Offshoring Jobs? Multinationals and US Manufacturing Employment *

Ann Harrison♠
UC Berkeley
NBER

Margaret McMillan♣
Tufts University
NBER

September 2007

*For assistance with data the authors would like to thank Raymond Mataloni, Fritz Foley and Stanley Watt. For helpful comments we wish to thank David Card, the fellows at the Radcliffe Institute for Advanced Study, especially Larry Katz, seminar participants at the BEA, the University of Michigan, Stanford, UC Berkeley, the IMF, the University of Maryland and Pierluigi Balduzzi. For financial assistance the authors gratefully acknowledge the National Science Foundation. McMillan acknowledges the Radcliffe Institute for Advanced Study for both financial support and time to devote to this project. The statistical analysis of firm-level data on US multinational companies was conducted at the International Investment Division, Bureau of Economic Analysis of the US Department of Commerce under arrangements that maintain legal confidentiality requirements. The views expressed in this paper are those of the authors and do not reflect official positions of the US Department of Commerce. Research assistance from Joan Hamory, Clair Null, and Andrew Waxman is gratefully acknowledged.

♠Department of Agricultural and Resource Economics, 329 Giannini Hall, University of California, Berkeley, California, 94720-3310, 510-643-9676, email: harrison@are.berkeley.edu.
♣Tufts University Department of Economics, 617-627-3137, email: mmcmillan@tufts.edu.

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Ann Harrison
University of California Berkeley
NBER

Margaret McMillan
Tufts University
NBER

Abstract:

Critics of globalization claim that US manufacturing firms are being driven to shift employment abroad by the prospects of cheaper labor. Others argue that the availability of low-wage labor has allowed US-based firms to survive and even prosper. Yet evidence for either hypothesis, beyond anecdotes, is slim. Using firm-level data collected by the US Bureau of Economic Analysis (BEA), we estimate the impact on US manufacturing employment of changes in foreign affiliate wages, controlling for changing demand conditions and technological change. We find that the evidence supports both perspectives on globalization. For firms most likely to perform the same tasks in foreign affiliates and at home ("horizontal" foreign investment), foreign and domestic employees appear to be substitutes. For these firms, lower wages in affiliate locations are associated with lower employment in the US. However, for firms which do significantly different tasks at home and abroad ("vertical" foreign investment), foreign and domestic employment are complements. For vertical foreign investment, lower wages abroad are associated with higher US manufacturing employment. These offsetting effects may be combined to show that offshoring is associated with a quantitatively small decline in manufacturing employment. Other factors, such as declining prices for consumer goods, import competition, and falling prices for investment goods (which substitute for labor) play a more important role.

I. Introduction

During the last three decades, domestic manufacturing employment of US-based multinationals has fallen steadily.[1] Between 1982 and 1999, foreign manufacturing employment of US multinationals increased from 26 percent to nearly 40 percent of their labor force. These parallel developments have led critics of globalization to conclude that US firms are shutting down factories at home and shifting employment abroad in order to lower labor costs. Concerns about offshoring have intensified as newly released data indicate a further decline in manufacturing employment both by US-based multinationals and for the US economy as a whole.

The public outcry motivated Congress to take action. On October 22, 2004 the US Congress passed the American Jobs Creation Act of 2004. The Act contains a provision to encourage profit repatriation back to the US by domestic multinationals--explicitly for the purpose of job creation at home. Yet the evidence linking offshore activities to falling domestic labor demand is, in fact, contradictory. Several studies suggest that there are no employment losses from offshoring activities. Borga (2005), Desai, Foley, and Hines (2005), and Slaughter (2003) find that expansion of US multinationals abroad *stimulates* job growth at home. Slaughter (2003) reports the largest positive effects of offshoring: for every new job abroad, US employment increases two-fold.[2] Reviewing these studies, Mankiw and Swagel (2006) conclude that "foreign activity does not crowd out domestic activity; the reverse is true."

A second set of studies (Brainard and Riker (2001), Hanson, Mataloni and Slaughter (2003), Muendler and Becker (2006)) reaches the opposite conclusion: jobs abroad do replace jobs at home, but the effect is small. How can we reconcile these two different sets of findings? Some of the discrepancies may be explained by data coverage. For example, Slaughter (2003) reaches opposite conclusions depending on whether he uses the entire universe of multinationals or only manufacturing firms. Methodological differences may also account for some of the discrepancies. These different answers are problematic for policymakers who are left uncertain about how to respond to the growing ranks of US firms setting up shop abroad.

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[1] See Table 1, which shows a four million worker decline between 1982 and 1999.

[2] Slaughter's estimates are presented in a recent high profile report released by the government on the consequences of offshoring for the US economy.

Theoretical models of trade and foreign investment imply that different types of foreign investments will be associated with opposite effects on domestic labor demand. Markusen and Maskus (2001) separate multinationals into vertically- and horizontally-integrated types. They show how different incentives for foreign investment lead to different organizational structures, which in turn produce different degrees of substitution between employment at home and abroad. Horizontal multinationals, which are defined as firms which produce the same products in different locations, are primarily motivated by trade costs to locate abroad.[3] For these types of firms, investment abroad substitutes for exports. One implication is that foreign affiliate employment should substitute for home employment. For vertically-integrated firms, however, trade and foreign investment are complements. Vertically-integrated enterprises are motivated by factor endowment differences (and consequently factor price differences in a world where there is not factor price equalization) to locate different components of production in different locations. As pointed out by Brainard and Riker (1997) in important early work on this subject, one implication of this kind of multinational activity is that parent and affiliate employment should be complementary.

More recent work by Grossman and Rossi-Hansberg (2006) draws on insights from Autor, Levy and Murnane (2002) to develop a framework in which falling costs of offshoring can lead to wage gains for workers at home. Grossman and Rossi-Hansberg (2006) use Autor, Levy and Murnane's differentiation betweem routine and non-routine tasks to build a theoretical model of trade in tasks. Advances in technology (such as improvements in communication) make offshoring of routine tasks less costly, leading firms to shift production abroad. What is surprising is that offshoring of routine tasks for vertically-integrated multinationals (there is no horizontal motive for foreign investment here) leads to ambiguous predictions for domestic wages. The intuition behind this result is that falling costs of offshoring act like a positive productivity shock, reducing costs of intermediate goods production. Although the primary motivation for offshoring is to save labor costs, low-skill workers at home may still gain if terms of trade effects and labor supply effects are not too large.

In this paper, we develop an empirical framework which is flexible enough to allow different elasticities of substitution (or complementarity) between home and affiliate employment for firms that

[3] For the purpose of simplicity, we will occasionally refer to horizontally-integrated firms as horizontal firms, and

have different motivations to engage in foreign activities. With this framework, we are able to identify the separate effects of horizontal versus vertical foreign investment on home employment, and also allow for different effects of wages in high- and low-income affiliate locations. At the same time, we control for other confounding changes, such as other factor prices, demand shocks, import competition and technological change. To address the possibility that methodological differences might be driving the conflicting results described above, we adopt a variety of different approaches to estimating labor demand and a range of econometric techniques.

We find that the insights derived from trade theory go a long way towards explaining the apparently contradictory evidence on the relationship between offshoring and domestic manufacturing employment. For US parents involved in primarily horizontal activities, affiliate activity abroad substitutes for domestic employment. For vertically-integrated parents, however, the results suggest that home and foreign employment are complementary. Foreign wage reductions are associated with an increase in domestic employment. The results differ across high- and low-income affiliate locations, in part because factor-price differences relative to the US are much more important in low-income regions. Nevertheless, the negative effects for horizontal foreign investment are small: a 10 percent reduction in wages in affiliate locations is associated with only a 0.2 percent reduction in US parent employment.

In this paper, we show that offshoring is not the primary driver of declining domestic employment of US manufacturing multinationals between 1977 and 1999. In fact, there is some evidence that operating in low-income affiliate locations preserves jobs, instead of destroying them. We show that declining domestic employment of US multinationals is primarily due to falling prices of investment goods (such as computers, which substitute for labor), falling prices of consumption goods, and increasing import penetration. 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 US labor demand..

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vertically-integrated firms as vertical.

Our results are consistent with the literature that focuses on the impact of international trade on US jobs. Revenga (1992) finds a negative impact of changes in import prices on US employment growth. Katz and Murphy (1992) also find that increased import competition negatively affected relative labor demand in the US, particularly in the 1980s with the growing of the US 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 US imports on both the survival and employment of US manufacturing firms. They find that imports only harm US manufacturing employment when those imports are from low wage countries.

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 US direct investment abroad, collected each year by the Bureau of Economic Analysis (BEA) of the US Department of Commerce. The BEA collects confidential data on the activities of US-based multinationals, defined as the combination of a single US 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, non-bank foreign affiliates and non-bank US parents for the benchmark years from 1982 and 1999. These benchmark years (1982, 1989, 1994 and 1999) include more comprehensive information than the annual surveys.[4]

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 dollars in 1982, 1989 and 1994 and rose to $7 million dollars 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.[5] To determine whether the changes in reporting requirements biased 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 US dollars and $79.87 1982 US 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.[6] We keep those parents whose primary 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 manufacturing affiliates.[7]

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[4] While the BEA collects annual data on US direct investment abroad, these data do not include all the variables we need and can find in the benchmark years.

[5] Parents who do not meet this cutoff but who have affiliates that meet the $7 million cutoff are still required to provide extensive information for affiliates.

[6] 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 upon request) that assigns the SIC-ISI codes for the years 1977-1994 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.

[7] There are a number of parents who 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

Table 1 reports the number of employees of US manufacturing parents both in the US and in foreign affiliate locations. US 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 perform the cleaning procedures described above. The sample size remains almost the same, particularly in the later years. The following two rows report the breakdown of US employment for horizontal versus vertical multinationals (discussed in more detail below and defined in Table 2). US employment declines are twice as large for horizontal versus vertical multinationals. While US employment of both types of multinationals declined, foreign affiliate employment increased. Almost all the increase in foreign affiliate employment occurred in low-income affiliate locations, and affiliate employment gains in vertically-integrated firms were twice as large as for horizontally-integrated firms. The fact that US employment of vertical multinationals fell by less but (low-income) affiliate employment increased significantly more is consistent with the idea of complementarity between home and foreign employment for vertical multinationals, as suggested by Markusen and Maskus (2001) and Grossman and Rossi-Hansberg (2006).

The share of US multinational employment concentrated in affiliates increased from 26 percent in 1982 to 39 percent in 1999. Although total affiliate employment increased by more than one million employees, the foreign employment gains did not fully offset the domestic losses. This suggests that there are other important determinants of falling domestic employment for US multinationals. Alternative explanations, which shall be incorporated into our empirical framework, include changing prices of capital, labor-saving technical change, changing terms of trade, and increased import competition.

Manufacturing multinationals reporting to the BEA accounted for the majority of economic activity in US manufacturing during the sample period. Appendix Table A.1 (based on Mataloni and Fahim-Nader (1996) and Mataloni and Yorgason (2006)) reports the coverage of the BEA data for benchmark years 1982 through 1999. In 1982, gross product by these enterprises accounted for over 80 percent of total manufacturing and 77 percent of manufactured exports in the United States. By 1999, the

all of their manufacturing is done overseas and not in the United States. To account for this, we chose our sample in two different ways. First, we included parents who either were classified in manufacturing or had previously been classified in manufacturing and their manufacturing affiliates. Next, we included only parents who were currently in manufacturing in any given year and their manufacturing affiliates. Since the results are not sensitive to this

BEA's coverage had declined slightly: these enterprises accounted for only 63 percent of US exports and about half of manufacturing employment. These firms also accounted for more than 80 percent of total private US research and development expenditures throughout the sample period (Mataloni and Fahim-Nader (1996)). Appendix Table A.1 also shows that the proportion of services firms accounted for by the BEA sample is extremely small. During the sample period, the BEA sample accounted for only between 6 and 8 percent of total gross product in services. Consequently, we restrict our analysis to manufacturing, which we believe provides a more representative sample.

How reliable are these data? These are the only data officially collected by a US government agency on affiliate activity abroad. We have initiated a number of data checks to analyze the reliability of the coverage.[8],[9] We were able to cross-check the employment numbers for US 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 Appendix Table A.2. We report total employment in both countries as indicated by the BEA database and show that it is quite close to the same 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 upon fiscal year vs. 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

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distinction, we use the larger of the two samples, keeping all parents that were *ever* classified in manufacturing and their manufacturing affiliates.

[8] 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 US multinational affiliates in Germany and Sweden.
[9] We also contacted Statistics Canada to check whether they record information on affiliates of US multinationals in Canada, which would allow us to cross-check US data on foreign affiliates there with Canadian data on inward

stem from different approaches or different datasets and time periods. Brainard and Riker (1997) estimate labor demand as a function of wages in different locations, Desai, et al. (2006) estimate a reduced form equation with log labor at home as a function of log labor abroad, and Brainard and Riker (2001), Hanson, Mataloni and Slaughter (2003) and Muendler and Becker (2006) use a 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 as our primary specification to derive labor demand from a generalized cost function. Our preferred approach is attractive for several reasons. First, 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. Second, we believe that identification problems are less likely to plague this approach. The translog approach leads to a specification where factor shares are a function of factor prices; unless factor shares are carefully defined, the results are more likely to be affected by differences in the quality of labor inputs (such as a changing composition of the labor force towards more highly skilled workers). Previous approaches in the offshoring literature have imposed a short-run cost function and kept capital inputs fixed, which would make it difficult for us to compare our results to earlier coefficient estimates. However, for completeness we also derive estimating equations using a generalized translog and CES function approach. We shall see that the implied elasticities of substitution are remarkably robust across these different specifications.

Following Hamermesh (1993), consider a firm using N factors of production $X_1 \ldots X_N$. Let the production function be

$$(1) \quad Y_i = f(X_{1i},....,X_{Ni}),\ f_i > 0,\ f_{ii} < 0$$

Then the associated cost function, based on the demands for X_1 through X_N is given by

$$(2) \quad C_i = g(w_{1i},....,w_{Ni},Y),\ g_i > 0$$

and the w_i's are the input prices. One can use Shepard's lemma to derive

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.

$$(3) \quad X_i = X_i^d(w_1, ..., w_N, Y), i = 1, ..., N$$

Our first approach will be to estimate a log-linear version of equation (3), allowing for three types of labor: home (domestic) labor (*h*), foreign labor in low-income affiliates and labor in high-income affiliates. This framework is flexible enough to allow for a range of production technologies, including Brainard and Riker's (2001) assumption that production is vertically decomposed across high-wage and low-wage regions. We will also allow for capital inputs, with capital at home and abroad allowed to enter production as different inputs, and for changing technology.

Our first set of estimating equations is based on log-linearization of (3) and takes the following form:

$$(4) \quad \ln L_{iht} = \beta_0 + \ln Y_{ijt} + \sum_j \beta_j A_{ijt} + \sum_j \eta_j w_{ijt} + \sum_j \omega_j r_{ijt} + d_t + f_i + \varepsilon_{ijt}$$

where ln *L* is the natural logarithm of net annual employment by the US parent in the United States, *Y* is final output, *A* allows for technological change at home and abroad , *w* is the wage in location *j* and time *t*, and *r* is the price of capital in location *j* and time *t*. 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 non-varying firm characteristics, while *j* indexes location and *t* indexes time.

Defining Horizontal and Vertical Multinationals

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 intra-firm trade will be low, since foreign investment substitutes for US 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, we can use the different implications for intra-firm trade as a way to distinguish vertical from horizontal foreign investment.

We construct intra-firm trade as the sum of exports to foreign affiliates for further processing plus imports from foreign affiliates as a share of sales. We then define firms as vertical if they have a high share of intra-firm trade and firms as horizontal if they have a low share. Grossman and Rossi-Hansberg (2006) also use intra-firm trade to quantify the increase in vertical activities of multinationals, pointing out that intra-firm trade "mostly reflects the international division of labor within multinational enterprises." We measure high intra-firm trade in two ways. First we run a regression of intra-firm trade on industry dummies, and define firms as vertical if the industry dummy is statistically significant. As reported in Table 2, this is equivalent to selecting those industries with a high average share of intra-firm trade during the sample period as vertical multinationals.

The results in Table 2 suggest that the following industries may be characterized as vertical: chemicals, plastics, primary and fabricated metals, machinery, computers and electronics, electrical equipment, and transportation equipment. The remaining industries are classified as horizontal: textiles and apparel, food, beverages and tobacco, leather products, wood and paper products, petroleum products, non-metallic metals and furniture. While it may be surprising that apparel is classified as horizontal and not vertical, potential vertical activity in that sector is limited by high trade costs. 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 (for developing countries, see Hanson and Harrison (2001)). To make this point more clearly, we have also listed in the last column a summary measure of tariffs plus transport costs for each sector for the US in 1979, based on Bernard, Jensen, and Schott (2006). Trade frictions are highest for textiles and apparel, beverages and tobacco, leather, and non-metallic minerals (cement). This implies 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.

It is also instructive to compare our classification of horizontal versus vertical with the classification used by Autor, Levy, and Murnane (2003) to categorize workers into routine and non-routine tasks. They argue that computers are likely to substitute for labor in the case of routine tasks, which could be either cognitive or manual, and most likely to be complementary with labor in the case of cognitive non-routine tasks. As pointed out by Grossman and Rossi-Hansberg (2006), "routine" tasks are more likely to be offshored via vertical foreign investment (there is no motivation for horizontal foreign investment in their framework). We posit that the type of routine tasks that are important in manufacturing are manual rather than cognitive. We pick a measure of non-routine manual tasks which measures eye-hand-foot coordination (EFT). It is possible to use the Autor, et al. data to classify industries according to their EFT level, by merging CPS worker and occupation data with their industry affiliation. In Table 2, firms defined as vertically-integrated on the basis of high intra-firm trade measure poorly in the EFT scale. So our measure of vertical versus horizontal could also be interpreted as a measure of distance from non-routine manual tasks.

Data and Estimation Issues

To estimate equation (4) we need data on home and foreign technology shocks (A's), employment (L's), capital prices, wages, and price or output shocks. We measure technology shocks with firm-level research and development (R&D) expenditures. We measure employment L as the (log) number of employees at home and abroad, since hours or even employment broken down by skill levels are not collected for US parents. Domestic prices of investment are defined at the disaggregated industry level and are taken from the NBER's manufacturing database.

Our summary statistics and raw correlations suggest that the degree to which affiliate wages and other factor prices affect domestic labor outcomes will depend critically on their location. US affiliate employment in high-income countries is likely to have very different effects than affiliate employment in low-income countries on US labor market outcomes. To account for this, we include separate values for foreign capital, labor, R&D expenditures, imports, and demand shocks for high- and low-income countries. Another 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 zero and add a dummy variable indicating whether or not the firm has a missing observation for low-income affiliates.

One estimation issue which arises is that output *Y* for firm *i* in time *t* is jointly determined with employment. We address the potential simultaneity problem by making output at home and abroad a function of exogenous demand shocks in our specification: For foreign affiliate output, we use consumption and investment prices, taken from the Penn World Tables. In US manufacturing, international competition plays an important role in price determination, so we proxy for US demand shocks using both industry dummies and import competition. We use industry-level import penetration to proxy for competition from third party imports – what are you trying to say here – outsourcing??. These data were made available at the 4-digit ISIC level for 1977 through 1999 by Bernard, Jensen, and Schott (2006). We also include a measure of import penetration from low-wage countries, also computed by these authors. Alternative specifications reported later in the paper use industry-level aggregates of output as alternative measures of output shocks, with separate industry-level measures of *Y* calculated for parents and affiliates.

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. Our wage measure is defined using the following formula:

$$w_{ijt} = \sum_{c \in j} Wct \; \frac{L_{ic,to}}{\sum_c L_{ic,to}}$$

where *w* is the wage facing the *i*th firm at time *t* in country *c* in affiliate location *j*, and the W_{ct}'s are country-time specific wages either computed using the BEA data on worker compensation aggregated to the country level or the UNIDO wages. Wages are employment-weighted averages of wages in high- and low-income affiliates, where the weights are given by the parent's initial share of employment within countries belonging to each high- and low-income category. Affiliate country locations are defined as either high- or low-income based on the World Bank's country classifications (see Table 3).

IV. Results

We report sample means in Table 4. The US employment share in worldwide parent activity averaged 83.4 percent for horizontally-integrated and 80.7 percent for vertically-integrated firms. Affiliate labor expenditure shares accounted for between 14 and 17.2 percent of expenditures, while low-income affiliate shares only accounted for the remaining two percent. During this period, the US parent share of worldwide labor expenses fell 4 percent, with most of the 4 percent drop in US parent shares going to low-income affiliate locations.

US parent employment shares of the multinational's global labor force fell considerably more than the expenditure shares going from 74 to 61 percent of worldwide parent employment (see Table 1). The reason why the employment changes were large but expenditure share changes were small is because wage trends offset the employment developments: real wages in the sample went up in the United States but fell in high-income and low-income affiliate countries. The real wage declines abroad were large, particularly in low-income locations. One explanation which is consistent with these wage trends is a change in the composition of employment: US parents (and their high-income affiliates) are retaining relatively high-skilled workers and shifting relatively low-skilled jobs to low-income countries where labor is less expensive. This was particularly true among vertical multinationals, where domestic wages increased by nearly 20 percent in real terms over the sample period and low-income affiliate real wages fell by 27 percent.

Research and development employment as a share of total parent employment averaged 3.1 percent for horizontal and 9.1 percent for vertically-integrated US multinationals. The significantly higher R&D shares and much larger domestic (US) wage increases for vertical multinationals is consistent with the hypothesis that these types of firms divide their activities between foreign and domestic locations, performing the most skill-intensive activities at home. R&D employment as a share of total employment rose in the US but fell in both high- and low-skill affiliate locations, suggesting that US parents chose to increasingly concentrate R&D activity in the United States.

Average import penetration in the four-digit SIC sector over the period was 12.7 percent for horizontal firms and 17.8 percent for vertical firms. Import penetration increased by 8.2 percentage points for horizontal firms and 14.6 for vertical firms between 1977 and 1999, which reflects an enormous increase in the exposure of US manufacturing firms to import competition. Import competition from low-wage countries also increased for both types of enterprises, increasing by 9.9 for horizontal firms and 6.2 percentage points for vertical firms. While the price of investment goods in the US fell for both sets of enterprises, prices fell faster for vertically-integrated firms, reflecting, in part, the importance of falling computer-related costs for these firms. The real price of consumption goods, as reported by the Penn World Tables, also fell for both sets of enterprises.

Fixed Effect Results for Labor Demand

We report the results of estimating (4) in Table 5. The log of US 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. The first column of Table 5 reports coefficient estimates when we pool horizontal and vertical enterprises. The results suggest that employees in low-income affiliates are substitutes for parent home employment and employees in high-income affiliates are complements. The point estimate of 0.067 on low-income affiliate wages indicates that a 10 percent fall in foreign wages would lead to a 0.67 percent fall in US parent employment. The point estimate on high-income affiliate wages suggests the opposite: that a 10 percent increase in high-income affiliate wage increases would be associated with a 0.31 percent fall in parent employment. In columns (2) and (3), we allow the slope coefficients of our explanatory variables to vary according to whether firms are vertically or horizontally integrated. Formal F-tests of equality of coefficients are presented in column (4); in most cases, we reject that the coefficients are the same across the two types of enterprises. Consequently, we adopt this approach throughout the remainder of the paper.

Column (2) reports the results for vertically-integrated multinational enterprises. The coefficient on low-income affiliate wages, at -0.032, suggests that a 10 percent fall in affiliate wage levels would lead to a 0.32 percent increase in domestic (US) labor demand. For these types of firms, employment in low-income affiliates is complementary with home employment. The coefficient on high-income wages, while also negative, is smaller in magnitude and statistically insignificant. These results suggest that falling wages abroad should boost US manufacturing employment for vertically-integrated firms, consistent with the predictions in Grossman and Rossi-Hansberg (2006). Their model suggests that for firms that offshore different components of their operations, lower wages abroad act as cost savings that translate into higher employment at home.

The results are different for horizontal foreign investment, as reported in column (3) of Table 5. The coefficient on both high- and low-income affiliate wages is now positive and statistically significant. The coefficient on low-income affiliate wages, at 0.027, suggests that a 10 percent fall in affiliate wages would be associated with a 0.27 percentage point fall in parent employment. The coefficient on high-income affiliate wages is also positive and statistically significant. These results suggest that affiliate employment in horizontally-integrated multinationals substitutes for parent employment. However, the magnitudes are very small: even an implausibly large decline of 50 percent in foreign affiliate wages would result in only a 1.5 percent fall in parent employment.

The own-wage elasticity, which varies between -0.34 and -0.52, suggests that a one percent increase in the domestic US manufacturing wage reduces labor demand by 0.34 to 0.52 percent. 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 for both types of enterprises, suggesting that increases in the price of domestic investment goods increase domestic labor demand. The coefficient on investment abroad has the opposite sign, suggesting that higher prices of investment abroad are associated with lower labor demand at home. The coefficient estimates on the domestic and affiliate prices of investment goods imply that investment and labor are generally substitutes, consistent with previous labor demand studies on capital-labor substitution cited in Hamermesh (1993).

Increases in arms-length trade and foreign demand shocks also affect domestic labor demand. A 10 percentage point increase in import penetration during the sample period would imply a decline in US manufacturing employment of 3.5 percentage points for vertical but is not statistically significant for horizontal multinationals. A one percent increase in the prices of consumption goods in affiliate locations is associated with a 0.58 percentage point increase in employment for vertical multinationals and a 1.15 increase for horizontal multinationals.

Big negative employment effects are also associated with our domestic proxy for technological change, the share of research and development employment in total parent employment. The results indicate that a ten percentage point increase in the parent research and development employment shares would be associated with a 3.5 percentage point decline for vertical firms and 9.1 percentage point decline for horizontal firms. For horizontally-integrated firms, parent research and development employment as a share of total employment increased by 4.3 percentage points between 1977 and 1999, implying a reduction in home employment of 4 percent. However, the coefficients on affiliate R&D employment are either insignificant or positive, suggesting that R&D activities in affiliates are associated with positive employment gains for the US parent.

The critical parameters of interest in Table 5 are the coefficients on affiliate wages, which indicate whether affiliate employment substitutes for or is complementary to home employment. In Table 6, we explore whether our results are robust to the 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 3 digit ISIC level (Revision 2). All values are converted to US dollars using the IMF exchange rate series rf. As in Table 5, 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 home and foreign employment are complements for vertical multinationals but that home and foreign employment are substitutes for horizontal multinationals.

Alternative Specifications

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 US operations, then our estimates of the employment costs of multinational activity could be downward biased. Following Wooldridge (2002, p. 581), 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 zero for firms that do not exit the sample and switches from zero to one in the period just before attrition. The results of this test are reported in the third to last row of columns one and three of Appendix Table A5. The coefficient on the lead of the selection indicator is negative and significant for both vertically- and horizontally-integrated firms. This is consistent with the fact that firm size, as measured by the value of the capital stock, is one of the most important determinants of attrition in our sample: large firms are 21.6% more likely to survive than small firms. The significant and negative sign on the selection variable is also a possible indicator that firms which relocate abroad are those most likely to contract employment. To address this potential criticism, we correct for selection bias below.

To obtain consistent estimates of our parameters, we use the inverse probability weighting scheme outlined in Wooldridge (2002) which 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:

$$\hat{p}_{it} = \hat{\pi}_{it} * \hat{\pi}_{i,t-1} * \ldots \hat{\pi} i1.$$

where hats denote fitted probabilities. This methodology allows 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 include all of the regressors in our original model plus firm size, firm profitability and the firm's share of employment in low-income countries.

Columns (2) and (4) of Appendix Table 5 report the estimated coefficients and standard errors obtained using the weighting procedure described above. In columns (1) and (3) we report the unweighted estimates for purposes of comparison. In general, the point estimates in the weighted regressions are larger for home prices and smaller for foreign prices: the implication is that small firms are more sensitive to domestic price movements and less sensitive to foreign price movements than large firms. However, in most cases the point estimates are not very different from those in Tables 5 and 6.

One serious drawback to using the weighted estimates is that the weighting scheme gives an inordinate amount of importance to the small firms in our sample. The correction is problematic for the following reason: if we define "small" as a firm for which the size of the capital stock is less than the mean of the capital stock of all firms, then the "small" firms in our sample account for only 23.8% of employment while the large firms account for the remainder. Since small firms are much more likely to drop out of our sample, our weighting scheme assigns larger weights to firms with a relatively small share of total employment. From this standpoint, it might make sense to weight firms by firm size rather than the inverse of firm size. The problem is that we would still be left with inconsistent estimates. For all of these reasons, we prefer to use as our baseline the unweighted estimates reported in the previous tables.

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, Mataloni and Slaughter (2003) and Muendler and Becker (2006). 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*, technical change *A* and output *Y* is given by:

(5)

$$\begin{aligned}\ln \mathrm{TC} = {} & \alpha_0 + \sum_j \varpi_j \ln Y + \sum_j \alpha_{jw} \ln W + \sum_j \nu_j \ln r + \sum_j \alpha_{jA} \ln A \\ & + \frac{1}{2}\sum_j\sum_k \alpha_{jY} (\ln Y)^2 + \frac{1}{2}\sum_j\sum_k \xi_{jk} (\ln W)^2 + \frac{1}{2}\sum_j\sum_k \beta_{jk} (\ln A)^2 \\ & + \frac{1}{2}\sum_j\sum_k \omega_{jk} (\ln r)^2 + \sum_j\sum_k \vartheta_{jk} \ln W \ln r + \sum_j\sum_k \tau_{jk} \ln Y \ln A \\ & + \sum_j\sum_k \rho_{jk} \ln Y \ln W + \sum_j\sum_k \chi_{jk} \ln r \ln A + \sum_j\sum_k \varphi_{jk} \ln r \ln Y + \sum_j\sum_k \kappa_{jk} \ln A \ln W + \varepsilon\end{aligned}$$

Differentiating ln TC with respect to ln *Wj* 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*:

$$(6) \quad LSHARE_{ijt} = \beta_0 + \sum_j \rho_j \ln Y_{ijt} + \sum_j \kappa_j \ln A_{ijt} + \sum_j \xi_j \ln w_{jt} + \sum_j \vartheta_j \ln r_{ijt} + f_i + \varepsilon_{ijt},$$

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 report coefficient estimates for equation (6) and the implied Allen elasticities of substitution from the translog cost share approach in Appendix Table A.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. The magnitudes for high-income affiliates are consistent with our first two approaches: in both vertical and horizontal firms, workers in high-income locations are substitutes for domestic employees. In low-income affiliates, however, employment is complementary with US employment. As expected, the own-price elasticity is negative.

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

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

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.[10]

The first-order condition with respect to labor hired in the US is:

$$(8)\quad p_{i,h} Y_L \frac{\partial L_i}{\partial L_{i,h}} = w_{i,h}$$

The first-order condition with respect to labor hired in high-income affiliates is:

$$(9)\quad p_{i,hif} Y_L \frac{\partial L_i}{\partial L_{i,hif}} = w_{i,hif}$$

where p are final goods prices at home and abroad and w are wages at home and abroad. The first-order condition with respect to labor hired in low-income affiliates is:

$$(10)\quad p_{i,lif} Y_L \frac{\partial L_i}{\partial L_{i,lif}} = w_{i,lif}$$

Since,

$$(11)\quad \frac{\partial L_i}{\partial L_{i,h}} = \frac{\sigma}{\sigma-1} \left[\sum_j \left(e_{ij} L_{ij}\right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{1}{\sigma-1}} \frac{\sigma-1}{\sigma} \left[\left(e_{i,h} L_{i,h}\right) \right]^{\frac{-1}{\sigma}} \quad e_{i,h}$$

and,

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

$$(12a)\quad \frac{\partial L_i}{\partial L_{i,hif}} = \frac{\sigma}{\sigma-1}\left[\sum_j \left(e_{ij}L_{ij}\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{1}{\sigma-1}} \frac{\sigma-1}{\sigma}\left[\left(e_{i,hif}L_{i,hif}\right)\right]^{\frac{-1}{\sigma}} \quad e_{i,hif}$$

$$(12b)\quad \frac{\partial L_i}{\partial L_{i,lif}} = \frac{\sigma}{\sigma-1}\left[\sum_j \left(e_{ij}L_{ij}\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{1}{\sigma-1}} \frac{\sigma-1}{\sigma}\left[\left(e_{i,lif}L_{i,lif}\right)\right]^{\frac{-1}{\sigma}} \quad e_{i,lif}$$

we can insert (11) and (12) into (8) through (10) and take the following:

$$(13a)\qquad \frac{p_{ih}e_h^{\frac{\sigma-1}{\sigma}} L_h^{\frac{-1}{\sigma}}}{p_{i,hif}\,e_{i,hif}^{\frac{\sigma-1}{\sigma}} L_{i,hif}^{\frac{-1}{\sigma}}} = \frac{w_{ih}}{w_{i,hif}}$$

$$(13b)\qquad \frac{p_{ih}e_h^{\frac{\sigma-1}{\sigma}} L_h^{\frac{-1}{\sigma}}}{p_{i,lif}\,e_{i,lif}^{\frac{\sigma-1}{\sigma}} L_{i,lif}^{\frac{-1}{\sigma}}} = \frac{w_{ih}}{w_{i,lif}}\,.$$

Taking logs of both sides of (13a) and (13b) yields the following:

$$(14a)\quad \ln(L_h / L_{hif}) = \sigma \ln\frac{p_h}{p_{hif}} + (\sigma-1)\ln\frac{e_h}{e_{hif}} \quad -\sigma\ln\frac{w_h}{w_{hif}} \quad .$$

$$(14b)\quad \ln(L_h / L_{lif}) = \sigma \ln\frac{p_h}{p_{lhif}} + (\sigma-1)\ln\frac{e_h}{e_{lif}} \quad -\sigma\ln\frac{w_h}{w_{lif}} \quad .$$

Equations (14*a*) and (14*b*) underscore the fact that as long as there is some substitution between domestic and foreign labor (i.e., σ >0), the cost of labor abroad plays an important role in determining the demand for US 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.

The estimates are reported in Appendix Table A7. The implied Allen elasticity of substitution, which is the negative of the reported coefficient estimate on wages, is positive for horizontally-integrated multinationals. For horizontal firms, a one percentage point increase in the ratio of US to foreign affiliate wages would lead to a decline in US employment of between 0.16 and 0.19 percentage points. The CES approach corroborates the results in Tables 5 and 6 showing that affiliate labor in horizontal multinationals substitutes for parent employment. For vertical multinationals, labor in low-income affiliates is complementary with US parent employment but labor in high-income affiliates substitutes for US parent employment.

Comparing Elasticities of Labor Demand Across Specifications

All three approaches yield coefficient estimates which can be used to derive elasticities of factor demand η and Allen elasticities of substitution σ. In equation (4), 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 zero, and p-substitutes if η_{ij} is greater than zero. 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 :

$$(15)\ \sigma_{jk} = (\xi_{jk} + s_j s_k) / s_j s_k$$
$$\sigma_{jj} = (\xi_{jj} + s_j s_j - s_j) / s_j s_j$$

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 (14*a*) and (14*b*)). To convert the Allen partial elasticity of substitution into an elasticity of factor demand, we multiply by the factor share:

$$(16)\ \eta_{ij} = s_j \sigma_{ij} = \partial \ln L_i / \partial \ln w_j$$

We report both Allen and factor price elasticities of substitution for each of the three estimation strategies in Table 7. Factor shares are typically computed by taking the sample means of the data.[11] Recall that a negative elasticity η_{ij} implies that an increase in foreign wages reduces the demand for US labor, while a positive sign indicates that US and foreign labor are price substitutes. The different

[11] Confidence intervals could be computed using bootstrapped standard errors.

approaches suggest that home and affiliate employment are substitutes for horizontal multinationals but complements for vertically-integrated firms. The price elasticity of demand η_{ij} is positive and significant for horizontal multinationals across all specifications, consistent with substitution between home and foreign affiliate employment. The price elasticity appears to be between 0.02 and 0.03 in low-income affiliates and averages around 0.10 for high-income affiliates. In high-income affiliate locations, a 1 percentage point increase in affiliate employment is associated with a 0.1 percentage point decline in US employment. The point estimates for horizontal multinationals are similar to those derived by Muendler, et al. (2006) and Brainard and Riker (2001) for low-income locations but higher in high-income affiliates. For vertical multinationals, the point estimates are consistently negative in low-income locations but not precisely estimated for high-income locations. The results imply that low-income employment is complementary with domestic employment in vertical multinationals, but again the magnitudes are not large: a 10 percentage point decline in foreign wages would be associated with a .3 percentage point increase in US employment.

We summarize the effects of factor price changes, trade, and technical change on US manufacturing employment in Table 8. We combine the coefficient estimates presented in Table 5 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 US manufacturing parent employment are (1) falling real prices of consumption goods (2), falling prices of investment goods (which incorporates the falling prices of computers), which makes it cheaper to substitute capital for labor, and (3) increasing import competition. While the increase in home wages relative to affiliate wages has played a role for both vertical and horizontal multinationals, that effect is quantitatively small. For horizontal foreign investment, the combined effects of higher domestic wages and falling foreign wages only account for a 3 percent decline in US employment. In comparison, falling consumption prices account for an 11 percent decline, falling investment prices at home account nearly a 9 percent decline, and increasing import competition from low-wage countries accounts for a 6 percent decline in home employment. For vertical multinationals, falling prices in low-income countries boosted employment by a small percentage, but falling domestic investment prices and import competition again played a much more important role. These figures suggest that high US labor costs are not the primary force behind the significant reduction in US employment of American multinational firms.

We have not allowed for the possibility that hiring workers abroad prevents a parent from shutting down operations. Borjas, Freeman and Katz (1997) study this counterfactual by asking what would have happened to low wage workers if imports from developing countries had been produced by US firms. In a similar spirit, we would like to know what might have happened to US workers if the parent had not hired workers in developing countries. Our dummy for employment in developing countries suggests that low-income affiliate activities have, in fact, preserved some jobs. Table 8 shows that firms which had expanding operations in low-income affiliate locations on average increased parent employment by 2 (for horizontal) to 3 (for vertical) percentage points relative to firms that did not have operations in low income locations. On the other hand, the gains from operating in low-income countries were not sufficient to offset the negative effects on domestic parent employment of falling investment prices, falling consumer prices abroad, and increasing import competition.

VI. Concluding Comments

This paper measures the impact of different forms of globalization on manufacturing employment by US multinationals in the United States. Over the period 1977 to 1999 manufacturing employment of US multinationals contracted by 4 million jobs, possibly foreshadowing the overall reduction in US manufacturing employment that accelerated from 1999 onwards. During this period, the number of workers hired by affiliates in developing countries increased while wages paid to these workers declined. These facts are consistent with the hypothesis that US parents are exporting low-wage jobs to low-income countries. In this paper, we show that this hypothesis is only partially supported by the evidence.

The expansion of manufacturing employment in developing countries amounts to only one-quarter of the jobs lost at home. Our research shows that other factors—including technological change, and international trade—are much more important determinants of US manufacturing employment. Moreover, the results also suggest that job losses would have probably been even greater in the absence of offshoring expansion by US multinationals.

Using data on US based multinationals from the Bureau of Economic Analysis (BEA), we estimate the impact on US 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 why 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 ("horizontal" foreign investment), foreign and domestic employees appear to be substitutes. For these firms, lower wages in affiliate locations are associated with lower employment in the US. However, for firms which do significantly different tasks at home and abroad ("vertical" foreign investment), foreign and domestic employment are complements. The complementarity between domestic and foreign activities for vertically-integrated firms is consistent with theoretical models developed by Grossman, Markusen, Maskus, and Rossi-Hansberg. For vertical foreign investment, lower wages abroad are associated with higher US manufacturing employment.

However, even for horizontal multinationals, the negative impact of offshoring on US labor demand is small. For horizontal foreign investment, the combined effects of higher domestic wages and falling foreign wages only accounts for a 4 percent decline in US employment. In comparison, falling consumption prices account for an 11 percent decline, falling investment prices which have allowed firms to replace workers with computers or machines account for a 9 percent decline, and increasing import competition from low-wage countries accounts for a 6 percent decline in home employment. For vertical multinationals, the gains from operating in low-income countries were not sufficient to offset the negative effects on domestic parent employment of falling investment prices, falling consumer prices abroad, and increasing import competition. We conclude that high US labor costs are not the primary force behind the significant reduction in US manufacturing employment of American multinational firms.

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TABLE 1

TRENDS IN MANUFACTURING EMPLOYMENT BY US MULTINATIONALS 1982-1999

		1982	1989	1994	1999
Parents					
(1)	BEA Mfg	11,758	10,706	9,622	7,954
(2)	Our sample	10,689	9,668	9,104	7,564
	Vertical	5,812	5,581	4,958	4,963
	Horizontal	4,877	4,087	4,146	3,301
High-income Affiliates					
	Total	2,595	3,171	3,048	2,903
	Vertical	1,664	2,124	1,901	1,905
	Horizontal	932	1,048	1,147	998
Low-income Affiliates					
	Total	1,064	1,405	1,584	1,868
	Vertical	589	833	894	1,105
	Horizontal	475	571	690	764
All Affiliates					
	Total	3,659	4,576	4,632	4,772
	Vertical	2,253	2,957	2,795	3,010
	Horizontal	1,406	1,619	1,837	1,762
Affiliate Share of Employment					
	Total	26%	32%	34%	39%
	Vertical	28%	35%	36%	38%
	Horizontal	22%	28%	31%	35%

(1) Source: Mataloni (1994, 2007), Employment is by Industry of Parent and includes petroleum extraction and refining.
(2) Our totals differ from the BEA's because we drop observations for which wages, employment, R&D spending and/or R&D employment are negative.

TABLE 2:
DEFINING HORIZONTAL AND VERTICAL FOREIGN DIRECT INVESTMENT

Industry (97 NAICS code)	Intrafirm Dummy	Mean Intrafirm Trade	Autor, et al. EHF Measure of Non-Routine Manual Task	US Tariffs and freight costs in 1979 (Bernard, Jensen, and Schott)
Textiles & Apparel	-0.004 [0.004]	.008	1.268	26.3 %
Food	-0.003 [0.004]	.018	1.261	15.2 %
Beverages & Tobacco	0.004 [0.005]	.016	1.257	27.3 %
Leather Products	-0.005 [0.010]	.019	1.210	16.0 %
Wood Products	0.053 [0.514]	.013	2.131	14.0
Paper	-0.006 [0.004]	.016	1.010	9.9
Petroleum & Coal Products	0.003 [0.005]	.027	1.211	5.1
Chemicals	0.039 [0.004]**	.072	0.866	9.7
Plastics & Rubber	0.016 [0.004]**	.051	1.032	16.2
Nonmetallic Minerals	0.002 [0.005]	.024	1.387	17.3
Primary Metals	0.010 [0.005]*	.043	1.253	12.1
Fabricated Metals	0.017 [0.004]**	.048	0.953	14.0
Machinery	0.049 [0.004]**	.082	0.781	9.0
Computer & Electronics	0.110 [0.005]**	.143	0.550	7.9
Electrical Equipment	0.042 [0.006]**	.074	0.825	10.8
Transportation Equipment	0.021 [0.004]**	.055	1.050	10.0
Furniture	0.011 [0.007]	.014	1.162	16.0
Miscellaneous	0.060 [0.005]**	.093	.726	12.5
Observations	3866			
R-squared	0.25			

Robust standard errors in brackets, * significant at 5%; ** significant at 1%
For a detailed description of which industries are included in miscellaneous see: http://www.census.gov/epcd/naics/NAICS33C.HTM#N339. Intrafirm trade is defined as the sum of exports to foreign affiliates for further processing plus imports from foreign affiliates, divided by sales.

TABLE 3

CLASSIFICATION OF COUNTRIES INTO LOW VERSUS HIGH INCOME CATEGORIES

		Nominal Manufacturing Wages 1994 in US Dollars	
Country	World Bank / Our Classification for Low versus High Income	UNIDO	BEA
Estonia	Low		1,470
Guyana	Low		1,504
China	Low	4	1,579
Malawi	Low	1,235	1,689
Romania	Low	958	1,866
Sri Lanka	Low	740	1,898
Ukraine	Low	534	2,151
India	Low	1,161	2,325
Dominican Republic	Low		2,763
Tanzania	Low	216	3,057
Zimbabwe	Low	2,624	3,109
Uzbekistan	Low		3,136
Zambia	Low	2,000	3,152
Vietnam	Low		3,326
Indonesia	Low	945	3,401
Botswana	Low	3,998	3,517
Pakistan	Low		3,631
Nigeria	Low	980	3,940
Honduras	Low	1,483	4,111
Thailand	Low	3,344	4,168
Costa Rica	Low	3,360	4,236
Yemen, Rep.	Low		4,248
Senegal	Low	2,948	4,318
Philippines	Low	2,848	4,427
Slovak R.	Low	2,330	4,531
Colombia	Low	3,851	4,603
El Salvador	Low	4,270	4,622
Egypt, Arab Rep.	Low	1,732	4,756
Fiji	Low		4,824
Kenya	Low	1,052	5,098
Malaysia	Low	4,279	5,334
Hungary	Low	3,702	5,426
Ghana	Low	1,053	5,475
Poland	Low	2,610	5,540
Jamaica	Low	4,002	5,557
Ecuador	Low	2,314	5,596
Panama	Low	6,860	6,453
Mexico	Low	7,786	6,465
Guatemala	Low	316	6,786
Trinidad and Tobago	Low	5,323	6,994
Venezuela, RB	Low	4,291	7,393

Swaziland	Low	4,833	7,500
Russian Federation	Low	1,100	7,527
Uruguay	Low	6,349	7,997
Turkey	Low	7,375	8,370
Morocco	Low	3,759	8,422
Tunisia	Low	4,566	9,058
Nicaragua	Low		9,206
Malta	Low	10,422	9,211
Chile	Low	7,743	9,485
South Africa	Low	9,233	10,257
Barbados	Low	10,402	10,480
Peru	Low	4,696	11,065
Brazil	Low	8,563	11,227
Singapore	High	17,695	11,885
Portugal	High		14,236
Bahamas, The	High		14,288
Taiwan	High	13,937	14,699
Saudi Arabia	Low		14,912
Korea, Rep.	High	14,328	15,549
Bahrain	High		16,047
Netherlands Antilles	High	13,798	16,596
Hong Kong, China	High	14,989	17,478
New Zealand	High	17,257	17,736
Argentina	Low	14,431	18,003
Israel	High	22,649	19,572
Greece	High	13,829	22,855
Australia	High	22,554	23,313
Ireland	High	22,382	23,392
Spain	High	18,978	25,848
United Kingdom	High	23,128	26,487
Sweden	High	25,235	27,380
Italy	High	32,145	30,574
Austria	High	31,854	31,209
Finland	High	24,729	32,049
Denmark	High		32,934
Norway	High	30,983	33,022
United Arab Emirates	High		33,603
France	High		33,628
Aruba	High		34,745
Canada	High	27,027	35,268
Netherlands	High		35,973
Belgium	High		40,134
Luxembourg	High		43,614
Germany	High	35,988	44,146
Switzerland	High		44,248
Japan	High	30,613	57,126

TABLE 4

SUMMARY STATISTICS: VERTICALLY-INTEGRATED FIRMS

Variable	No. of Obs	Mean	Standard Deviation	Change in 1982-1999
US (domestic) Share in Labor Expenditures across all locations	2088	0.807	0.131	-0.041
High-Income Affiliate Share in Labor Expenditures	2088	0.172	0.116	0.038
Low-Income Affiliate Share in Labor Expenditures	2088	0.021	0.040	0.003
Log US Manufacturing Wages, NBER	2088	3.394	0.155	0.166
Log High-Income Affiliate Wages	2088	2.979	0.380	-0.170
Log Low-Income Affiliate Wages	2088	2.319	1.088	-0.266
Log US Price of Investment, NBER	2088	0.798	0.092	-0271
Log High-Income Affiliate Price of Investment	2088	0.675	0.264	-0.079
Log Low-Income Affiliate Price of Investment	2088	0.712	0.283	-0.059
U.S R&D Employees (% in Total Employment)	2088	0.091	0.091	0.043
High-Income Affiliate R&D Employment (% in Total Employment)	2088	0.036	0.063	-0.024
Low-Income Affiliate R&D Employment (% in Total Employment)	2088	0.005	0.016	-0.006
Import Penetration, Schott	2088	0.178	0.108	0.146
Import Penetration from Low-Income Countries, Schott	2088	0.044	0.040	0.062
Log Price of Consumption Goods Abroad	2088	0.063	0.178	0.036
Percent Firms with Employees in Low-income Countries	2088	12.225	1.564	0.096
Parent Sales by Industry	2088	9.649	1.406	0.348
Affiliate Sales by Industry	2088	9.281	1.366	0.351

SUMMARY STATISTICS: HORIZONTALLY-INTEGRATED FIRMS

Variable	No. of Obs	Mean	Standard Deviation	Change in 1982-1999
US (domestic) Share in Labor Expenditures across all locations	1778	0.834	0.137	-0.039
High-Income Affiliate Share in Labor Expenditures	1778	0.140	0.126	0.036
Low-Income Affiliate Share in Labor Expenditures	1778	0.025	0.046	0.005
Log US Manufacturing Wages, NBER	1778	3.322	0.204	0.009
Log High-Income Affiliate Wages	1778	3.001	0.363	-0.199
Log Low-Income Affiliate Wages	1778	2.208	1.080	-0.189
Log US Price of Investment, NBER	1778	0.827	0.040	-0.131
Log High-Income Affiliate Price of Investment	1778	0.647	0.259	-0.117
Log Low-Income Affiliate Price of Investment	1778	0.674	0.276	-0.094
U.S R&D Employment (% in Total Employment)	1778	0.031	0.050	0.003
High-Income Affiliate R&D Employment (% in Total Employment)	1778	0.020	0.058	-0.023
Low-Income Affiliate R&D Employment (% in Total Employment)	1778	0.006	0.023	-.009
Import Penetration, Schott	1778	0.127	0.085	0.082
Import Penetration from Low-Income Countries, Schott	1778	0.0513	0.059	0.099
Log Price of Consumption Goods Abroad	1778	0.103	0.217	0.058
Percent Firms with Employees in Low-income Countries	1778	12.828	1.733	-0.082
Parent Sales by Industry	1778	9.746	1.704	0.212
Affiliate Sales by Industry	1778	9.486	1.651	0.244

Unless indicated, variables are computed using the BEA benchmark surveys of direct investment abroad for the years 1982, 1989, 1994, 1999.

TABLE 5

WITHIN ESTIMATES OF LABOR DEMAND BY US PARENTS

	(1)	(2)	(3)	(4)
	Pooled	Vertical	Horizontal	F-test (p-value) for equality of coefficients for columns (2) and (3)
Log US Industrial Wages	-0.398	-0.336	-0.518	0.105
	[0.069]**	[0.080]**	[0.090]**	
Log Industrial Wages in Low-income Countries	0.067	-0.032	0.027	0.000
	[0.033]*	[0.007]**	[0.008]**	
Log Industrial Wages in High-income Countries	-0.031	-0.060	0.092	0.034
	[0.015]*	[0.291]	[0.036]**	
Log of the US Price of Capital	0.251	0.474	0.573	0.834
	[0.160]	[0.181]**	[0.406]	
Log of the Foreign Price of Capital	-0.338	-0.121	-0.587	0.114
	[0.150]*	[0.205]	[0.212]**	
Log of the Foreign Price of Consumer Goods	0.819	0.577	1.150	0.032
	[0.149]**	[0.198]**	[0.208]**	
Import Penetration	0.031	-0.350	0.531	0.000
	[0.120]	[0.116]**	[0.491]	
Import Penetration from Low Wage Countries	-0.143	0.327	-0.610	0.000
	[0.204]	[0.291]	[0.274]**	
R&D (% Employment)	-0.475	-0.354	-0.913	0.013
	[0.100]**	[0.115]**	[0.194]**	
R&D (% Employment) in High-income Countries	0.346	0.247	0.723	0.014
	[0.164]*	[0.190]	[0.312]*	
R&D Spending (% Employment) in Low-income Countries	1.399	1.905	1.271	0.122
	[0.671]*	[0.947]*	[0.981]	
Dummy Equal to One if Firm has Employees in Low-income Countries	0.453	0.931	0.173	0.000
	[0.097]**	[0.143]**	[0.128]	
Time dummy 1989	-0.023	0.017	-0.001	0.819
	[0.026]	[0.036]	[0.044]	
Time dummy 1994	-0.001	0.105	0.002	0.564
	[0.036]	[0.051]*	[0.066]	
Time dummy 1999	0.154	0.268	0.196	0.744
	[0.046]**	[0.064]**	[0.090]*	
Observations	3866		3866	
Number of firms	1868		1868	
R-squared	0.05		0.16	

Notes: Standard errors corrected for arbitrary heterskedasticity are in brackets. * indcates significant at 5% while ** indicates significant at 1%. In column (1), we impose that the coefficients on horizontal and vertical multinationals are the same. In columns (2) and (3) we allow the coefficients to differ. Column (4) reports tests of the equality of coefficients across the two types of enterprises. Dependent variable is the log of US employment. Within estimates calculated by taking deviations from firm-level means over the sample period. Log industrial wages in high and low income countries taken from UNIDO database, INDSTAT3 (2006), based on surveys and secondary sources collected by UNIDO and converted to US dollars.

TABLE 6

WITHIN ESTIMATES OF US LABOR DEMAND USING UNIDO WAGES INSTEAD OF BEA WAGES IN LOW AND HIGH INCOME AFFILIATE LOCATIONS

	(1) Pooled	(2) Vertical	(3) Horizontal
Log US Industrial Wages	-0.311	-0.299	-0.399
	[0.079]**	[0.077]**	[0.088]**
Log Industrial Wages in Low-income Countries	0.076	-0.025	0.031
	[0.033]*	[0.007]**	[0.007]**
Log Industrial Wages in High-income Countries	-0.041	-0.061	0.092
	[0.023]*	[0.029]*	[0.036]**
Log of the US Price of Capital	0.121	0.411	0.373
	[0.060]*	[0.112]**	[0.226]
Log of the Foreign Price of Capital	-0.338	-0.111	-0.518
	[0.150]*	[0.191]	[0.209]**
Log of the Foreign Price of Consumer Goods	0.723	0.579	0.970
	[0.149]**	[0.198]**	[0.333]**
Import Penetration	-0.007	-0.389	0.444
	[0.120]	[0.155]**	[0.694]
Import Penetration from Low Wage Countries	-0.267	0.307	-0.734
	[0.105]*	[0.292]	[0.334]**
R&D (% Employment)	-0.482	-0.358	-0.915
	[0.100]**	[0.115]**	[0.194]**
R&D (% Employment) in High-income Countries	0.345	0.243	0.720
	[0.264]	[0.190]	[0.312]*
R&D (% Employment) In Low-income Countries	1.356	1.879	1.259
	[0.671]	[0.999]	[0.982]
Dummy Equal to One if Firm has Employees in Low-income Countries	0.332	0.734	0.183
	[0.077]**	[0.314]**	[0.128]
Time dummy 1989	-0.059	-0.073	-0.098
	[0.038]	[0.043]	[0.101]
Time dummy 1994	-0.062	-0.044	0.057
	[0.040]	[0.045]	[0.115]
Time dummy 1999	0.075	0.082	0.072
	[0.046]	[0.071]	[0.071]
Observations	3166	3166	3166
Number of firms	1529		1529
R-squared	0.04		0.15

Notes: Standard errors corrected for arbitrary heterskedasticity are in brackets. * indcates significant at 5% while** indicates significant at 1%. In column (1), we impose that the coefficients on horizontal and vertical multinationals are the same. In columns (2) and (3) we allow the coefficients to differ. Dependent variable is the log of US employment. Within estimates calculated by taking deviations from firm-level means over the sample period.

TABLE 7

Implied Elasticity of Labor Demand and Allen Elasticity of Substitution Across Alternative Specifications

	(1) Basic Specification (Table 5)	(2) Replacing BEA wages with UNIDO wages (Table 6)	(3) CES specification (Table A.7)	(4) Translog Cost Function (Table A.6)	(5) Adding Sales to Basic Specification
Implied Elasticity of Labor Demand ηij					
(% Change in Li in Response to % Change in wj)					
Own Elasticity of Labor Demand					
Vertical	-0.336	-0.299	--	-0.126	-0.501
Horizontal	-0.518	-0.399	--	-0.153	-0.658
Elasticity with respect to wages in Horizontal Firms					
Low-income Affiliate Locations	0.027	0.031	0.029	0.020	0.027
High-income Affiliate Locations	0.092	0.092	0.087	0.125	0.077
Elasticity with respect to wages in Vertical Firms					
Low-income Affiliate Locations	-0.032	-0.025	-0.033	-0.010	-0.032
High-income Affiliate Locations	-0.060	-0.061	0.051	0.162	-0.001
Implied Allen Elasticity of Substitution σ *jk*					
Own Elasticity of Substitution					
Vertical	-0.416	-0.371	--	-0.156	-0.621
Horizontal	-0.621	-0.478	--	-0.184	-0.789
Elasticity with respect to Low-income Countries					
Vertical	.-1.51	-1.2	-1.381	-0.455	-1.50
Horizontal	1.08	1.24	1.571	0.803	1.09
Elasticity with respect to High-income Countries					
Vertical	-.351	-0.355	0.297	0.939	-0.006
Horizontal	0.657	0.657	0.621	0.892	0.550

Notes: Coefficients taken from Tables 5 and 6 and Appendix Tables A.6 and A.7 in the text. Factor shares used to compute elasticities taken from sample means (see Table 4). See equations (15) and (16) for formulas to convert elasticities of labor demand into Allen elasticities of substitution and vice versa. 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.

Table 8
Calculating the Impact of Different Aspects of Globalization on Labor Market Outcomes

Factors Affecting US Labor Demand	VERTICAL				HORIZONTAL			
	Impact of 1% increase in factor	Actual increase in sample	Percentage Change in Labor Demand	Keeping Only Significant coefficients	Impact of 1% increase in factor	Actual increase in sample	Percentage Change in Labor Demand	Keeping Only Significant coefficients
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log US Industrial Wages	-0.336	0.177	-5.931	-5.931	-0.518	0.043	-2.217	-2.217
Log Industrial Wages in Low-income Countries	-0.032	-0.266	0.846	0.846	-0.027	-0.189	0.510	0.510
Log Industrial Wages in High-income Countries	-0.060	-0.170	1.020		0.092	-0.199	-1.831	-1.831
Log of US Price of Capital	0.474	-0.271	-12.845	-12.845	0.573	-0.151	-8.652	-8.652
Log of Foreign Price of Capital	-0.121	-0.079	0.956		-0.587	-0.117	6.868	6.868
Log of Foreign Price of Consumer Goods	0.577	-0.059	-3.404	-3.404	1.150	-0.094	-10.810	-10.810
Import Penetration	-0.351	0.146	-5.125	-5.125	0.531	0.082	4.354	
Import Penetration form Low Wage Countries	0.327	0.062	2.027		-0.610	0.099	-6.039	-6.039
R&D Employment	-0.354	0.043	-1.522	-1.522	-0.913	0.003	-0.274	-0.274
R&D Employment in High-income Countries	0.247	-0.024	-0.593		0.730	-0.023	-1.679	-1.679
R&D Employment in Low-income Countries	1.905	-0.006	-1.143	-1.143	1.271	-0.006	-0.763	
Dummy equal to 1 if Firm has Operations in Developing Countries	0.93	0.03	2.61	2.61	0.173	0.09	1.63	1.626
Net Impact of all Above Variables			-23.49	-26.90			-19.08	-22.67
Adding Parent Sales	0.142	0.096	1.36	1.36	0.16	-0.082	-1.31	-1.312
Adding Affiliate Sales	0.036	0.348	1.25	1.25	0.124	0.212	2.63	2.629
Net effect including Parent and Affiliate Sales			-20.88	-24.29			-17.76	-21.35

Notes: coefficients in columns (1) and (5) taken from Table 5. Numbers in columns (2) and (6) taken from means Table 4. Numbers is columns (3) and (7) calculated by multiplying by 100 column (1) and column (2) (for column (3)) and column (5) and column (6) (for column (7)). Columns (4) and (8) calculated the same way as columns (3) and (7), but only the coefficients which were significant in Table 5 are reported. The Net Impact column sums up all the previous effects.

APPENDIX TABLE A.1: 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 US 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 (US 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 US	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 US	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 (US 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 US	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 US	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 (US 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 US	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 US	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 US	62.5 %	NA	NA

APPENDIX TABLE A.2:

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, US reporting requirements vary over time, no reporting requirement for Sweden)	Imposing no Cut-off on Germany affiliate reporting
BEA Data		
Employees of US Affiliates in 1999 in Germany	458,744	NA
Employees of US Affiliates in 1999 in Sweden	67,044	NA
German Government Data (Direct US Ownership only)		
Employees of US Affiliates in 1998	466,941	488,866
Employees of US Affiliates in 1999	509,537	532,594
Employees of US Affiliates in 2000	488,157	509,176
Swedish Government Data		
Employees of US Affiliates in 1997 (Majority owned only)	51,138	NA
Employees of US Affiliates in 1998 yoo(Majority owned only	61,089	NA
Employees of US Affiliates in 1999 (Majority owned only)	78,621	NA

APPENDIX TABLE A.3:
DESCRIPTION OF VARIABLES AND DATA SOURCES

Variable Name	Source	Description
Log Wage (Industry level)	US Bureau of Economic Analysis	Wages and salaries of employees and employer expenditure employee benefit plans in parents computed separately for p high-income affiliates and other affiliates and averaged acro industries.
Log Wage (Industry level)	UNIDO	Wages calculated based on surveys administered by UNIDO supplemented with secondary sources (such as national stat agencies). Wages calculated as compensation divided by n of employees at the 3 digit ISIC level Revision 2. All valu converted to US dollars using the IMF exchange rate series taken from INDSTAT3, published in 2006 by UNIDO.
Log Employment	US Bureau of Economic Analysis	Log of the number of full-time and part-time employees on payroll at the end of the fiscal year in all affiliates. Howeve count taken during the year was accepted if it was a reasona proxy for the end-of-year number. Computed separately for high-income affiliates and other affiliates.
R&D Share R&D Share (High-income Affiliates) R&D Share (Low-income Affiliates)	US Bureau of Economic Analysis	Number of employees in research and development as a per of total employment. Computed separately for US parents, a in high-income locations and affiliates in low-income locat
US 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 s deflators for structures and equipment, based on the distribu 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 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 Appendix for PWT 6.1 for more details, or http://pwt.econ.upenn.edu.
US Import Penetration	Bernard, Jensen and Schott (2006)	Imports into the US divided by imports into the US plus tot production in the US less exports from the US by year by 4 SIC 1987 revision code industrial classification.
US Import Penetration from Low-Income Countries	Bernard, Jensen and Schott (2006)	Share of products in an industry sourced from at least one c with less than 5 percent of US per capita GDP

APPENDIX TABLE A.4
WITHIN ESTIMATES OF LABOR DEMAND BY US PARENTS
WITH INDUSTRY SALES ADDED AS A CONTROL

	(1) Pooled	(2) Vertical	(3) Horizontal
Log US Industrial Wages	-0.533	-0.501	-0.658
	[0.070]**	[0.092]**	[0.096]**
Log Industrial Wages In Low-income Countries	0.064	-0.032	0.027
	[0.033]	[0.007]**	[0.005]**
Log Industrial Wages in High-income Countries	0.030	-0.001	0.077
	[0.023]	[0.029]	[0.036]*
Log of the US Price of Capital	0.137	0.319	0.262
	[0.161]	[0.106]**	[0.433]
Log of the Foreign Price of Capital	-0.298	-0.141	-0.487
	[0.149]*	[0.204]	[0.211]**
Log of the Foreign Price of Consumer Goods	0.734	0.536	1.034
	[0.148]**	[0.197]**	[0.207]**
Import Penetration	-0.098	-0.523	0.296
	[0.120]	[0.156]**	[0.194]
Import Penetration from Low Wage Countries	-0.046	0.524	-0.551
	[0.205]	[0.292]	[0.276]**
R&D Spending (% Sales)	-0.494	-0.344	-1.016
	[0.099]**	[0.114]**	[0.194]**
R&D Spending (% Sales) in High-income Countries	0.308	0.210	0.637
	[0.163]	[0.189]	[0.310]*
R&D Spending (% Sales) in Low-income Countries	1.021	1.933	0.899
	[0.667]	[0.937]*	[0.979]
Dummy Equal to One if Firm has Employees in Low-income Countries	0.466	0.955	0.160
	[0.098]**	[0.142]**	[0.129]
Log of Parent Sales by Industry	0.144	0.142	0.160
	[0.016]**	[0.025]**	[0.019]**
Log of Affiliate Sales by Industry	0.029	0.036	0.124
	[0.005]**	[0.007]**	[0.007]**
Time dummy 1989	-0.017	-0.033	0.019
	[0.028]	[0.034]	[0.065]
Time dummy 1994	0.012	0.025	0.039
	[0.041]	[0.047]	[0.107]
Time dummy 1999	0.101	0.102	0.154
	[0.046]*	[0.052]*	[0.120]
Observations	3866	3866	3866
Number of firms	1868	1868	1868
R-squared	0.07	0.18	0.18

Standard errors in brackets
* significant at 5%
** significant at 1%

Appendix Table A.5
Correcting For Selection

	(1) Unweighted	(2) Weighted (Controlling for Selection)	(3) Unweighted	(4) Weighted (Controlling for Selection)
	Vertical	Vertical	Horizontal	Horizontal
Log US Industrial Wages	-0.339	-0.351	-0.520	-0.541
	[0.112]**	[0.123]*	[0.131]**	[0.180]**
Log Industrial Wages in Low-income Countries	-0.032	-0.021	0.071	0.097
	[0.008]**	[0.009]*	[0.030]**	[0.039]**
Log Industrial Wages in High-income Countries	-0.003	0.010	0.088	0.047
	[0.032]	[0.029]	[0.039]*	[0.016]*
Log of the US Price of Capital	0.472	0.854	0.566	0.909
	[0.130]**	[0.136]**	[0.162]**	[0.178]**
Log of the Foreign Price of Capital	-0.117	-0.076	-0.583	-0.219
	[0.037]**	[0.026]**	[0.224]**	[0.092]**
Log of the Foreign Price of Consumer Goods	0.572	0.372	1.148	0.424
	[0.231]*	[0.126]**	[0.249]**	[0.132]**
Import Penetration	-0.357	-0.398	0.529	0.980
	[0.122]**	[0.121]**	[0.532]	[0.910]
Import Penetration from Low Wage Countries	0.331	0.957	-0.606	-0.664
	[0.354]	[0.789]	[0.223]**	[0.502]**
R&D (% Employment)	-0.354	-0.250	-0.911	-1.061
	[0.136]**	[0.125]*	[0.411]**	[0.513]*
R&D (% Employment) in High-income Countries	0.247	0.155	0.719	0.667
	[0.470]	[0.568]	[0.357]*	[0.522]
R&D Spending (% Employment) in Low-income Countries	1.905	1.221	1.267	1.322
	[0.915]*	[1.062]	[0.726]	[0.709]
Dummy Equal to One if Firm has Employees in Low-income Countries	0.931	0.697	0.172	0.133
	[0.178]**	[0.239]**	[0.140]	[0.251]
Time dummy 1989	0.017	0.110	-0.002	0.265
	[0.050]	[0.062]	[0.056]	[0.266]
Time dummy 1994	0.106	0.227	0.001	0.521
	[0.077]	[0.096]*	[0.089]	[0.259]*
Time dummy 1999	0.269	0.482	0.195	0.812
	[0.101]**	[0.126]**	[0.129]	[0.144]**
Lead Sit+1	-0.088		-0.151	
	[0.032]**		[0.040]**	
Observations	3866	3866	3866	3866
Number of firms	1868	1868	1868	1868

Standard errors in brackets
* significant at 5%
** significant at 1%

APPENDIX TABLE A.6

TRANSLOG COST SHARE SPECIFICATION: DEPENDENT VARIABLE IS US WAGE BILL AS A SHARE OF TOTAL EXPENDITURES ON LABOR ACROSS ALL LOCATIONS

	(1) Pooled	(2) Vertical	(3) Horizontal
Log of US Industrial Wages	0.055 [0.004]**	0.074 [0.005]**	0.030 [0.006]**
Log Industrial Wages in Low-income Countries	-0.023 [0.007]**	-0.047 [0.011]**	-0.007 [0.003]**
Log Industrial Wages in High-income Countries	0.002 [0.004]	-0.009 [0.006]	-0.016 [0.006]**
σ_{jj} : own elasticity	-0.167	-0.156	-0.184
σ_{jk} : low income countries	0.303	-0.455	0.803
σ_{jk} : high income countries	1.106	0.939	0.892
Log of the US Price of Capital	0.151 [0.026]**	0.159 [0.031]**	0.087 [0.092]
Log of the Foreign Price of Capital	-0.154 [0.025]**	-0.092 [0.034]**	-0.228 [0.034]**
Log of the Foreign Price of Consumer Goods	0.028 [0.025]	-0.060 [0.033]	0.117 [0.034]**
Import Penetration	-0.005 [0.020]	-0.040 [0.026]	0.049 [0.031]
Import Penetration from Low Wages	0.073 [0.033]*	0.202 [0.048]**	-0.046 [0.045]
R&D Employment	-0.018 [0.017]	-0.021 [0.019]	-0.039 [0.034]
R&D Employment in High-income Countries	-0.110 [0.027]**	-0.105 [0.031]**	-0.097 [-.052]
R&D Employment in Low-income Countries	0.295 [0.111]**	0.404 [0.157]*	0.215 [0.162]
Dummy Equal to One if Firm has Employees in Low-income Countries	0.017 [0.016]	0.065 [0.024]**	-0.023 [0.021]
Time dummy 1989	-0.083 [0.004]**	-0.088 [0.005]**	-0.082 [0.008]**
Time dummy 1994	-0.119 [0.006]**	-0.116 [0.007]**	-0.129 [0.013]**
Time dummy 1999	-0.145 [0.007]**	-0.156 [0.008]**	-0.140 [0.015]**
Observations	3866	3866	3866
Number of firms	1898	1898	1898
R-squared	0.20	0.31	0.31

Standard errors in brackets
* significant at 5%
** significant at 1%

APPENDIX TABLE A.7

CES SPECIFICATION: DEPENDENT VARIABLE IS RATIO OF LOG EMPLOYMENT AT HOME TO LOG EMPLOYMENT ABROAD
REPORTED COEFFICIENT IS ON THE INDEPENDENT VARIABLE : (LOG) WAGES AT HOME RELATIVE TO WAGES ABROAD
COEFFICIENT IS (THE NEGATIVE OF) THE IMPLIED ALLEN ELASTICITY OF SUBSTITUTION σij

	(1) Pooled	(2) Pooled	(3) Vertical	(4) Vertical	(5) Horizontal	(6) Horizontal
Log of the Ratio of US Wages to Wages in High-income Countries	-0.146 [0.031]**		-0.297 [0.227]		-0..621 [0.223]**	
Log of the Ratio of US Wages to Wages in Low-income Countries		0.063 [0.086]		1.381 [0.061]**		-1.571 [0.342]**
Log of the Foreign Price of Consumer Goods	-0.271 [0.211]	-1.100 [0.375]**	-0.606 [0.275]*	0.559 [0.561]	0.117 [0.284]	-2.155 [0.455]**
Import Penetration	-0.208 [0.170]	-0.414 [0.388]	-0.586 [0.217]**	-0.332 [0.546]	0.278 [0.260]	-0.244 [0.484]
Import Penetration from Low Wage Countries	0.111 [0.285]	0.154 [0.526]	1.292 [0.405]**	2.818 [0.965]**	-0.953 [0.369]**	-0.650 [0.287]**
R&D Spending (% Sales)	-0.231 [0.141]	0.248 [0.413]	-0.094 [0.162]	0.378 [0.481]	-0.745 [0.275]**	0.295 [0.720]
R&D Spending (% Sales) in High-income Countries	-0.784 [0.231]**	-1.239 [0.368]**	-0.468 [0.267]	-1.164 [0.519]*	-1.464 [0.437]**	-1.784 [0.518]**
R&D Spending (% Sales) in Low-income Countries	-0.871 [0.947]	0.764 [1.128]	0.292 [1.334]	-1.960 [1.688]	-1.091 [1.375]	3.090 [1.573]*
Time dummy 1989	-0.346 [0.038]**	-0.471 [0.080]**	-0.340 [0.039]**	-0.540 [0.088]**	-0.340 [0.039]**	-0.540 [0.088]**
Time dummy 1994	-0.445 [0.054]**	-0.516 [0.121]**	-0.449 [0.058]**	-0.686 [0.138]**	-0.449 [0.058]**	-0.686 [0.138]**
Time dummy 1999	-0.624 [0.060]**	-0.929 [0.138]**	-0.633 [0.065]**	-1.111 [0.157]**	-0.633 [0.065]**	-1.111 [0.157]**
Observations	3866	1254	3866	1254	3866	1254
Number of firms	1868	598	1868	598	1868	598
R-squared	0.10	0.18	0.10	0.19	0.10	0.19

Standard errors in brackets
* significant at 5%
** significant at 1%