveys administered by UNIDO, supplemented with secondary sources (such as national statistical agencies) gathered by UNIDO as well. Wages are calculated as compensation divided by number of employees, collected at the three-digit ISIC level (Revision 2). All values are converted to U.S. dollars using the IMF exchange rate series RF. As in table 4, we weight country-level wages using the parent's initial distribution of employment across affiliate locations when the parent first appears in the sample.

The results in table 6 are consistent with our earlier results, suggesting that the source for country-level wages does not affect our coefficient estimates. The coefficients on high- and low-income affiliate wages are the same sign and close in magnitude to the previous results. As before, the results indicate that offshoring to low-wage countries generally depresses home employment except for parents that export a significant amount of goods for further processing to low-wage countries. Negative employment effects are associated with offshoring to high-wage countries, and the magnitude of the effect is a function of the share of exports sent to high-wage countries for further processing.

B. Attrition Bias

We face potentially important selection problems. Between each benchmark year, roughly 20% of the parents drop out of our sample and do not reappear. If some of these firms relocate all operations abroad and close down their U.S. operations, then our estimates of the employment

TABLE 6.—IMPLIED ELASTICITY OF LABOR DEMAND ACROSS ALTERNATIVE SPECIFICATIONS

	(1)	(2)	(3)	(4)
Implied Elasticity of Labor Demand η_{ij} (% Change in Li in Response to % Change in wj)	Basic Specification (table 5)	Replacing BEA Wages with UNIDO wages	CES Specification	Translog Cost Function
<i>Coefficient estimates without controls for degree of vertical integration</i>				
Parent wages	-0.359	-0.287	—	-0.225
High-income affiliate wages	-0.006	-0.001	-0.007	-0.003
Low-income affiliate wages	0.097	0.102	0.081	0.112
<i>Coefficient estimates controlling for degree of vertical integration (exports for further processing)</i>				
Parent wages	-0.351	-0.299	—	-0.313
High-income affiliate wages	-0.048	-0.003	-0.007	-0.004
Low-income affiliate wages	0.104	0.122	0.091	0.132
High-income Affiliate Wages \times Vertical	1.741	1.666	1.765	1.701
Low-income Affiliate Wages \times Vertical	-3.915	-4.103	-3.221	-4.245

Coefficients taken from column 3b of table 4 and unreported coefficients for robustness checks including replacing BEA wages with UNIDO wages and using estimating equations based on CES and translog functional forms. Factor shares used to compute elasticities taken from sample means. All coefficients are significant at the 95% level, and standard errors for CES and translog coefficient estimates are bootstrapped.

costs of multinational activity could be downward biased. Following Wooldridge (2002), we test for survivorship bias by including a lead of the selection indicator $s_{i,t+1}$ in our estimating equations, where $s_{i,t+1}$ is equal to 0 for firms that do not exit the sample and switches from 0 to 1 in the period just before attrition. The coefficient on the lead of the selection indicator was negative and significant for both vertically and horizontally integrated firms. The significant and negative sign on the selection variable is a possible indicator that firms that exit the sample are those most likely to contract employment. To address this potential criticism, we correct for selection bias using two approaches: a Heckman-type selection correction and inverse probability weighting.

Following Wooldridge (2002) our first approach, a Heckman-type correction, models this selection problem as follows. If our equation of interest is given by

$$y_{it} = x_{it}\beta + u_{it}, t = 2, \dots, T,$$

then conditional on the parent reporting in the previous period, $s_{i,t-1} = 1$, we can write a reduced-form selection equation for $t \geq 2$ as

$$s_{it} = 1[w_{it}\delta_t + v_{it} > 0],$$

where, $v_{it}|\{x_{it}, w_{it}, s_{i,t-1} = 1\} \sim \text{Normal}(0, 1).$

In the context of panel data with an unobserved firm fixed effect and attrition, Wooldridge (2002) proposes as a solution a variant of a two-stage Heckman correction. In each period, Wooldridge proposes estimating a selection equation using a probit approach and calculating lambda, the inverse Mills ratio, for each parent i . Once a series of lambdas has been estimated for each year and parent, the estimating equations are augmented by these lambdas.

This approach is successful only if we can identify determinants of the binary selection variable s_{it} before the firm exits the sample (in period $t - 1$) that do not belong in the estimating equation. We identified candidate variables

using the insights derived from a class of models indicating that heterogeneity in productivity is a significant determinant of whether firms enter into international trade or foreign investment (see Melitz, 2003). These models suggest that only the most profitable firms are likely to engage in trade or foreign investment. Since we already control for output and factor price shocks using a variety of input and output prices, parent profitability in the previous period does not belong in the estimating equations (indeed, auxiliary regressions show that lagged profits from the benchmark surveys five years earlier do not predict current period employment). Consequently, we use as the excluded determinant of survival the parent's profitability in the previous period.

Table A5 reports the second-stage estimates using this two-step approach. The sample size decreases significantly, since implementing the selection correction eliminates the first time-series observation for each parent. The coefficients on the inverse Mills ratios are statistically insignificant across all specifications, indicating that selection is not biasing our results. Additionally, adding the inverse Mills ratio to control for selection does not change the sign and barely changes the point estimates on the coefficients of interest. The coefficients on affiliate wages in low-income countries remain positive and statistically significant across all specifications. The coefficient on the interaction between high-income affiliate wages and exports for further processing to high income countries is positive and significant, while the coefficient on the interaction between low-income affiliate wages and exports for further processing to low-wage countries changes sign depending on the degree of vertical integration.

We also explored using inverse probability weighting as outlined in Wooldridge (2002) to correct for selection bias. This approach consists of the following two-step procedure. In each time period, we estimate a binary response model for the probability of survival for the group in the sample at time $t - 1$. Using the fitted probabilities from the first step, we obtain the following weights:

TABLE 7.—CALCULATING THE IMPACT OF DIFFERENT ASPECTS OF GLOBALIZATION ON PARENT LABOR DEMAND

Factors Affecting U.S. Labor Demand	Impact of 1% Increase in Factor	Actual Increase in Sample	Percentage Change in Labor Demand	Keeping Only Significant Coefficients
	(1)	(2)	(3)	(4)
Log U.S. Industrial Wages	−0.351	0.116	−4.072	−4.072
Log Industrial Wages in High-Income Countries	−0.048	0.229	−1.099	
Log Industrial Wages in Low-Income Countries	0.104	−0.229	−2.382	−2.382
Log of U.S. Price of Capital	0.439	−0.276	−12.116	−12.116
Log of Foreign Price of Capital	0.162	−0.099	−1.604	−1.604
Import Penetration	−0.192	0.121	−2.323	−2.323
Import Penetration from Low-Wage Countries	0.181	0.059	1.068	
R&D Spending (% Sales)	0.737	0.011	0.811	0.811
R&D Spending in High-Income Countries (% Sales)	1.449	0.004	0.580	0.580
R&D Spending in Low-Income Countries (% Sales)	4.949	0.0001	0.049	0.049
Log of Industry Sales	0.142	0.109	1.548	1.548
Log of Affiliate Sales by Industry	−0.033	0.314	−1.036	
Log Industrial Wages in Low-Income Countries × Exports for Further Processing	−3.127	−0.008	2.502	2.502
Log Industrial Wages in High-Income Countries × Exports for Further Processing	1.741	0.005	0.871	0.871
Net Impact of All Above Variables			−17.204	−16.137

Coefficients in columns 1 are taken from column (3b) of table 4. Numbers in column 2 are taken from means table 4. Numbers in column 3 are calculated by multiplying by $100 \times \text{column 1} \times \text{column 2}$. Column 4 is calculated the same way as column 3, but only the coefficients that were significant in table 4 are reported. The final row net impact sums up all the previous effects.

$$\hat{p}_{it} = \hat{\pi}_{it} * \hat{\pi}_{i,t-1} * \dots * \hat{\pi}_{i,1},$$

where hats denote fitted probabilities. This methodology allowed us to choose covariates in the probits that are essentially everything we can observe for units in the sample at time $t - 1$ that might affect attrition. In our case, we included all of the regressors in our original model plus firm size, firm profitability, and the firm's share of employment in low-income countries. Using this approach also did not affect our estimates, and consequently we do not report them here.

In both cases, the first-stage results indicate that expansion into low-wage countries is positively correlated with the probability of firm survival. Thus, we find some evidence that the jobs lost as a result of offshoring might have been lost anyway. However, controlling for this possibility does not change the sign or magnitude of our wage elasticities in table 4.

C. Extensive and Intensive Margin

All of the results we presented examine activity at the intensive margin. As Muendler and Becker (2009) noted, expansion (contraction) of employment at existing affiliates—the intensive margin—may have different employment effects from opening (closing) new operations—the extensive margin. In what follows, we show that the vast majority of affiliate employment expansions and contractions take place at the extensive margin. Even in China where most of the employment expansion took place between 1994 and 1999, the activity took place at the intensive margin. Although there was significant entry into

China between 1982 and 1989, these affiliates had very few employees (11,000 in total) when they were established. Thus, this activity at the extensive margin in China between 1982 and 1989 could not have had much of an impact on parent employment between 1982 and 1989.

Before proceeding, we note an important data limitation. Parents can report affiliate activity on an aggregated basis or file separate reports for each affiliate. Because there is no way to distinguish this in the data, the only certain information is whether a parent is present in a particular country in a given time period. Therefore, the BEA statistics on affiliate activity could mask some underlying opening and closing of specific plants by the same parent.⁷

Table A6 shows entry and exit to and from low-wage countries where activity at the extensive margin is most likely to be an issue because of extensive deregulation in these countries over the sample period. The numbers represent counts of parents with affiliates in low-income countries, and the percentages indicate the percentage of affiliate employment in low-income countries accounted for by those affiliates. Each of the three panels shows activity between two consecutive years: 1982–1989, 1989–1994, and 1994–1999. For example, the top panel shows that between 1982 and 1989, thirty parents entered developing country markets for the first time. These thirty parents accounted for only 4.39% of the total employment expansion in low income affiliates. Table A7 shows that affiliate employment in low-income countries increased by around 353,978 between 1982 and 1989. Of this expansion, only

⁷ We take care of this in the data analysis by aggregating information for affiliates of parents in the same country year, thus making all of the affiliate data comparable.

15,539 jobs were a result of activity at the extensive margin. The magnitudes of activity at the extensive margin are even smaller for the periods 1989 to 1994 and 1994 to 1999.

Since Mexico accounts for more than a third of all affiliate employment in low-income countries, we repeat this exercise for Mexico in Table A6. Once again, the magnitudes of employment expansion and contraction at the extensive margin are small. Between 1982 and 1989, affiliate employment in Mexico increased by 288,012. Of this increase, only 10% or 28,012 jobs, were created at the extensive margin. Between 1994 and 1999, when the effects of NAFTA would be prominent, 87% of affiliate activity took place at the intensive margin, while only 6% of affiliate activity (or 9,180 jobs) took place at the extensive margin.

D. Alternative Specifications: Translog and CES Specifications

We also test for the robustness of our results to two alternatives: a framework based on a translog cost function and a framework based on CES production functions. The translog approach has been adopted by Brainard and Riker (2001), Hanson et al. (2001), and Muendler and Becker (2009). This alternative approach has the advantage that the translog cost function approximates many well-behaved cost functions. The translog total variable cost (TC) function (omitting time and parent subscripts) for wages W , investment prices r , research and development input prices t and output Y is given by

$$\begin{aligned} \ln TC = & \alpha_0 + \sum_j \omega_j \ln Y + \sum_j \alpha_{jw} \ln W + \sum_j v_j \ln r \\ & + \sum_j \alpha_{jA} \ln t + \frac{1}{2} \sum_j \sum_k \alpha_{jY} (\ln Y)^2 \\ & + \frac{1}{2} \sum_j \sum_k \xi_{jk} (\ln W)^2 + \frac{1}{2} \sum_j \sum_k \beta_{jk} (\ln t)^2 \\ & + \frac{1}{2} \sum_j \sum_k \omega_{jk} (\ln r)^2 + \sum_j \sum_k \vartheta_{jk} \ln W \ln r \quad (5) \\ & + \sum_j \sum_k \tau_{jk} \ln Y \ln t + \sum_j \sum_k \rho_{jk} \ln Y \ln W \\ & + \sum_j \sum_k \chi_{jk} \ln r \ln t + \sum_j \sum_k \phi_{jk} \ln r \ln Y \\ & + \sum_j \sum_k \kappa_{jk} \ln t \ln W + \varepsilon. \end{aligned}$$

Differentiating $\ln TC$ with respect to $\ln W_j$ according to Shepard's lemma and allowing for a firm fixed effect yields labor's share in total costs in location j for parent i at time t :

$$\begin{aligned} LSHARE_{ijt} = & \beta_0 + \sum_j \rho_j \ln Y_{ijt} + \sum_j \kappa_j \ln t_{ijt} \\ & + \sum_j \xi_j \ln w_{ijt} + \sum_j \vartheta_j \ln r_{ijt} + f_i + \varepsilon_{ijt}, \end{aligned} \quad (6)$$

where $LSHARE$ is defined as the cost share of labor expenditures in location j for parent i in time t , relative to expenditures on labor and capital across all locations. We impose the restrictions implied by the framework; in particular, it must be the case that the coefficients on factor prices sum to 0.

For completeness, we also consider aggregating capital and labor across locations using a CES function (Katz & Murphy, 1992, and Card, 2001, use this approach). Thus, we define L as

$$L_i = \left[\sum_j (e_{ij} N_{ij})^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \quad (7)$$

where e represents productivity shocks, L_i is the total quantity of labor used, and σ is the Allen elasticity of substitution between labor in location i and j and is defined below.⁸ Manipulation of the first-order conditions for profit maximization yields the following estimating equations:

$$\begin{aligned} \ln(L_h/L_{hif}) = & \sigma \ln \frac{p_h}{p_{hif}} + (\sigma - 1) \ln \frac{e_h}{e_{hif}} \\ & - \sigma \ln \frac{w_h}{w_{hif}}, \end{aligned} \quad (8a)$$

$$\begin{aligned} \ln(L_h/L_{lif}) = & \sigma \ln \frac{p_h}{p_{lif}} + (\sigma - 1) \ln \frac{e_h}{e_{lif}} \\ & - \sigma \ln \frac{w_h}{w_{lif}}. \end{aligned} \quad (8b)$$

Equations (8a) and (8b) underscore the fact that as long as there is some substitution (or complementarity) between domestic and foreign labor, the cost of labor abroad plays an important role in determining the demand for U.S. labor. In addition, one of the restrictions of the CES specification is that the Allen elasticity of substitution between parent and low-income affiliates should be the same as the elasticity of substitution between parent and high-income affiliates.

E. Comparing Elasticities of Labor Demand across Specifications

All three approaches yield coefficient estimates that can be used to derive elasticities of factor demand η and Allen

⁸ If sigma is equal to 0, we have the case of perfect complements (that is, left shoes and right shoes, The leontief function that looks like $L = \min(L_h, L_p)$). This is obviously extreme but might be applicable to some kinds of natural resource extraction. The polar opposite is σ tending to infinity (labor at home and labor abroad are perfect substitutes so $L = L_h + L_p$). This is also extreme, but some version of this might be realistic for production workers.

elasticities of substitution σ . In equation (5), the key parameters are the elasticities of factor demand η . Typically inputs i and j are referred to as p-complements if η_{ij} is less than 0 and p-substitutes if η_{ij} is greater than 0. The key parameters in equation (6) are the ξ_j 's. To convert these into Allen partial elasticities of substitution between locations, we can calculate the following based on observed labor shares s_j :

$$\sigma_{jk} = (\xi_{jk} + s_j s_k) / s_j s_k \text{ and } \sigma_{jj} = (\xi_{jj} + s_j s_j - s_j) / s_j s_j. \quad (9)$$

The Allen partial elasticity of substitution σ_{jk} gives us the percentage change in the ratio of L_j to L_k with respect to the percentage change in the ratio of w_k to w_j . The Allen partial elasticity of substitution is directly estimated as the coefficient on relative wages using the CES approach—equations (8a) and (8b). To convert the Allen partial elasticity of substitution into an elasticity of factor demand, we multiply by the factor share:

$$\eta_{jj} = s_j \sigma_{jj} = \partial \ln L_j / \partial \ln w_j. \quad (10)$$

We report elasticities of substitution for each of the three estimation strategies in table 6. Factor shares are computed by taking the sample means of the data. For the translog approach, we report the implied elasticities from estimating equation (6). The coefficients on affiliate wages imply that foreign labor in horizontal multinationals substitutes for home labor in both high- and low-income affiliate locations. For vertical multinationals, the results are the opposite: workers in low-income locations are complementary to domestic employees. As expected, the own-price elasticity is negative. The results are generally consistent with the results of our labor demand specification reported in columns 1 and 2.

The point estimates are consistently positive for low-income affiliate wages but not precisely estimated for high-income affiliate wages. These results imply that across all specifications, low-income affiliate employment substitutes for domestic employment. However, when multinationals are differentiated on the basis of how much they export for further processing, the results change. Employees in high-income affiliates substitute for domestic employment, while employees in low-income affiliates complement domestic employment.

We summarize the effects of factor price changes, trade, and technical change on U.S. manufacturing employment in table 7. We combine the coefficient estimates presented in table 4 with the actual mean changes in wages, investment prices, trade, research and development employment, and goods prices taken from table 3. We see that the major determinants of contraction in U.S. manufacturing parent employment are (a) falling prices of investment goods (which incorporate the falling prices of computers) (b) rising real wages in the United States, (c) falling real wages in

low-income affiliate locations, and (d) increasing import competition. While much of the debate on offshoring focuses on falling real wages in low-income affiliate locations, the impact of relative wage changes on U.S. parent labor demand is only one factor that explains contraction in parent employment. The combined effects of higher domestic wages and falling foreign wages account for only a 6.4% decline in U.S. employment. In comparison, falling investment prices account for a 13.7% decline and increasing import competition from low-wage countries accounts for a 2.3% decline in home employment. Moreover, for multinationals that export significant amounts of goods to developing countries for further processing, falling real wages in low-income affiliates boosted employment.

V. Conclusion

Over the period 1982 to 1999, domestic employment of U.S. multinationals contracted by nearly 4 million jobs, possibly foreshadowing the overall reduction in U.S. manufacturing employment that accelerated from 1999 onwards. During this period, the number of workers hired by affiliates in developing countries increased, while real wages paid to these workers declined. These facts are consistent with the hypothesis that U.S. parents are exporting low-wage jobs to low-income countries. In this paper, we show that this hypothesis is only partly supported by the evidence.

Using data on U.S.-based multinationals from the BEA, we measure the impact on U.S. manufacturing employment of changes in foreign affiliate wages, controlling for changing demand conditions, import competition, and technological change. We find that the evidence on the links between offshoring and domestic employment is mixed and that the effect depends on both the type and the location of foreign investment. We conclude that the heterogeneity in effects is one reason that previous research on this topic has yielded such apparently contradictory results.

For firms most likely to perform the same tasks in foreign affiliates and at home, foreign and domestic employees are substitutes. For these firms, lower wages in affiliate locations are associated with lower employment in the United States: A 1 percentage point fall in affiliate wages is associated with reductions in parent employment of between 0.009% and 0.598%. However, for firms that do significantly different tasks at home and abroad, foreign and domestic employment are complements: A 1 percentage point decline in low-income affiliate wages is associated with increases in parent employment of between 0.089% and 0.761%. The complementarity between domestic and foreign employment for firms where affiliates perform significantly different tasks is consistent with the theoretical models developed and discussed by Markusen (1989) and Markusen and Maskus (2001).

Finally, we show that other factors, including falling investment goods prices and import competition, are quantitatively more important determinants of falling US manufac-

turing employment. Together these other factors account for 16.02% of the decline in manufacturing employment.

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APPENDIX

Tables

TABLE A1.—COVERAGE OF THE BEA SAMPLE

Year and Variable	Coverage of BEA Sample in Manufacturing	Coverage of BEA Sample in Services	Coverage of BEA Sample in Total U.S. Economic Activity (Includes Manufacturing, Services, Other, Wholesale Trade)
1982			
Total number of employees in BEA sample (thousands)	11,758.1	993.8	18,704.6
Gross product in the BEA sample (U.S. millions of dollars)	421,050	25,997	796,017
Coverage of the BEA sample (in %) relative to gross product for all firms operating in the United States	80%	6%	33%
Value of dollar export sales by firms in the BEA sample (millions)	163,383	NA	NA
Coverage of the BEA sample (in %) relative to exports of all firms operating in the United States	77%	NA	NA
1989			
Total number of employees in BEA sample (thousands)	10,706.8	1,700	18,785.4
Gross product in the BEA sample (U.S. millions of dollars)	586,568	57,090	1,044,884
Coverage of the BEA sample (in %) relative to gross product for all firms operating in the United States	67%	6%	25%
Value of dollar export sales by firms in the BEA sample (millions)	236,371	NA	NA
Coverage of the BEA sample (in %) relative to exports of all firms operating in the United States	65%	NA	NA
1994			
Total number of employees in BEA sample (thousands)	9,622.5	2,653.4	18,947.4
Gross product in the BEA sample (U.S. millions of dollars)	690,466	102,520	1,325,945
Coverage of the BEA sample (in %) relative to gross product for all firms operating in the United States	59%	8%	26%
Value of dollar export sales by firms in the BEA sample (millions)	337,036	NA	NA
Coverage of the BEA sample (in %) relative to exports of all firms operating in the United States	59%	NA	NA
1999			
Total number of employees in BEA sample (thousands)	7,954.9	2,220,174	23,006.8
Value of dollar export sales by firms in the BEA sample (millions)	441,587	NA	NA
Coverage of the BEA sample (in %) relative to exports of all Firms operating in the United States	62.5%	NA	NA

Based on Mataloni and Fahim-Nader (1996) and Mataloni and Yorgason (2006).

TABLE A2.—CROSS CHECKING THE ACCURACY OF THE BEA DATABASE

	Imposing a Cut-Off (reporting requirement of a balance sheet total of at least 7 million euros for Germany; U.S. reporting requirements vary over time; no reporting requirement for Sweden)	Imposing No Cut-Off on Germany Affiliate Reporting
BEA data		
Employees of U.S. affiliates in 1999 in Germany	458,744	NA
Employees of U.S. affiliates in 1999 in Sweden	67,044	NA
German government data (direct U.S. ownership only)		
Employees of U.S. affiliates in 1998	466,941	488,866
Employees of U.S. affiliates in 1999	509,537	532,594
Employees of U.S. affiliates in 2000	488,157	509,176
Swedish government data		
Employees of U.S. affiliates in 1997 (majority owned only)	51,138	NA
Employees of U.S. affiliates in 1998 (majority owned only)	61,089	NA
Employees of U.S. affiliates in 1999 (majority owned only)	78,621	NA

TABLE A3.—DESCRIPTION OF VARIABLES AND DATA SOURCES

Variable Name	Source	Description
Log Wage (Industry Level)	U.S. Bureau of Economic Analysis	Wages and salaries of employees and employer expenditures for all employee benefit plans in parents computed separately for parents, high-income affiliates, and other affiliates and averaged across industries.
Log Wage (Industry Level)	UNIDO	Wages calculated based on surveys administered by UNIDO, supplemented with secondary sources (such as national statistical agencies). Wages calculated as compensation divided by number of employees at the 3-digit ISIC level Revision 2. All values converted to U.S. dollars using the IMF exchange rate series rf. Data taken from INDSTAT3, published in 2006 by UNIDO.
Log Employment	U.S. Bureau of Economic Analysis	Log of the number of full-time and part-time employees on the payroll at the end of the fiscal year in all affiliates. However, a count taken during the year was accepted if it was a reasonable proxy for the end-of-year number. Computed separately for parents, high-income affiliates, and other affiliates.
R&D Share R&D Share (High-Income Affiliates) R&D Share (Low-Income Affiliates)	U.S. Bureau of Economic Analysis	Number of employees in research and development as a percentage of total employment. Computed separately for U.S. parents, affiliates in high-income locations, and affiliates in low-income locations.
U.S. Investment Price	NBER Manufacturing Database	This is the variable PIINV in the NBER's manufacturing productivity database. It is set to 1 in 1987. It combines separate deflators for structures and equipment, based on the distribution of each type of asset in the industry. This is a deflator for new investment flows, not the existing capital stock. See www.nber.org .
Foreign Investment Price	Penn World Tables	PPP price of domestic investment calculated from the PWT 6.1. See appendix for PWT 6.1 for more details or http://pwt.econ.upenn.edu .
Foreign Consumer Goods Price	Penn World Tables	PPP price of consumption goods calculated from the PWT 6.1. See appendix for PWT 6.1 for more details or http://pwt.econ.upenn.edu .
U.S. Import Penetration	Bernard et al. (2006)	Imports into the United States divided by imports into the United States plus total production in the United States less exports from the United States by year by four-digit SIC 1987 revision code industrial classification.
U.S. Import Penetration from Low-Income Countries	Bernard et al. (2006)	Share of products in an industry sourced from at least one country with less than 5% of U.S. per capita GDP

TABLE A4.—ANNUAL CHANGES IN REAL WAGES AND EMPLOYMENT BY REGION AND INCOME

Region	Average Annual Percentage Change in Real Wages (per employee)	Average Annual Percentage Change in Employment
Developed economies	1.48	−0.62
East Asia and Pacific ^a	0.28	4.00
Europe and Central Asia	8.31	−4.29
Latin America and Caribbean	−1.40	1.02
Middle East and North Africa	−1.88	3.21
South Asia	−0.78	3.77
Sub-Saharan Africa ^b	−4.54	1.83
World	0.21	1.27
Income Group		
High income: OECD	1.07	−0.94
High income: non-OECD	1.88	−0.29
Low income	−3.34	1.61
Lower middle income ^c	1.39	1.36
Upper middle income ^d	−0.34	0.20

Madagascar was excluded from the sample due to data inconsistencies. Source: Authors' calculations based on UNIDO INDSTAT2 data. Time period covered is 1980–2007.

^aThe numbers are 0.78% and 4.05%, respectively, if China is excluded from the sample;

^bThe numbers are −4.81% and 2.01%, respectively, if South Africa is excluded from the sample

^cThe numbers are 1.53% and 1.25%, respectively, if China is excluded from the sample

^dThe numbers are −0.28% and 0.23%, respectively, if South Africa is excluded from the sample.

TABLE A5.—TESTING FOR THE IMPACT OF SELECTION INTO EXIT: HECKMAN CORRECTION

	(1)	(2)	(3)	(4)	(5)	(6)
	Pooled	Imports from	Exports to Affiliates	Exports for Processing	Exports for Resale	Platform FDI
Log U.S. Industrial Wages	−0.329 [0.040]**	−0.310 [0.044]**	−0.415 [0.045]**	−0.381 [0.045]**	−0.372 [0.042]**	−0.380 [0.102]**
Log Industrial Wages High-Income Countries	−0.020 [0.035]	−0.031 [0.039]	−0.066 [0.043]	−0.039 [0.041]	−0.049 [0.038]	−0.012 [0.087]
Log Industrial Wages Low-Income Countries	0.057 [0.017]**	0.062 [0.019]**	0.080 [0.020]**	0.084 [0.019]**	0.062 [0.019]**	0.079 [0.045]
Log of the U.S. Price of Capital	0.172 [0.040]**	0.163 [0.040]**	0.150 [0.039]**	0.128 [0.039]**	0.197 [0.039]**	0.157 [0.040]**
Log of the Foreign Price of Capital	0.076 [0.074]	0.082 [0.075]	0.061 [0.074]	0.066 [0.074]	0.071 [0.074]	0.077 [0.075]
Import Penetration	−0.406 [0.202]*	−0.411 [0.202]*	−0.414 [0.200]*	−0.407 [0.201]*	−0.409 [0.201]*	0.404 [0.202]*
Import Penetration from Low-Wage Countries	−0.054 [0.358]	−0.056 [0.359]	−0.010 [0.356]	−0.040 [0.357]	−0.024 [0.356]	−0.050 [0.359]
R&D (% Sales)	0.747 [0.451]	0.753 [0.451]	0.713 [0.450]	0.872 [0.451]	0.581 [0.451]	0.774 [0.452]
R&D (% Sales) in High-Income Countries	0.534 [0.697]	0.538 [0.697]	0.377 [0.692]	0.448 [0.694]	0.466 [0.694]	0.537 [0.697]
R&D (% Sales) in Low-Income Countries	3.642 [2.276]	3.788 [2.282]	3.626 [2.259]	3.599 [2.267]	3.607 [2.263]	3.670 [2.278]
Log of Industry Sales	0.086 [0.032]**	0.087 [0.032]**	0.078 [0.032]*	0.084 [0.032]**	0.081 [0.032]**	0.086 [0.032]**
Log Affiliate Sales by Industry	−0.088 [0.043]*	−0.087 [0.043]*	−0.092 [0.042]*	−0.089 [0.043]*	−0.092 [0.042]*	−0.085 [0.043]*
Log U.S. Industrial Wages × Vertical		−0.553 [0.534]	2.265 [1.560]	2.172 [1.902]	3.045 [0.1878]	0.083 [0.154]
Log Industrial Wages High-Income Countries × Vertical		0.377 [0.515]	1.114 [0.531]*	0.772 [0.754]	1.946 [0.931]*	−0.051 [0.129]
Log Industrial Wages Low-Income Countries × Vertical		−0.217 [0.371]	−0.463 [0.166]**	−3.923 [1.299]**	−0.329 [0.245]	−0.035 [0.067]
Lambda for 1994	−0.031 [0.039]	−0.031 [0.039]	−0.039 [0.039]	−0.036 [0.039]	−0.034 [0.039]	−0.032 [0.039]
Lambda for 1999	0.080 [0.068]	0.078 [0.069]	0.070 [0.068]	0.070 [0.068]	0.081 [0.068]	0.077 [0.069]
Observations	3,177	3,177	3,177	3,177	3,177	3,177
R ²	0.08	0.08	0.09	0.08	0.09	0.08

Standard errors corrected for arbitrary heteroskedasticity are in brackets. *Significant at 5%. **Significant at 1%. Each of columns 2–6 includes an interaction term between the wage measures and vertical integration defined at the firm level as the mean of the variable in the column heading over the entire sample period. All specifications include time dummies.

TABLE A6.—ACTIVITY AT THE INTENSIVE AND EXTENSIVE MARGINS

A: Entry or Exit to and from Low-Wage Countries				B: Entry and Exit to and from Mexico			
Activity 1982–1989	In	Out	Total	Activity 1982–1989	In	Out	Total
In	586	67	653	In	313	72	415
	85.8%	9.81%	95.61%		78.67%	11.51%	89.18%
Out	30	0	30	Out	51	0	21
	4.39%	0	4.39%		10.82%	0	10.82%
Total	616	67	683	Total	364	72	436
	90.19%	9.81%	100%		89.49%	11.51%	100%
Activity 1989–1994				Activity 1989–1994			
In	542	74	616	In	331	33	364
	85.33%	8.55%	93.88%		89.21%	5.27%	94.48%
Out	53	0	53	Out	29	0	29
	6.12%	0	6.12%		5.51%	0	5.51%
Total	595	74	669	Total	360	33	393
	91.45%	8.55%	100%		94.72%	5.27%	100%
Activity 1994–1999				Activity 1994–1999			
In	516	79	595	In	340	20	360
	86.69%	9.14%	95.83%		89.18%	7.15%	96.33%
Out	36	0	36	Out	26	0	26
	4.17%	0	4.17%		3.67%	0	3.67%
Total	552	79	631	Total	366	20	386
	90.86%	9.14%	100%		92.85%	7.15%	100%

The number entries are the counts of parents belonging in each cell. The percentages below these numbers are the shares of affiliate employment accounted for by the row column entries.

TABLE A7.—LOW-INCOME AFFILIATE EMPLOYMENT AND EMPLOYMENT SHARES
BY COUNTRY OVER TIME

	1982	1989	1994	1999
Low-income affiliate employment by country				
Mexico	208,860	496,872	501,066	654,076
Brazil	332,370	462,105	468,184	384,854
China	77	11,131	33,560	133,371
Malaysia	55,583	50,055	73,073	85,365
Thailand	14,804	18,375	25,460	81,054
South Africa	76,728	32,024	30,432	53,288
India	27,798	37,032	21,193	48,124
Argentina	63,130	35,956	53,580	41,007
Philippines	73,651	63,430	68,278	40,980
Total	853,001	1,206,979	1,274,824	1,522,118
Low-income affiliate share of employment by country				
Mexico	19.63%	35.36%	31.63%	37.69%
Brazil	31.24	32.89	29.56	15.25
China	0.01	0.79	2.12	9.82
Malaysia	5.22	3.56	4.61	4.57
Thailand	1.39	1.31	1.61	4.34
South Africa	7.21	2.28	1.92	2.85
India	2.61	2.64	1.34	2.58
Argentina	5.93	2.56	3.38	2.20
Philippines	6.92	4.51	4.31	2.19
Total	80.17	85.91	80.48	81.48

TABLE A8.—CLASSIFICATION OF COUNTRIES INTO LOW-VERSUS HIGH-INCOME CATEGORIES

Countries classified as low income by the World Bank	Countries classified as high income by the World Bank
Estonia (1,470), Guyana (1,504), China (1,579), Malawi (1,689), Romania (1,866), Sri Lanka (1,898), Ukraine (2,151), India (2,325), Dominican Republic (2,763), Tanzania (3,057), Zimbabwe (3,109), Uzbekistan (3,136), Zambia (3,152), Vietnam (3,326), Indonesia (3,401), Botswana (3,517), Pakistan (3,631), Nigeria (3,940), Honduras (4,111), Thailand (4,168), Costa Rica (4,236), Yemen, Rep. (4,248), Senegal (4,318), Philippines (4,427), Slovak R. (4,531), Colombia (4,603), El Salvador (4,622), Egypt, Arab Rep. (4,756), Fiji (4,824), Kenya (5,098), Malaysia (5,334), Hungary (5,426), Ghana (5,475), Poland (5,540), Jamaica (5,557), Ecuador (5,596), Panama (6,453), Mexico (6,465), Guatemala (6,786), Trinidad and Tobago (6,994), Venezuela, RB (7,393), Swaziland (7,500), Russian Federation (7,527), Uruguay (7,997), Turkey (8,370), Morocco (8,422), Tunisia (9,058), Nicaragua (9,206), Malta (9,211), Chile (9,485), South Africa (10,257), Barbados (10,480), Peru (11,065), Brazil (11,227)	Singapore (11,885), Portugal (14,236), Bahamas (14,288), Taiwan (14,699), Saudi Arabia (14,912), Korea, Rep. (15,549), Bahrain (16,047), Netherlands Antilles (16,596), Hong Kong, China (17,478), New Zealand (17,736), Argentina (18,003), Israel (19,572), Greece (22,855), Australia (23,313), Ireland (23,392), Spain (25,848), United Kingdom (26,487), Sweden (27,380), Italy (30,574), Austria (31,209), Finland (32,049), Denmark (32,934), Norway (33,022), United Arab Emirates (33,603), France (33,628), Aruba (34,745), Canada (35,268), Netherlands (35,973), Belgium (40,134), Luxembourg (43,614), Germany (44,146), Switzerland (44,248), Japan (57,126)

Nominal manufacturing wages in 1994 U.S. dollars in parentheses.