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ABSTRACT

Critics of globalization claim that firms are being driven by the prospects of cheaper labor to shift employment abroad. Yet the evidence, beyond anecdotes, is slim. This paper focuses on the labor market decisions of US multinationals at home and abroad for the years 1977 to 1999. Using firm level data collected by the US Bureau of Economic Analysis (BEA), we separately estimate the impact on US manufacturing employment of affiliate activity abroad, imports and exports within multinational firms, and technological change. We begin by reporting correlations between US multinational employment at home and abroad. Evidence based on the operations of US multinationals suggests that the sign of the correlation depends upon the crucial distinction between affiliates in high-income and low-income countries. US employment and employment in low-income (high-income) countries are substitutes (complements). The complementarity is driven by an overall contraction in manufacturing employment both in the US and in affiliates based in high-income countries. We then develop an empirical framework which allows the firm to determine employment at home and abroad simultaneously. Using a variety of different theoretical approaches to estimating labor demand and a range of econometric techniques, we find that employment in low income countries substitutes for employment at home. Employment in high income affiliates, however, is generally complementary with US employment. Second, US capital investments in both high and low income affiliates are associated with lower employment in the United States. Finally, our results show that other factors have made important contributions to falling manufacturing employment in the United States, including technological change and import competition. Taken together, our results suggest that concerns over the impact of globalization on US jobs are grounded in reality.

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I. Introduction

Critics of globalization claim that U.S. firms are shutting down factories at home and shifting employment abroad to countries with cheaper labor and lower labor standards. Yet the evidence for this, beyond anecdotes, is slim. In a now-infamous press conference for the Economic Report of the President (2004), Gregory Mankiw pointed out that U.S. outsourcing is good for the U.S. economy. More recently, Mankiw and his co-author, Phillip Swagel, have further argued that "increased employment in the overseas affiliates of U.S. multinationals is associated with *more* employment in the U.S. parent rather than less."

Yet it seems likely that the increased internationalization of U.S. business would be accompanied by downsizing at home. This is only natural as the U.S. loses its comparative advantage in producing some types of goods (for example, apparel) and shifts to the production of other goods (aircraft, high-tech). Why should offshore activities—either through outsourcing or outward foreign investment (the expansion of U.S. affiliates abroad)—be perceived any differently than international trade in goods? Just as international trade benefits the economy as a whole, but creates both winners and losers in the domestic economy, we would expect some winners and losers from offshoring as well. The winners are likely to be the owners of firms who are able to increase profits by finding lower labor or investment costs abroad, the consumers who pay lower prices for their goods, and the workers whose jobs are made easier by having access to a global labor force. The losers are those who must now compete with workers in foreign locations, whether these are steel workers in Brazil or computer programmers in Bangalore. Identifying these losers could be quite difficult if the firm could not have survived without spinning off some of its activities abroad. What is clear, however, is that there will be losers within the U.S. labor force, just as there are both winners and losers from international trade.

Yet several prominent economists have argued that expansion abroad helps employment at home. Such an argument is difficult to reconcile with the fact that U.S. multinational firms shed more than 3 million manufacturing jobs (net) in the U.S. between 1977 and 1999, while expanding employment in low-income countries[1]. Indeed, firms like Mattel and Levi Strauss that once employed a significant number of workers in the U.S. no longer manufacture in the United States. Where does this evidence for the job-creating effects of offshoring come from?

The recent academic evidence on this question is in fact contradictory. Brainard and Riker (2001), Muendler and Becker (2006), and Hanson, Mataloni, and Slaughter (2003) find that jobs abroad do substitute for jobs at home but the effect is small. Other recent studies, by Amiti and Wei (2005), Borga (2005), and Desai, Foley, and Hines (2005) suggest the opposite: expansion abroad stimulates job growth at home. Mankiw and Swagel (2006), reviewing the available evidence, argue that when US firms expand employment abroad they boost employment at home. Slaughter (2003) suggests that for every new job abroad, US domestic manufacturing employment increases three-fold.[2]

In this paper, we show that the degree of complementarity between US and foreign labor in manufacturing depends on whether affiliates are located in high-income or low-income countries. Aggregating across all locations, employment expansions and contractions in US multinational parents and their affiliates on average move in the same direction. The overall contraction in US manufacturing employment has been accompanied by an overall contraction in affiliate employment. However, these averages mask significant heterogeneity across different kinds of enterprises. For parents that hire workers in developing countries – roughly half the sample – the story is different. For these firms, the contraction in US manufacturing employment

[1] Our numbers differ from official BEA statistics because we do not use data estimated by the BEA.

[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.

has been accompanied by an increase in affiliate employment. This evidence highlights the importance of differentiating between jobs in low-income countries and jobs in other industrialized countries. It also helps to reconcile contradictory findings in the academic literature and anecdotal evidence in the popular press of factory closings and falling manufacturing employment.

To determine the relative importance of "exporting" jobs, we develop an empirical framework which allows firms to simultaneously determine employment at home and abroad. We address simultaneity problems using instrumental variables techniques. Instruments for employment abroad include factors that positively affect labor supply in affiliate locations, such as educational attainment, as well as factors that reduce transport costs (such as infrastructure development). We also account for sample selection problems: US firms most affected by global competition may leave the sample. Previous research (such as Borja (2005)) which finds evidence that parent employment in the United States and foreign affiliates is complementary fails to account for selection issues. To identify determinants of entry and exit which do not belong in the labor demand equation, we draw on the recent literature on firm heterogeneity, which predicts that the most productive firms are those most likely to engage in outward foreign investment. Our results show that survival of affiliates is most likely for highly productive as well as more profitable enterprises, which is consistent with recent theoretical work but has not been tested with firm-level data.

We find that while some jobs have been "exported abroad", this is only part of the explanation for the sharp contraction in US parent employment. Previous papers on this issue have failed to take into account that international trade, physical investment abroad by US parents and technological change play an equally important role. The negative demand shock for parent employment induced by expansion in low-income countries is robust to different ways of estimating labor demand.

Even for enterprises that expanded their labor force in low-income regions and reduced employment in the US, there remains the possibility that access to cheap labor and foreign markets has helped US parents to survive. Our analysis suggests that this is the case: firms operating in low-income countries are more likely to survive. In addition, the majority of turnover in the sample is among small firms that do not operate at all in low-income countries. Viewed in this light, the overall impact of globalization on US employment may have been positive.

Our data are firm level data collected by the Bureau of Economic Analysis (BEA) in Washington, D.C. on employment, wages, net-income and investment. During 1982 through 1999, these firms accounted for 60 percent of US sales and employment in manufacturing, 70 percent of exports, and 80 percent of private R&D in manufacturing, a sizeable share of US manufacturing[3]. We use this dataset for several reasons. First, this is the most comprehensive database available that includes information on both US parent activity and the operations of those parents in foreign countries through affiliate ownership activities. Second, the dataset includes information on other international activities of US enterprises, such as trade. In particular, the dataset includes information on imports and exports between the parent and its affiliates, allowing us to compare the employment impact of trade and foreign investment operations within the firm. Third, the dataset includes detailed research and development activities of the parents and affiliates, allowing us to use this information as a proxy for technological change. Consequently, we are able to compare the impact of foreign affiliate activity, trade, and technological change on US labor market outcomes.

[3] This is for the period 1982-1999. See Figure 1.

Before describing our research, we briefly summarize the literature on the employment effects of offshoring. Using data for 1982 through 1992, Brainard and Riker (2001) use a translog cost function approach to derive the implied substitutability between labor employed by the U.S. parent and its' affiliates. Brainard and Riker find that foreign affiliate employment abroad is a substitute for employment in the U.S., but the magnitudes are small. For low-income affiliates, a 10 percentage point decline in affiliate wages would be associated with a .15 percent fall in U.S. employment, while a 10 percentage point decline in high-income affiliate wages would be associated with a 1.1 percent fall in U.S. employment. Recent work by Muendler et al (2005) and Muendler and Becker (2006) suggests that in Sweden and Germany, foreign affiliate employment also substitutes for home employment, but the magnitudes are also small.

Three other studies that use the same BEA dataset as Brainard and Riker come to a different conclusion. Borga (2005) finds a significant positive correlation between changes in parent employment and changes in affiliate employment, which leads her to conclude that there is a complementary relationship between US parent and affiliate employment. She finds the same positive relationship whether she uses total affiliate employment or affiliate employment in low-income countries, suggesting to her that "expansion of operations in low-income countries is associated with gains, not losses, in employment at the parent". Desai, Foley, and Hines (2005) also find a positive association between domestic and foreign activity of US multinationals. They find that an additional $10 dollars of foreign capital investment is associated with $15 additional domestic investment, and increasing foreign employment is associated with increasing employment at home. Mankiw and Swagel (2006) conclude from this that "foreign activity does not crowd out domestic activity; the reverse is true". Finally, Brainard and Riker (1997), using the same BEA manufacturing data but focusing only on the foreign operations of U.S.

companies, find that labor demand across high- and low-income locations is complementary. The fact that Brainard and Riker (2001) reach different conclusions from Brainard and Riker (1997) can be attributed to a different methodology and also to the use of different samples from the BEA data. While Brainard and Riker (1997) restrict their work to non-U.S. locations, Brainard and Riker (2001) focus on U.S. employment outcomes.

To summarize, the recent evidence on the linkages between multinational parent employment and affiliate employment is mixed, even for different studies using the same BEA data. Our work differs from previous work in important ways. We account for the fact that hiring an additional worker in a high-wage country is likely to have a different impact on US employment than hiring a worker in a low-wage country. The different effects of U.S. multinational activity on domestic employment outcomes is consistent with evidence on the employment effects of international trade presented by Bernard, Jensen and Schott (2005). Bernard et al. examine the impact of U.S. imports on both the survival and employment of U.S. manufacturing firms. They find that imports only harm U.S. manufacturing employment when those imports are from low wage countries.

We also separately identify the impact of an expansion in the US capital stock and an expansion in the capital stock in foreign affiliates (high-wage and low-wage) on parent employment. The negative impact of US investment abroad on US employment is an effect which has been overlooked in the existing literature. Equally important, we control for the impact of technical change and import competition on parent employment. Finally, we control for simultaneity and sample selection problems and also address the possibility that methodological differences might be driving the conflicting results described above.

The remainder of this paper is organized as follows. In Section II, we outline broad trends in employment and wages for US parent companies and their affiliates in developed and developing countries. We also report the correlations between hiring and firing at home and abroad for US multinationals, at both the firm and industry level. Section III describes the empirical framework and discusses econometric issues, including the strategy for identification and the proposed correction for selection out of the BEA dataset. Section IV presents the results and Section V concludes.

II. Broad Trends in US Multinational Activity: the BEA Data

We analyze the firm-level surveys on US direct investment abroad, collected each year by the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce. The BEA collects confidential data on the activities of 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 between 1977 and 1999. The benchmark years are 1977, 1982, 1989, 1994 and 1999 and include more comprehensive information than the annual surveys. To our knowledge, very little work has been done with the firm-level data using the entire length of the time series from 1977 through 1999. [4]

Creating a panel using the benchmark years of the BEA survey data is a nontrivial task. First, not all firms are required to report to the BEA and reporting requirements vary across years. Second, because we are interested in understanding what is happening at the industry

[4] Although the BEA parent identification codes changed between 1977 and 1982, linking parents from 1977 to the remaining benchmark years proved relatively straightforward. This is because in addition to a parent identification code created by the BEA (which changed between 1977 and 1982), each parent has an employee identification number (EIN) assigned to it by the Internal Revenue Service which did not change during the period 1977-1999. Using the EIN number plus the country in which the affiliate operates, we are also able to track parent/affiliate pairs over time.

level, 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. And finally, 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 to the BEA. This amount was $.5 million dollars in 1977, $3 million dollars in 1982, 1989 and 1994 and jumped 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 $100 million.[5] To determine whether the changes in reporting requirements biased our sample toward small firms 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. Therefore, we use all of the available *actual* data. We drop from our sample data that has been estimated by the BEA.[6]

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[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] This means that we have also dropped firms whose reporting status in that benchmark year is "exempt" (be11 code equal to five) since data for these firms are also effectively estimated based on data in the previous benchmark survey.

Finally, there is the issue of how to choose our sample of "manufacturing" firms.[7] Parent employment is classified both by industry of sales (up to ten industries are reported) and by industry of employment. Since none of the other data are classified by industry of employment, we choose our sample based on industry of sales using only those parents whose primary industry of sales is manufacturing. Parents have several affiliates and these affiliates are typically spread across a number of industries. We choose only affiliates classified in manufacturing since our goal is to determine whether manufacturing jobs at home are being replaced by manufacturing jobs abroad. We further limit the sample to parents whose affiliates report non-zero production employment which allows us to identify the effects of hiring both non-production and production workers on US employment.

There are a number of parents who have been reclassified from manufacturing to wholesale trade and/or services. For example, several firms were in manufacturing but are now classified in wholesale trade because almost 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 distinction , w use the larger of the two samples, keeping all parents that were ever classified in manufacturing and their manufacturing affiliates.

[7] 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 the 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.

While the number of US parents included in the BEA sample may appear small (see Table 1), these enterprises accounted for the majority of economic activity in US manufacturing during the sample period. Figure 1 updates a table by Mataloni and Fahim-Nader[8] to 1999 and reports averages over the benchmark years 1982 and 1999. Figure 1 shows that over the period 1982 to 1999, sales by these enterprises accounted for over 60 percent of total manufacturing sales in the United States. These enterprises also accounted for 71 percent of all exports of goods, and nearly 60 percent of employment in manufacturing. These multinationals also account for most of US research and development expenditures: over the period 1982 to 1999, the US parents included in the BEA sample account for 82 percent of total US research and development expenditures.

Table 1 shows that between 1977 and 1999 the multinational manufacturing firms in our sample shed more than 3 million jobs in the United States.[9] In addition, Table 1 also documents that labor's share of income (defined as parent compensation over parent compensation plus parent net income) for our sample fell from ninety-six to seventy-nine percent. The loss of jobs in the U.S. has been mirrored by job reductions (for the period between 1977 and 1999) or job stagnation (for the period between 1982 and 1999) for affiliates in developed countries. In developed country affiliates, employment fell by roughly half a million between 1977 and 1999. Labor's share and wages in the developed countries follow the US labor share and wages, although in the developed country affiliates, labor's share is substantially lower and real wages are as well. These job losses have been only partially offset by an increase in the number of jobs

[8] See the December 1996 issue of *The Survey of Current Business*, "Operations of US Multinational Companies: Preliminary Results from the 1994 Benchmark Survey," by Mataloni and Fahim-Nader, as well as the authors' own calculations.

[9] The variables we use are reported to the BEA on the basis of the fiscal year. General trends in employment weighted averages are reported in Table 1 for manufacturing and in Table 2 for services. The numbers in Table 2 include all firms classified in services under the SIC classification prior to 1997 and under the NAICS system post-1997. Because the NAICS system classifies some industries as services that were not previously classified as services, the employment numbers are slightly exaggerated. However, when we restrict our analysis of services to only those sub-categories that can be exactly matched across years, we get nearly identical trends.

in developing countries, where the number of jobs increased by half a million between 1977 and 1999 and by three quarters of a million between 1982 and 1999. In developing countries, labor's share also fell. Unlike in the developed countries, real wages paid by US based multinationals to employees in their developing country affiliates has actually fallen. The evidence for the US parents is in line with the aggregate trends in the U.S. manufacturing sector. According to the NBER Manufacturing Productivity Database, labor's share in value-added declined from .53 to .31 – roughly 50% - over the period 1958 to 1996.

There has been a substantial shift in activity from developed to developing country affiliates. Affiliate employment as a share of total employment globally for our sample of US multinationals increased from 28 percent in 1977 to 35 percent in 1999. The increase was almost entirely driven by a doubling of affiliate employment shares in developing countries, from 8 to 15 percent. Affiliate employment in developed countries, as a share of total worldwide employment, remained roughly constant over the entire period at around 20 percent. Total affiliate share of employment, employee compensation, and investment in the firms' total has increased by 20, 22 and 11 percent, respectively. This increase in overseas activity has been largely reserved for developing countries where the respective increases are 44, 47 and 31 percent.

The contraction in domestic jobs in the manufacturing sector has been more than offset by job creation in the services sector. Table 2 shows that between 1977 and 1999, employment by US parents in the sample increased by more than 4 million or 802 percent. Expansion at home has been more than matched by expansion abroad. In developed country affiliates employment increased from 73 thousand in 1977 to 1.2 million in 1999 and in developing country affiliates employment went from 24 thousand in 1977 to 363 thousand in 1999. While the share of affiliate activity still counts for less than the share of affiliate activity in manufacturing, it has grown much more rapidly in services than in manufacturing. Affiliate share of employment, employee compensation, and investment in the firms' total has risen by 63, 62 and 66 percent, respectively. Except for affiliate share of compensation, this increase in overseas activity has been fairly evenly spread between developed and developing country affiliates. The increase in developing country activity has been accompanied by a reduction in labor's share at the parent level of 11 percent. Unlike in manufacturing, labor's share overseas has remained relatively constant.

Tables 1 and 2 suggest that job losses in the manufacturing sector may have been offset by employment increases in the service sector. However, it is important to keep in mind that throughout the period 1977-1999, real compensation per worker in the service sector amounts to little more than half of real compensation per worker in the manufacturing sector. This may be partly a reflection of the change in the mix of workers in the US manufacturing sector—if unskilled US workers have been replaced by unskilled foreign workers then the average wage in the US manufacturing sector reflects the wages of skilled workers. However, the fact that this differential existed even in 1977 before the big contraction in US manufacturing suggests that this is not the only reason for the difference. Since data on the composition of employment for US parents is less detailed than the information on the skill mix of foreign affiliates, it is difficult to reach any strong conclusions on this point. What Tables 1 and 2 do show is that employment in manufacturing has shifted to services, and that average compensation in services was well below compensation in manufacturing even at the start of the sample period.

We now turn to a discussion of broad trends in the pattern of manufacturing employment changes in US parents and their affiliates. We restrict our analysis to the period 1982 to 1999 for comparability with the work by Brainard and Riker (1997, 2001) and Desai et al. (2005) who used these same data beginning in 1982.[10] As a first test of whether US parents are substituting US employment with affiliate employment, we created a series of employment offsets at the industry level. Figure 2 shows employment offsets aggregated to the 3-digit level for the manufacturing sector. Changes in parent (US) total employment are indicated by the horizontal axis and changes in affiliate total employment are indicated by the vertical axis. A point in the upper right-hand quadrant indicates expansion both at home and abroad. A point in the lower left-hand side quadrant indicates contraction at home and abroad. Substitution occurs if data points are either in the upper left-hand quadrant (indicating contraction at home and expansion in affiliate employment) or in the lower right-hand quadrant (indicating expansion at home and contraction abroad). Most US critics of globalization center on supposed activity in the upper left-hand quadrant, which would indicate expansion of affiliate employment and contraction of employment in the US; so-called substitution of foreign for US jobs. As Figure 2 shows, most of the activity of US manufacturing multinational enterprises has taken place in the lower left-hand quadrant, indicating employment contraction both at home and abroad.

Figures 3 and 4 separate changes in employment from 1982 to 1999 based on the location of the parent's affiliates. Figure 3 reports employment offsets at the 3 digit level for developed country affiliates and parents; Figure 4 reports the same trends for developing country affiliates. The trends are similar across Figures 2 and 3 – employment in high-income affiliates and parent employment are complementary but that relationship is driven by the contraction in manufacturing. However, Figure 4 reveals that employment in low-income affiliates substitutes for employment in the US. Moreover, the downward sloping regression line appears to be driven by contraction in two key sectors: computers and electronics.

[10] If we extend the period to 1977, and redo the results for 1977 to 1999, the results look similar though we lose some of our variables. In addition, if we use 1977, we are unable to correct for selection bias since no electronic version of the data exists prior to 1977.

While the stylized facts reported in Tables 1 and 2 and the figures are useful for explaining why opinions on the outsourcing of US jobs are so different, these facts do not tell us enough about the underlying mechanisms at work. The fact that substitution occurs only between US jobs and jobs in low-wage countries suggests that labor costs are important. To properly identify the causal mechanisms at work, we now develop a conceptual framework that incorporates both of these possibilities.

III. Empirical Framework and Identification Issues

Previous work has used a variety of approaches to test for the impact of foreign affiliate activity on labor demand at home, making it difficult to identify whether the conflicting results stem from different approaches or different datasets and time periods. Brainard and Riker (1997) estimate labor demand as a function of wages in different locations, while Brainard and Riker (2001) and Muendler and Becker (2006) use a translog cost function approach to derive factor shares as a function of wages in different locations. To help us disentangle why previous results contradict each other, we adopt a general enough framework that allows us to incorporate all these different approaches in our estimation strategy. We begin by deriving an empirical framework based on factor quantities. The primary reason for using this framework is that all of the variables of interest are directly observable in our dataset. For purposes of comparison with previous work and as a robustness check we also estimate these effects using a framework based on factor costs. Finally, we review the translog cost function approach.

Framework Based on Factor Quantities

Consider a representative firm that has the choice of producing either at home (*h*), or abroad (*f*). To simplify the analysis we restrict ourselves to two locations, but in our empirical estimation we will allow for sales and production in three locations – home, low-income countries and high-income countries. We assume that firm *i*'s global production function can be described in the following way:

(1) $Q_i = A_i K_i^{\beta} L_i^{1-\beta}$

where *Q* is total output, and *K* and *L* are total capital (and other non-labor inputs) and labor employed and *A* represents Hicks neutral technological change. If technical change varies across locations, then we can think of *A* as a function of technical change in different locations.

We introduce the possibility of production in various locations in the following way:

(2) $L_i = g(L_h, L_f)$

(3) $K_i = f(K_h, K_f)$.

We do not impose functional forms on (2) and (3) to acknowledge the fact that labor (capital) at home and labor abroad could be perfect complements (the Leontief aggregation), perfect substitutes (a linear function) or something in between (the CES class of functions). This nests Brainard and Riker's (2001) assumption that production is vertically decomposed across high-wage and low-wage regions – an assumption we can test in our empirical work.

The firm maximizes the following global profit function:

$$(4)\ \pi_i = P_i Q_i - w_h L_h - w_f L_f - r_h K_h - r_f K_f$$

Where π_i is the firms' total profits, P_i is a function of prices received at home and abroad and Q_i is the firms' total output.

Since we are interested in labor demand and wages in the US, we maximize (4) with respect to labor demand at home (L_h) and obtain the following first order condition:

$$(5)\ w_h = P_i \frac{\partial Q_i}{\partial L_h} \quad .$$

The marginal product of labor at home depends on the form of the aggregate production function and on the functional forms of equations (2) and (3). In other words,

$$(6)\ \frac{\partial Q_i}{\partial L_h} = \frac{\partial Q_i}{\partial L_i}\frac{\partial L_i}{\partial L_h} = \beta A_i \left(\frac{K_i}{L_i}\right)^{(1-\beta)} \frac{\partial L_i}{\partial L_h}$$

Equations (5) and (6) implicitly define the following labor demand function:

$$(7)\ L_h = z(w_h, L_f, K_h, K_f, P_i, A_i)\,,$$

where the sign of the derivatives of L_h with respect to its arguments depends on the functional forms assumed in (2) and (3). For example, if the aggregation in (2) is Leontief, then labor at home and labor abroad are perfect complements and the sign on $\frac{\partial L_h}{\partial L_f}$ depends on whether labor abroad is the binding constraint. The opposite extreme is the case in which labor at home and labor abroad are perfect substitutes in which case $\frac{\partial L_h}{\partial L_f} < 0$. Similarly the sign on $\frac{\partial L_h}{\partial K_f}$ depends on the degree of substitutability between US and foreign capital. As long as $\frac{\partial L_h}{\partial K_h} > 0$, investment abroad reduces the demand for labor at home if investment abroad and investment at home are substitutes. If investment abroad and investment at home are perfect complements then the impact of investment abroad on the demand for labor at home depends on which is the binding constraint. If investment abroad is the binding constraint, then it should have a positive impact on domestic employment, otherwise it will have no effect. In the polar extreme where investment abroad and investment at home are perfect substitutes then investment abroad will have a negative impact on home labor demand through its impact on domestic investment.

Equation (7) makes it clear that estimating employment at home as a function of foreign employment without controlling for capital inputs, productivity shocks and demand shocks *both at home and abroad* is likely to lead to biased or incorrect estimates. To the extent that final goods prices are influenced by demand abroad (i.e., to the extent that affiliates produce to sell in local markets)[11], using foreign demand shocks as instruments for labor employed abroad could exacerbate simultaneity bias.

For illustrative purposes, we derive labor demand given the following functional forms for (2) and (3):

$$(8)\, L_i = L_h^a L_f^{1-a}$$

$$(9)\, K_i = K_h^b K_f^{1-b}\,.$$

In this case, equation (7) takes the form:

$$(10)\ln L_h = \frac{1}{1-\beta a}\left[\ln aA_i\beta + \ln P_i - \ln w_h + (\beta(1-a))\ln L_f + (1-\beta)(1-b)\ln K_h + (1-\beta)b\ln K_f\right].$$

Where,

$$\frac{\partial \ln L_h}{\partial \ln L_f} = \frac{\beta(1-a)}{1-\beta a} > 0 \quad and \quad \frac{\partial \ln L_h}{\partial \ln K_f} = \frac{(1-b)(1-\beta)}{1-\beta a} > 0$$

[11] We should probably say here that around 75% of FDI is in fact done with the intention of selling locally – we could use our data to make the exact calculation but this is what all the papers and the BEA says…

by assumption. For the CES class of functions (of which Cobb-Douglas is a special case), the signs on these partial derivatives depend on the elasticity of substitution between labor at home and labor abroad and investment at home and investment abroad.

To derive our wage equation, we assume that labor supply at home is an upward sloping function of home wages (w_h) and time effects (possibly associated with increasing educational opportunities common across industries but changing over time) so that:

(11) $L_h = s(t, w_h)$.

Labor market clearing implies the following reduced form equations for employment:

(12) $L_h = q(L_f, K_h, K_f, P_i, A_i, t)$

Our first set of estimating equations is based on log-linearization of (12) and takes the following form:

$$(14) \quad Z_{iht} = \beta_0 + \sum_j \alpha_j P_{ijt} + \sum_j \beta_j A_{ijt} + \sum_j \gamma_j L_{ijt} + \sum_j \omega_j K_{ijt} + \sum_j \sigma_j X_{ijt} + f_i + \varepsilon_{ijt}$$

where Z is the outcome of interest (log of U.S. employment), P are final goods prices, A represents technological change, L is log of employment and we have separated non-labor inputs into log K for capital stock and log X for other non-labor inputs. We allow for 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. We divide the locations in which U.S. firms can do business into two: high-income locations and low-income locations.

Framework Based on Factor Prices

For comparison with previous work (see Brainard and Riker (2001) and, Katz and Murphy (1992)) and to check the robustness of our results, we consider an alternative framework based on factor prices. If we substitute employment at home and abroad with industry-level factor prices in those locations, then in the context of the model we sketched out in the previous section, this yields the following estimating equations:[12]

$$(15) \quad L_{iht} = \beta_0 + \sum_j \alpha_j \ln P_{ijt} + \sum_j \beta_j A_{ijt} + \sum_j \gamma_j w_{jt} + \sum_j \omega_j K_{ijt} + \sum_j \sigma_j X_{ijt} + f_i + \varepsilon_{ijt}$$

where L is U.S. employment now expressed as a function of wages at home and abroad in addition to the other controls included earlier.

The key parameters in equation (15) are the γ 's. The coefficients on industry-level wages abroad tell us that the cross-wage elasticity between foreign and U.S. labor and can take any sign. A negative cross-wage elasticity implies that an increase in foreign wages reduces the demand for U.S. labor, while a positive sign indicates that U.S. and foreign labor are price substitutes.

Framework Based on a Translog Cost Function Approach

An alternative framework for estimating the impact of foreign competition on domestic employment has been adopted by Brainard and Riker (2001) and Muendler and Becker (2005). This alternative approach has the advantage that the translog cost function approach provides an approximation to many well behaved cost functions. The disadvantage lies in the way the approach has been applied: both Brainard and Riker (2001) and Muendler and Becker (2005) assume a short-run cost function, and allow capital K, other inputs X, and technology A to be predetermined. Nevertheless, we also report results using this approach for the sake of completeness. Following this previous work, we assume that short-run costs are determined by labor costs in various locations. Consequently, the short-run translog variable cost (TVC) function (omitting time and parent subscripts) is given by:

[12] We again obtain the wage equation by assuming labor market clearing.

(16)

$$
\begin{aligned}
\ln \mathrm{TVC} = {} & \alpha_0 + \sum_j \varpi jk \ln Y + \sum_j \alpha_{jw} \ln W_j + \sum_j \eta j \ln K_j + \sum_j \sigma_{jk} \ln X + \sum_j \alpha_{jA} \ln A \\
& + \frac{1}{2} \sum_j \sum_k \alpha_{jk} (\ln Y)^2 + \frac{1}{2} \sum_j \sum_k \gamma_{jk} (\ln W)^2 + \frac{1}{2} \sum_j \sum_k \beta_j (\ln A)^2 \\
& + \frac{1}{2} \sum_j \sum_k \omega_{jk} (\ln K)^2 + \frac{1}{2} \sum_j \sum_k \pi jk (\ln X)^2 + \sum_j \sum_k \vartheta_{jk} \ln W \ln K_i \\
& + \sum_j \sum_k \rho_{jk} \ln Y \ln W_i + \sum_j \sum_k \chi_{jk} \ln K \ln A_i + \sum_j \sum_k \delta_{jk} \ln X \ln A_i \\
& + \sum_j \sum_k \phi_{jk} \ln X \ln W_i + \sum_j \sum_k \varphi_{jk} \ln K \ln Y_i + \sum_j \sum_k \kappa_{jk} \ln A \ln W_i + \varepsilon \\
& + \sum_j \sum_k \rho_{jk} \ln Y \ln A + \sum_j \sum_k \vartheta_{jk} \ln X \ln Y_i + \sum_j \sum_k \vartheta_{jk} \ln X \ln K_i
\end{aligned}
$$

Differentiating ln TVC with respect to ln *Wj* according to Shepard's lemma, and allowing for a firm fixed effect, yields labor share in location *j* for parent *i* at time *t*:

(17) $$LSHARE_{ijt} = \beta_0 + \sum_j \alpha_j \ln Y_{ijt} + \sum_j \beta_j A_{ijt} + \sum_j \gamma_j w_{jt} + \sum_j \omega_j K_{ijt} + \sum_j \sigma_j X_{ijt} + f_i + \varepsilon_{ijt} .$$

LSHARE is defined as the cost share of labor expenditures in location *j* for parent *i* in time *t*, relative to expenditures on labor across all locations[13].

The key parameters are again the γ's. To convert these into Allen partial elasticities of substitution across locations *j* and *k*, we can calculate the following if we have labor shares s_j and s_k in each location:

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

These sigmas are the Allen partial elasticities of substitution, which tell 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. σ_{jj} is the

[13]Equation (17) can be jointly estimated using a SUR approach across all N-1 locations, if N is the total number of locations. Although less efficient, we estimate only the share equation at home, leaving joint estimation with affiliate share equations in other locations for future work.

own (Allen) elasticity of substitution and σ_{jk} is the cross-elasticity of substitution. To convert the Allen partial elasticities of substitution into an elasticity of factor demand, we multiply sigma by the factor share:

$$\eta_{ij} = s_j \sigma_{ij} = \partial \ln x_i / \partial \ln w_j$$

The symbol η_{ij} represents the percentage change in employment in location *i* in response to a percentage change in the wage in location *j*. Muendler et al. report elasticities of factor demand while Brainard and Riker report both Allen partial elasticities and elasticities of factor demand η_{ij}, which they refer to as price elasticities of demand. Factor shares are typically computed by taking the sample means of the data. Confidence intervals can be computed using bootstrapped standard errors; future revisions of this paper will include these in the results.

Estimation Issues and Identification Strategy

To estimate equations (14), (15) and (17) we need data on home and foreign technology shocks (*A*'s), employment (*L*'s), capital (*K*'s), other factor inputs (*X*'s), wages, and price shocks (*P*'s). We measure technology shocks alternatively with firm-level research and development (R&D) expenditures or with R&D employment. We measure *L* as number of employees at home and abroad, and measure *K* as the net book value of property, plant, and equipment at home and abroad. We also control for intermediate inputs by including the log of real intermediate input purchases from within the United States.

In U.S. manufacturing, international competition plays an important role. Consequently, we measure US demand shocks using both industry dummies and time-varying import penetration. These data were made available at the 4-digit ISIC level for 1977 through 1999 by Bernard, Jensen, and Schott (2005). Firms in our sample also report imports to and exports from each affiliate location, with separate information available on imports manufactured by affiliates and delivered by third parties. Consequently we can compare the impact of imports on U.S. jobs manufactured by affiliates and U.S. imports outside the firm's control.[14]

We capture foreign demand shocks with GDP growth in high- and low-income affiliate locations, as well as a price measure of local consumption, investment, and government goods from the Summers-Heston database. In contrast to Desai et al. (2005), our framework suggests that foreign demand shocks should be included in the estimating equation and are not valid as instruments. Our summary statistics and raw correlations, as well as previous work by Brainard and Riker (1997, 2001) and Bernard et al. (2005), suggest that the degree to which foreign employment, investment and imports affect domestic labor outcomes will depend critically on their location. U.S. affiliate employment in high-income countries is likely to have very different effects than affiliate employment in low-income countries on U.S. labor market outcomes. Consequently, we include separate values for foreign capital, labor, R&D employees, imports, and demand shocks for high- and low-income countries.

Since the U.S.-based multinationals have affiliates in multiple locations, we construct aggregate measures of activity abroad for affiliate activity in high- and low-income countries. Specifically, we use employment weighted averages of the right-hand side variables in equations (14), (15) and (17) across affiliate country locations within each set of high- and low-income countries. Our weights are the parent's share of foreign employment in each affiliate location, using the initial distribution of employment across countries within each high or low-income set of countries. The initial distribution is determined by when that parent first enters the sample.

Estimation of (14), (15) and (17) using OLS is likely to lead to biased coefficient estimates since capital, employment, intermediate inputs, and firm-specific trade flows are

[14] In previous work, we also controlled for goods imported from and exported to the affiliate but manufactured by

simultaneously determined with wages and employment. Consequently, we also report IV results, using a number of appropriate excluded instruments for the endogenous regressors. We have eight endogenous variables that we need to instrument: capital stock (at home, as well as in high- and low-income affiliates), employment (in high- and low-income affiliates), intermediate inputs, exports to foreign affiliates and imports from foreign affiliates. We have identified twelve instruments, and since the number of instruments exceeds the number of endogenous independent variables, we can test for over-identification. For capital abroad, we use the following instruments: capital controls in the host country affiliate, distance between the US and the affiliate, a dummy for the use of a common language, C02 emissions in metric tons per capita, the percentage of child labor, fixed line and mobile phone subscribers per 1,000 people, the number of cable TV subscribers per 1000 people, and number of telephone main lines per 1,000 people. The last three measures capture the ease with which parents are able to communicate with their affiliates and should be positively correlated with investment abroad. Emissions and child labor are also likely to adversely affect foreign investment, as firms now care increasingly about corporate responsibility.

For intra-firm trade, as instruments we use US tariffs at the four-digit industry level, distance, capital controls in the affiliate location, and trade agreements with the affiliate. These all are correlated with bilateral trade but should be excluded from the estimating equation. Finally, instruments for employment in high- and low-income locations include the percentage of the labor force engaged in manufacturing, the percentage of national income spent on education, and the number of PC's per 1,000 people. The measures we use determine both the supply of labor available as well as the quality of that labor, yet should only affect U.S. labor market outcomes through their impact on the choice of employment in affiliate locations. These

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third parties, but this is excluded in the current draft because it is not statistically significant and is collinear with measures could also affect US labor market outcomes by affecting the comparative advantage of the low-income country, indirectly affecting US labor markets through greater import competition. So this measure could also be an instrument for parent imports from the affiliate. Since all the instruments will be used in the first stage for each of the endogenous variables for efficiency reasons, assigning an instrument to each endogenous variable is not strictly necessary.

In addition to problems of simultaneity bias, we also face potentially important selection problems. The sample is highly unbalanced with significant entry and exit. The dependent variables in our estimating equations (14), (15), and (17), which are the log of parent employment and US labor cost shares, are not observed in every time period. We are particularly concerned about attrition, since the sample could exhibit "survivorship bias" if all the firms which relocated all operations abroad, closing down US activities, exit the sample. Such a possibility would clearly lead to underestimating the employment costs of multinational activity.

Following Wooldridge (2002) we model this selection problem as follows. We create a binary selection indicator equal to one if the firm is still present in the BEA database. If our equation of interest is given by,

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

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

$$s_{it} = 1[w_{it}\delta_t + v_{it} > 0], \qquad where, \qquad v_{it} \mid \{x_{it}, w_{it}, s_{i,t-1} = 1\} \sim Normal(0,1)$$

imports and exports manufactured by the affiliate and parent.

A problem arises if the error terms u_{it} and v_{it} are correlated. In the context of panel data with an unobserved firm fixed effect, attrition, and endogenous right-hand side variables, Wooldridge (2002) proposes as a solution a variant of a two-stage Heckman correction for selection modified for a panel context. In each period, Wooldridge proposes estimating a selection equation using a probit approach and calculating lambda, the inverse Mills ratio, for each time period and each parent *i*. Once a series of lambdas have been estimated for each year and parent, the estimating equations are augmented by these lambdas. For example, equations (14), (15) and (17) would be estimated as the following:

$$(14') \quad Z_{iht} = \beta_0 + \sum_j \alpha_j P_{ijt} + \sum_j \beta_j A_{ijt} + \sum_j \gamma_j L_{ijt} + \sum_j \omega_j K_{ijt} + \sum_j \sigma_j X_{ijt} + \rho_2\, d2_t\, \hat{\lambda}_{it} + \cdots + \rho_T\, dT_t\, \hat{\lambda}_{it} + f_i + \varepsilon_{ijt}$$

$$(15') \quad L_{iht} = \beta_0 + \sum_j \alpha_j \ln P_{ijt} + \sum_j \beta_j A_{ijt} + \sum_j \gamma_j w_{jt} + \sum_j \omega_j K_{ijt} + \sum_j \sigma_j X_{ijt} + \rho_2\, d2_t\, \hat{\lambda}_{it} + \cdots + \rho_T\, dT_t\, \hat{\lambda}_{it} + f_i + \varepsilon_{ijt} + \varepsilon_{ijt}$$

$$(17') \quad LSHARE_{ijt} = \beta_0 + \sum_j \alpha_j \ln P_{ijt} + \sum_j \beta_j A_{ijt} + \sum_j \gamma_j w_{jt} + \sum_j \omega_j K_{ijt} + \sum_j \sigma_j X_{ijt} + \rho_2\, d2_t\, \hat{\lambda}_{it} + \cdots + \rho_T\, dT_t\, \hat{\lambda}_{it} + f_i + \varepsilon_{ijt}$$

In the case where there are endogenous right-hand side variables, then (14'), (15') and (17') can be estimated using as instruments the original instrument list augmented to include the estimated lambdas. However, this approach is only successful if in addition to the instruments for the endogenous right-hand side variables, we can identify determinants of the binary selection variable s_{it} which are observed before the firm exits the sample and which do not belong in the estimating equation. We have identified candidate variables using the insights derived from a class of models indicating that heterogeneity in productivity is a significant determinant of whether firms enter into international trade or foreign investment. The insights from those models suggest that selection is likely to be a function of the plant's level of total factor productivity relative to other firms in the same industry. While the theoretical framework suggests that an individual firm's productivity (proxied by the increase in R&D employees) should be correlated with wages or employment, we use the level of a firm's productivity relative to a benchmark firm in the same sector as a measure of productivity. Another determinant of survival which does not belong in the estimating equations is parent profitability.

IV. Results

We begin by reporting sample means in Table 3. While we have already highlighted a number of important trends in the data in Tables 1 and 2, Table 3 also includes a number of additional variables. The share of parent expenditures on their US labor force relative to total worldwide expenditures on employment during the sample period was 72.3 percent. Affiliates in high-income countries accounted for 22.7 percent of expenditures on employees and affiliates in low-income countries accounted for the remaining 5 percent. While the US mean share fell, the mean share of labor expenditures by the parent on affiliate employment increased in both low and high-income affiliate locations. The means and changes in means in Table 3 are slightly different than those presented in Table 1, since Table 1 weights the data by employment shares and Table 3 presents simple means. In addition, Table 3 only includes enterprises with non-missing observations for all the dependent and independent variables in 1982 and 1999.

Although labor shares show small mean changes over time in Table 3, actual employment fell dramatically in the US and increased though less dramatically in low-income affiliates. The story is similar in Table 1. The reason why the employment changes were enormous but expenditure share changes were not is because wage trends offset the employment developments. Real wages in the sample went up in the United States and fell in low-income affiliate countries, offsetting the employment developments. One explanation which is consistent with these wage trends is a change in the composition of employment in US manufacturing towards higher-skilled workers, and a shift in low-income countries towards the use of less expensive labor. We cannot easily test this hypothesis since we do not have detailed information on worker characteristics, but the increase in R&D intensity at the US parent (but not at affiliates) is consistent with this possibility.

Research and development employees as a share of total employees at the US parent accounted, on average, for 5.9 percent of the labor force; in high-income affiliates the corresponding fraction was 2 percent and in low-income affiliates R&D employees accounted for a tiny .2 percent of employment. The share of R&D employment as a share of total employment increased by 2 percentage points of the labor force over the sample period in the United States, but fell slightly in both low- and high-income affiliates. The rising share of R&D employment in US manufacturing is consistent with skill-biased technological change, and is also consistent with rising average manufacturing wages, which, in part, reflect changing composition of the manufacturing labor force.

Exports to foreign affiliates from the US parent accounted on average for 5.1 percent of sales, and imports to the US parent from the foreign affiliate accounted for an average 2.8 percent of sales. Average import penetration in the four-digit SIC sector over the period across all of manufacturing was 16.5 percent. Import penetration increased by 11 percentage points during this period, which reflects an enormous increase in the US exposure of manufacturing to import competition. Exports to and imports from foreign affiliates as a share of sales also increased during the sample period, by an average of 1.2 and 2.2. The increase in imports by US parents directly from affiliates represents nearly a doubling of imports as a share of parent sales.

Before reporting the results of estimating equation (14'), we begin by reporting in Table 4 the results of the probit selection equations for each of the years 1982, 1989, 1994, and 1999. The probits for each of the years identify the determinants of survival based on determinants from the previous period in which data was collected. For example, in column (1), the coefficients tell us the marginal impact of different variables in 1977 on remaining in the dataset in 1982. For efficiency, we include all the excluded instruments used in the second stage to predict affiliate employment and wages, in addition to two variables that are only included in the selection equation: profitability and total factor productivity. Profitability is calculated as the ratio of net income to sales, averaged across all years that the parent is in the BEA dataset. Total Factor Productivity is calculated as the average residual across all years from subtracting share-weighted factor inputs from output. Factor inputs include employment, capital stock, and intermediate inputs. Total Factor Productivity is normalized by the highest TFP level within that four-digit industry. The results show that high TFP (relative to the industry) and high profitability are significant predictors of continuing in the BEA sample. Both TFP and profitability are significant in almost all years, while most of the other controls are not. The only other control which is significant across all years is the growth of GDP in low skilled affiliates, which is consistently positive. This suggests that firms investing in low-income countries with high growth are more likely to remain in the BEA sample. This is probably picking up the fact that the survivors tend to be firms operating in low-income countries while exit takes place primarily among small firms with no operations in developing countries.

We report the results of estimating (14') in Table 5. The log of US employment is our dependent variable and we use a within transformation of the data to eliminate the firm fixed effect. The first column of Table 5 reports the coefficient on the foreign affiliate employment, aggregated across all locations, in an OLS regression of log US parent employment on log affiliate employment. The point estimate .122 indicates that a 10 percent increase in foreign employment would lead to a 1.22 percent increase in US parent employment. The next two columns show that this result is very sensitive to the location of the affiliate and to the addition of other controls, as dictated by our model. Column (2) shows that the coefficient on high-income affiliate employment is .11 while the coefficient on low-income affiliate employment is significant and negative at -.03. These coefficients suggest that employment in high-income affiliates is complementary with US employment but employment in low-income affiliates substitutes for US employment. The point estimates imply that a 10 percent increase in affiliate employment in high-income countries is associated with a 1.1 percent increase in US employment, while a 10 percent increase in affiliate employment in low-income countries is associated with a .3 percent fall in US employment. Since high-income affiliate employment fell while low-income affiliate employment increased, the point estimates in column (2) are consistent with employment declines in the United States.

In column (3) we separate affiliate employment into non-production workers and production workers, which roughly corresponds to skilled and unskilled labor. The point estimates for both skilled and unskilled workers continue to be positive and significantly correlated with US employment for high-income affiliates, and are not significantly different from each other. However, for low-income affiliates, the point estimate is statistically insignificant for non-production workers in affiliates based in low-income countries and is equal to -.04 and statistically significant for production workers in these same affiliates. This suggests that substitution is occurring through the use of production (unskilled) workers, as jobs are being shifted from US workers to production workers in low-income countries.

The remaining columns control for selection by including the inverse Mills ratio computed separately for each year. We also add variables to control for technological change (R&D employment in each location as a share of total employment in each location), the capital stock in each location, GDP per capita in purchasing power parity dollars in high-income and low-income locations (to control for demand shocks abroad), import penetration into the US (to control for demand shocks in the US), and exports to (imports from) affiliates and other intermediate inputs. In both cases, the point estimates on labor hired abroad fall significantly indicating that the results are sensitive to the inclusion of additional controls. Adding the inverse Mills ratio to control for selection out of the sample does not change the sign of the estimated coefficients, although the positive coefficient on affiliate employment in high-income countries falls by over half. The coefficient on low-income affiliate employment remains negative and statistically significant, suggesting that employment in low-income countries by US multinationals substitutes for employment in the US. A joint F-test of the significance of the year-specific controls for selection shows that controlling for attrition out of the sample is statistically important. Since the standard errors are White-corrected for arbitrary heteroskedasticity, we do not need to further correct the standard errors despite the fact that our joint F-test indicates that we do need to control for attrition bias.

Before turning to the instrumental variable estimates reported in columns (5) and (7) of Table 5, we report in Appendix Tables A.1 and A.2 the first-stage estimates for the IV regressions in column (5). Appendix Table A.1 shows the first-stage results for employment in high- and low-income affiliates, capital stock in all three locations, intermediate inputs, and exports from and imports to foreign affiliates. We report the first-stage F-statistics both including and excluding the exogenous variables which enter as their own instruments in the final estimating equation, which include import penetration, time and industry dummies, and the year-specific Inverse Mills ratio. The first-stage results show that the first-stage F-statistic is sufficiently large that we feel confident that our instruments have enough power to explain the endogenous variables. The only possible exceptions are for the parent-specific trade flows. For parent imports from and exports to their affiliates, the instruments are somewhat weaker but still have predictive power.

The results for the first-stage estimation are useful for understanding why manufacturing affiliate employment in high- and low-income countries could have different effects on parent employment in the United States. The determinants of changes in affiliate employment in low-income countries are different from the determinants in high-income countries. While affiliate employment in low-income countries appears to be driven primarily by the search for low factor costs, in high-income countries affiliate employment is driven by the search for market access. The first column of Appendix Table A.1 reports the impact of different instruments on high-income affiliate employment. An increase in distance between the US parent and the affiliate increases employment there, while a free trade agreement with the high-income affiliate reduces employment there. Since all specifications are within transformations of the data, the results should be interpreted as changes in the instruments leading to changes in affiliate employment. The fact that high-income affiliate employment increases with distance and declines with trade access—as dictated by the coefficient on whether the US has a free trade agreement with the host country of the affiliate—suggests that market access is critical. The fact that communications access is positively related with employment in the high-income affiliate but neither computer use nor educational expenditures corroborates that market access, rather than an alternative source of cheap or highly skilled labor is the primary motivation.

The story is different for the determinants of employment in low-income affiliates. Distance negatively affects affiliate employment, while the signing of a free trade agreement positively affects employment. US import penetration is positively and significantly associated with increasing employment in low-income affiliates, suggesting that US parents are seeking low cost locations in order to respond to increasing import competition at home. In addition, income per capita is significantly associated with less employment in low-income affiliates, again suggesting that firms are seeking low wage labor when they locate there. The different results are consistent with factor-seeking foreign investment in low-income affiliates and market-seeking foreign investment in high-income affiliates.

Column (5) of Table 5 reports the results of instrumental variable estimation, using the instrument list described above. The over-identification test suggests that we cannot reject that the instruments are valid. Correction for simultaneity bias inflates the coefficient on employment in low-income affiliates, which is consistent with measurement error biasing downwards the within estimates. In column (5), the IV estimates indicate that a 10 percent increase in foreign affiliate employment is associated with a .5 percent employment increase in the US if the affiliate is in a high-income country and a 2.1 percent decline in US employment if the affiliate is in a low-income country. Since low-income affiliate employment increased by 64 percent between 1982 and 1999 (see Table 1) and high-income affiliate employment remained essentially unchanged, this implies a fall in US manufacturing employment of over 12 percentage points.

Columns (6) and (7) include the breakdown for production and non-production worker employment in low- and high-income affiliates. Column (6) is the OLS estimation with a full set of controls while column (7) presents the instrumental variable estimates. Although the IV estimates amplify the coefficients, as in column (5), the results are highly sensitive to the instrument list and should be treated with caution. However, across both the OLS and IV estimates, the results are quite similar: employment in the US is complementary with the use of non-production workers (skilled labor) in high-income affiliates but substitutable with the use of production labor (unskilled labor) in low-income countries. Particularly in the IV estimates in columns (5) and (7), the negative impact of foreign affiliate employment in low-income countries is economically important.

Although the negative impact of affiliate employment in low-income countries on US employment in manufacturing is significant, the results in Table 5 indicate that other factors have also played an important role in determining employment at the firm level. A 10 percent increase in the capital stock at home increases US manufacturing employment by 6 to 10 percent. Conversely, a 10 percent increase in capital stock in high- or low-income affiliates is associated with a US employment decline of between .1 and 1.8 percent. Since the capital stock in affiliates increased by over 100 percent between 1982 and 1999, this diversion of investment towards affiliates resulted in a decline of up to 18 percent in US manufacturing employment.

Increases in trade, both arms length and between the US parent and its affiliates, are also associated with US manufacturing employment declines. The over 10 percentage point increase in import penetration reported in Table 3 implies a decline in US manufacturing employment of between 1.1 and 3.4 percent. A 10 percentage point increase in imports from (exports to) the foreign affiliate is associated with an employment decline of 4.1 percentage points (for exports, 4.9 percentage points) in the last column of Table 5. The IV estimates in column (5) suggest a much larger negative impact, but these should be viewed with caution in light of the weak instrument problem for predicting intra-firm trade flows. While an employment decline associated with increasing exports from the US parent to its foreign affiliate seems puzzling, the data shows a strong positive correlation between exports to foreign affiliates and exports to foreign affiliates for further processing, suggesting that US exports to foreign affiliates reflect increasing outsourcing of manufacturing activity, rather than increasing sales. Foreign demand shocks are also associated with significant effects on US employment, suggesting that foreign GDP growth in affiliate locations would not be an appropriate instrument for foreign employment.

Big negative effects are also associated with our proxy for technological change by the US parent at home, which is the share of research and development employees in total US employment. The IV results indicate that a ten percentage point increase in the parent's R&D employee share would be associated with a 5.1 to 8.5 percentage point decline in total parent employment. Although parent R&D employment only increased by 2.1 percentage points on average between 1982 and 1999 (implying a reduction in home employment of between .5 and 1 percent), the coefficient estimates suggest that technological change as a source of falling manufacturing employment could be important in the future.

Table 6 presents the results from estimating equation (15'), which replaces employment in affiliates as an independent variable with industry-level wages in low- and high-income affiliates. Industry level wages were calculated as the weighted average of parent and affiliate wages, with the weights given by initial parent or affiliate employment. The results are consistent with those presented in Table 5. The coefficient on high-income affiliate wages is negative and significant, suggesting that high-income affiliate employment and US parent employment are complements: when wages in high-income affiliates increase, this hurts employment in the US. The IV estimate, at -.127, suggests that a 10 percentage point increase in high-income affiliate wages is associated with a 1.27 percentage point decline in US employment. However, the positive coefficient on wages in low-income affiliates suggests that employment there acts as a substitute for employment in the US: a 10 percentage point fall in low-income affiliate wages is associated with a .5 percentage point reduction in US employment. Since Table 1 indicates that average affiliate wages increased in high-income countries and fell (by 30 percent) in low-income countries, both of these trends contribute to falling US manufacturing employment. The own wage elasticity of demand, which varies from -.3 to -.6, is consistent with previous studies of US labor demand surveyed by Hamermesh (1993).

The results in Tables 5 and 6 are broadly consistent with each other, suggesting that affiliate employment in high-income locations is complementary with US manufacturing employment, while affiliate employment in low-income locations substitutes for US employment. Yet the magnitudes suggest much smaller effects than the results presented in Table 5. One possible reason may be that the industry wages reflect changes in the composition of the labor force.[15]

We now turn to our cost share equations, and report our results for estimating equation (17') in Table 7. Previous work using cost shares has been done by Muendler et al. (2005) using 2 or 3 years of data on Sweden and Germany, and by Brainard and Riker (2001) on the BEA data for 1982 to 1992. Despite the fact that they use different countries and time periods, both sets of authors get fairly similar results. Both studies find that foreign affiliate employment abroad (Germany, Sweden, and the United States) substitutes for home employment, but the magnitudes are very small. The results in Table 7 are remarkably consistent with these previous papers, although they contradict somewhat the conclusions reached in Tables 4 and 5. The coefficients on factor shares imply that foreign labor substitutes for home labor in *both* high- and low-income affiliate locations. The magnitudes from the OLS estimates are small and very similar to those derived by previous work: for low-income affiliates, a 10 percentage point decline in wages

[15] Using a similar approach but focusing *only* on the overseas affiliates of US parents, Brainard and Riker (1997) find that US affiliates in low income countries are complementary with affiliates in high income countries, while affiliates located in similar regions act as substitutes. Brainard and Riker suggest that this is evidence of vertical relationships between affiliates in high and low income regions, while affiliates from similar regions compete with each other. Using data on US parents and their affiliates, we find the opposite: US parent employment is complementary with employment in high income regions but substitutable with employment in low income regions. One area we leave for further research is to reproduce the results in Table 6 for affiliates in high and low income locations. It is conceivable that affiliates in similar regions act as substitutes, but that only activities in high income regions are complementary with US parent employment.

would be associated with a .36 percent fall in US employment (double the estimate by Brainard and Riker, but still very small) while a 10 percentage point decline in high-income affiliate wages would be associated with a 1.1 percent fall in US employment. As expected, the own price elasticity is negative. These results are robust to instrumental variable estimation (see column (3) of Table 7).

These results, while remarkably consistent with those derived by previous researchers, are problematic for a number of reasons. The own price elasticity of demand, at -1.5, is too big compared to what we would have expected from earlier tables and Hamermesh's work suggesting a plausible range between -.1 and -.75, with his best guess at -.3. The common assumption that the capital stock is fixed in the short-run is not appropriate in our case since we are looking at five year intervals. Indeed, changes in the capital stock and changes in trade are associated with significant effects on the cost share, suggesting that the more general approach presented in the earlier tables is justified. An additional concern has to do with the measurement of wages. The numbers in Table 1 suggest that there has been a shift in the composition of the labor force in US manufacturing away from "production" workers – parent employment has gone down while parent wages have increased. Thus, it is not clear what our dependent variable is measuring and with the current BEA data, there is no way to figure out the answer to this question since US wages are not broken down by skill level.[16] As in Tables 4 and 5, the results suggest that an increase in the US capital stock is associated with an increase in the US cost share while an increase in the capital stock in low- and high-income affiliates is associated with a decline in the US cost share. Consistent with previous estimates, increases in trade are associated with a decline in the US cost share.

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[16] The 1982 benchmark survey did include this information and the 2004 survey includes occupational codes.

Although the different approaches presented in Tables 4, 5 and 6 do not always yield a consistent message, one result is consistent across all specifications: employment in low-income affiliates substitutes for US employment. This outcome is robust to whichever framework we choose, although the magnitudes vary. The effects of changes in foreign affiliate employment (or wages) in low-income regions imply that employment in developing countries does substitute for employment in the United States. If we discount the IV estimates as too implausibly large, then the OLS results yield significant but not enormous effects: typically the large employment increases in developing countries and significant wage declines (see Table 1) only partially explain the large observed fall in employment in the United States.

The evidence suggests that other aspects of globalization have also played a significant role. One factor that has not received any attention in previous literature is the impact of US multinationals expanding physical investment abroad. Increases in the capital stock in foreign affiliates are associated with significant declines in US employment; these declines are at least as significant as the impact of expanding foreign employment. All the approaches show that both arms length trade, as captured by US import penetration, and intra-firm trade have also played an important role in reducing US manufacturing employment.

V. 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 multinational manufacturing firms shed more than 3 million jobs in the United States. The reduction in US jobs has been accompanied by an increase in real wages. Over this same period, the number of workers hired by affiliates in developing countries has increased while wages paid to these workers has declined. These facts are consistent with the notion that US parents are exporting low-wage jobs to low-income countries. However, the expansion in manufacturing employment in developing countries amounts to only one quarter of the jobs lost in the US. Therefore, other factors such as technological change and international trade must be important determinants of US manufacturing employment.

In this paper, we present a general approach to measuring the impact of globalization on US manufacturing employment. Our approach takes into account the simultaneity between a firm's employment decision in the US and its foreign affiliates. To solve the endogeneity problem, we develop a series of first-stage regressions that explain US multinational expansion at home and abroad as a function of predetermined factors such as free trade agreements, infrastructure in destination countries, and restrictions on capital repatriation. We address the problem of attrition in the sample by using a two-stage Heckman approach and modeling survival as a function of the productivity and profitability of the US parent.

We apply our framework to the Bureau of Economic Analysis (BEA) data on US multinational enterprises for the period 1977 through 1999 to identify the determinants of job losses in US manufacturing. One result is consistent across all specifications: employment in low-income affiliates substitutes for US employment. This outcome is robust to whichever framework we choose. However, the magnitude of this effect is probably not large: typically the large employment increases in developing countries and significant wage declines only partially explain the observed fall in manufacturing employment in the United States.

The evidence suggests that other aspects of globalization have played an equally important role in determining US manufacturing employment. For example, increases in the capital stock in foreign affiliates are associated with significant declines in US employment; these declines are at least as significant as the impact of expanding US multinational employment in low-income countries. Other factors that play an important role in determining US manufacturing employment are international trade, as captured by US import penetration and intra-firm trade, and technological change.

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Table 1: Trends of U.S. Multinationals in Manufacturing 1977-1999

Variable	1977	1982	1989	1994	1999	% Change 77-99	% Change 82-99
Number of Parents	1746	1154	1211	1199	878	-98.86%	-31.44%
Number of Countries in which Parents Have Affiliates	21.19	20.61	20.35	21.54	19.78	-7.14%	-4.17%
Developed Countries	12.25	12.54	13.47	13.41	11.33	-8.13%	-10.70%
Developing Countries	8.80	7.98	6.81	8.09	8.45	-4.11%	5.63%
Affiliate Share of Jobs	28.33%	26.57%	31.43%	33.91%	35.62%	20.46%	25.40%
Developed Country Affiliate Share of Jobs	20.09%	18.43%	21.59%	22.78%	20.98%	4.24%	12.14%
Developing Country Affiliate Share of Jobs	8.22%	8.11%	9.84%	11.08%	14.64%	43.88%	44.62%
Affiliate Share of Compensation	18.97%	17.56%	22.96%	25.61%	24.17%	21.52%	27.36%
Developed Country Affiliate Share of Compensation	16.35%	14.44%	20.15%	21.95%	19.27%	15.16%	25.09%
Developing Country Affiliate Share of Compensation	2.59%	3.09%	2.80%	3.63%	4.89%	47.05%	36.80%
Affiliate Share of Total Investment	25.99%	23.29%	25.14%	29.08%	29.10%	10.66%	19.96%
Developed Country Affiliate Share of Investment	20.12%	17.29%	20.95%	23.72%	20.88%	3.63%	17.21%
Developing Country Affiliate Share of Investment	5.67%	5.80%	4.17%	5.33%	8.22%	30.97%	29.36%
Parents							
Total Employment	11017	9771	9137	6893	7181	-53.42%	-36.07%
Real Total Compensation (per worker)	31.34	31.82	33.25	36.67	37.87	17.24%	15.97%
Labor's Share	0.96	0.91	0.84	0.86	0.79	-21.54%	-15.03%
Developed Country Affiliates: All							
Total Employment	3089	2753	2876	2376	2531	-22.05%	-8.78%
Real Total Compensation (per worker)	21	21	27	31	27	20.32%	20.05%
Labor's Share	0.61	0.59	0.57	0.57	0.30	-101.76%	-95.15%
Developing Country Affiliates: All							
Total Employment	1263	1079	1311	1156	1766	28.48%	38.91%
Real Total Compensation (per worker)	11	10	9	9	8	-38.25%	-19.93%
Labor's Share	1.09	1.18	0.61	0.60	0.67	-62.86%	-76.96%

Source: Bureau of Economic Analysis. Note: Data is for manufacturing parents and their manufacturing affiliates with non-missing observations for labor's share of income, positive employment, and non-zero production employment. Multiple affiliates in one country are treated as one affiliate. Weighted by employment shares, where applicable. Real wages, real benefits, and real total compensation are in '000 of 82-84 U.S. dollars; real net income and real total assets are in '000,000 of 82-84 U.S. dollars. Employment figures are in '000. Return on capital is net income over total assets. Variability in countries of affiliates is defined as the total number of countries in which the parent added or dropped an affiliate between the previous benchmark survey and the present one.

Table 2: Trends of U.S. Multinationals in Services 1977- 1999

Variable	1977	1982	1989	1994	1999	% Change 77-99	% Change 82-99
Number of Parents	58	76	112	133	242	317.24%	218.42%
Number of Countries in which Parents Have Affiliates	6.74	4.12	4.92	6.97	11.62	72.31%	182.10%
Developed Countries	5.19	3.10	4.27	5.64	7.61	46.66%	145.72%
Developing Countries	1.56	1.02	0.65	1.33	3.94	153.04%	284.93%
Affiliate Share of Jobs	15.43%	9.21%	16.93%	19.13%	25.09%	62.59%	172.39%
Developed Country Affiliate Share of Jobs	11.67%	7.09%	15.36%	16.22%	19.41%	66.30%	173.65%
Developing Country Affiliate Share of Jobs	3.76%	2.12%	1.57%	2.91%	5.67%	50.86%	167.86%
Affiliate Share of Compensation	13.41%	7.25%	14.99%	17.30%	21.75%	62.20%	200.04%
Developed Country Affiliate Share of Compensation	11.20%	6.06%	14.45%	16.38%	19.29%	72.23%	218.23%
Developing Country Affiliate Share of Compensation	2.21%	1.19%	0.54%	0.92%	2.46%	11.26%	107.00%
Affiliate Share of Total Investment	13.97%	6.76%	17.65%	21.60%	23.17%	65.93%	242.99%
Developed Country Affiliate Share of Investment	11.88%	5.79%	17.06%	20.15%	19.47%	63.86%	236.02%
Developing Country Affiliate Share of Investment	2.09%	0.96%	0.59%	1.45%	3.70%	77.35%	284.04%
Parents							
Total Employment	532	867	1377	1658	4795	801.93%	453.30%
Real Wages (per worker)	16.79	15.94	17.71	17.03	20.78	23.74%	30.36%
Labor's Share	91.46%	88.00%	85.70%	90.68%	81.24%	-11.17%	-7.68%
Developed Country Affiliates: All							
Total Employment	73	68	255	333	1243	1593.31%	1734.97%
Real Wages (per worker)	13.28	15.05	13.88	14.45	13.86	4.37%	-7.91%
Labor's Share	75.93%	45.66%	82.20%	72.93%	75.48%	-0.60%	65.30%
Developing Country Affiliates: All							
Total Employment	24	20	26	60	363	1436.03%	1696.20%
Real Wages (per worker)	7.43	9.03	5.38	4.69	4.45	-40.11%	-50.72%
Labor's Share	88.58%	94.40%	84.72%	90.09%	84.79%	-4.28%	-10.17%

Source: Bureau of Economic Analysis. Note: Data is for parents and affiliates with non-missing observations for labor's share of income and positive employment. Multiple affiliates in one country are treated as one affiliate. Excluding firms in the top and bottom 1% on the basis of labor shares and return to capital. Weighted by employment shares, where applicable. Real wagesare in '000 of 82-84 U.S. dollars. Employment figures are in '000.

Table 3: Sample Means			
Variable	**Mean**	**Standard Deviation**	**Change in 1982-1999**
U.S. Share in Labor Expenditures	.723	(.201)	-.044
High-Income AffiliateShare in Labor Expenditures	.227	(.141)	.034
Low-Income Affiliate Share in Labor Expenditures	.050	(.068)	.006
Log U.S. Employment	7.926	(1.647)	-.674
Log High-Income Affiliate Employment	5.855	(2.401)	.027
Log Low-Income Affiliate Employment	2.881	(3.556)	1.347
Log U.S. Capital Stock	11.154	(2.034)	0.348
Log High-Income Affiliate Capital Stock	8.731	(3.102)	1.239
Log Low-Income Affiliate Capital Stock	4.134	(4.842)	1.305
Log U.S. Wage (Industry level)	3.356	(.156)	.169
Log High-Income Affiliate Wage (Industry level)	3.120	(.159)	.276
Log Low-Income Affiliate Wage (Industry level)	2.095	(.300)	-.247
U.S. R&D Employee Share	.059	(.091)	.021
High-Income Affiliate R&D Employee Share	.020	(.047)	-.007
Low-Income Affiliate R&D Employee Share	.002	(.012)	-.001
Import Penetration	.165	(.147)	.110
Exports to Foreign Affiliates (share in sales)	.051	(.076)	.012
Imports from Foreign Affiliates (share in sales)	.028	(.070)	.022
Log GDP p.c. PPP in High-Income Affiliates	8.241	(3.095)	1.510
Log GDP p.c. PPP in Low-Income Affiliates	2.688	(3.541)	.180
TFP firm – TFP max by Industry	-3.58	(-3.009)	.860
Profit Margin	.046	(.083)	.021

Table 4:
Year-by-Year Probit Estimates of Probability of Survival
Marginal Effects Reported Only

	(1)	(2)	(3)	(4)
	1982	1989	1994	1999
Total Factor Productivity Of Parent	0.281 [0.034]**	0.037 [0.018]*	0.001 [0.007]	0.113 [0.007]**
Profit Margin of Parent	1.049 [0.218]**	0.753 [0.238]**	0.815 [0.005]**	0.721 [0.006]**
Tariffs in US	-0.872 [0.916]	0.054 [0.622]	-0.872 [0.916]	-0.075 [0.910]
Log GDP per capita in High-Income Affiliate	0.018 [0.011]	0.018 [0.009]	0.018 [0.011]	0.018 [0.012]
Log GDP per capita in Low-Income Affiliate	0.030 [0.008]**	0.027 [0.008]**	0.020 [0.009]**	0.034 [0.009]**
Free Trade Agreement with Country of Affiliate	0.008 [0.144]	-0.489 [0.155]**	0.008 [0.144]	-0.160 [0.092]
Capital Controls in Country of Affiliate	0.115 [0.096]	0.029 [0.082]	0.115 [0.096]	-0.179 [0.031]**
Probability of Survival	0.547	0.625	0.589	0.413
Observations	1198	834	824	742
Pseudo R^2	.254	.351	.291	.398

Robust standard errors in brackets; * significant at 5%; ** significant at 1%. Coefficients reported are marginal probabilities at the mean of the regressors. Probability of survival reflects the likelihood that a firm survived between the previous period (five years ago) and the current period. Other controls are insignificant and include US import penetration, air departures, no. of cable TV's, CO2 emissions, no. of PCs, no. of fixed line and mobile telephones and no. of telephones mainlines, child labor, percent industry, distance and common language.

Table 5:Within (FE) and IV Estimates of Labor Demand by US Parents

	(1) FE	(2) FE	(3) FE	(4) FE	(5) FE/IV	(6) FE	(7) FE/IV
Log Total Affiliate	0.122						
Employment	[0.021]**						
Log Employment in		0.110		0.044	0.049		
High-Income Affiliate		[0.019]**		[0.007]**	[0.022]**		
Log Employment in		-0.028		-0.031	-0.211		
Low-Income Affiliate		[0.010]**		[0.006]**	[0.052]**		
Log Non-Production Employment in			0.056			0.041	0.125
High-Income Affiliate			[0.015]**			[0.010]**	[0.059]**
Log Production Employment in			0.073			0.019	0.187
High-Income Affiliate			[0.014]**			[0.010]	[0.104]
Log Non-Production			-0.001			0.017	-0.114
Worker in Low-Income Affiliate			[0.013]			[0.010]	[0.107]
Log Production Employment in Low-			-0.040			-0.021	-0.104
Income Affiliate			[0.012]**			[0.006]**	[0.042]**
Log US Capital Stock				0.643	1.037	0.639	0.893
				[0.009]**	[0.103]**	[0.014]**	[0.047]**
Log Capital stock in				-0.014	-0.022	-0.022	-0.134
High-Income Affiliate				[0.006]**	[0.046]	[0.007]**	[0.061]**
Log Capital Stock in				-0.020	-0.181	-0.019	-0.173
Low-Income Affiliate				[0.005]**	[0.045]**	[0.006]**	[0.070]*
US R&D				-0.530	-0.852	-0.506	-0.814
Employee Share				[0.084]**	[0.158]**	[0.125]**	[0.217]**
High-Income Affiliate				0.062	-0.482	0.112	-0.176
R&D Employee Share				[0.152]	[0.320]	[0.229]	[0.453]
Low-Income Affiliate R&D				-0.351	0.216	0.039	2.119
Employee Share				[0.454]	[0.722]	[0.659]	[1.641]
US Import				-0.192	-0.343	-0.114	-0.295
Penetration				[0.051]**	[0.098]**	[0.033]**	[0.138]**
High-Income Affiliate				0.022	0.020	0.021	0.045
Log GDP per capita				[0.004]**	[0.007]**	[0.005]**	[0.013]**
Low-Income Affiliate				0.008	0.012	-0.001	-0.137
Log GDP per capita				[0.005]	[0.017]	[0.007]	[0.032]**
Exports to Foreign Affiliates				-0.413	-2.399	-0.425	-0.489
(Share in Sales)				[0.143]**	[1.543]	[0.209]**	[0.204]**
Imports from Foreign Affiliates				-0.097	-5.093	-0.298	-0.409
(Share in Sales)				[0.156]	[1.501]**	[0.121]**	[0.209]*
Real Intermediate Inputs					-0.041	0.005	-0.052
					[0.022]*	[0.003]	[0.024]*
Selection Controls	No	No	Yes	Yes	Yes	Yes	Yes
F-stat Lambdas			0.000	0.000	0.110	0.000	0.202
Sargan Test					0.963		0.689
Observations	2801	2801	2801	2801	2801	2801	2801
R-squared	0.13	0.13	0.14	0.70	0.23	0.69	0.58

Robust standard errors in brackets. All specifications include time and industry dummies. * significant at 5%; ** significant at 1%. The "F-stat Lambdas" reports the p-value of the joint significance of the controls for selection. The Sargan Test reports the p-value of Sargan's (1958) test of over-identifying restrictions. It is a test of the joint null hypothesis that the excluded instruments are valid instruments, i.e., uncorrelated with the error term and correctly excluded from the estimated equation. The reported p-value indicates the level of confidence with which we do not reject our model. Instruments used are: import weighted tariffs, education expenditures, aircraft departures, cable television, CO2 emissions, personal computers per capita, telephones per capita, telephone main lines, child labor, distance, capital controls and participation in free trade agreements.

Table 6:
Alternative Specification For Labor Demand With Industry Wages As Independent Variables
Fixed Effect (FE) And IV Estimates

	(1)	(2)
	FE	FE/IV
Log US Industrial Wages	-0.310 [0.090]**	-0.614 [0.123]**
Log Industrial Wages in Low-Income Affiliates	0.068 [0.025]	0.052 [0.022]**
Log Industrial Wages in High-Income Affiliates	-0.301 [0.126]**	-0.127 [0.066]*
Log US Capital Stock	0.645 [0.009]**	0.909 [0.063]**
Log Capital Stock in High-Income Affiliates	-0.016 [0.004]**	-0.014 [0.007]*
Log Capital Stock in Low-Income Affiliates	0.000 [0.002]	-0.035 [0.010]**
Real Intermediate Inputs	0.008 [0.002]**	-0.027 [0.014]
US R&D Employee Share	-0.510 [0.084]**	-0.939 [0.136]**
High-Income Affiliate R&D Employee Share	0.168 [0.153]	-0.158 [0.258]
Low-Income Affiliate R&D Employee Share	-0.194 [0.456]	0.360 [0.638]
Exports to Foreign Affil. (shr. in sales)	-0.270 [0.144]	-1.059 [1.127]
Imports to Foreign Affil. (shr. in sales)	-0.029 [0.156]	-6.052 [1.161]**
Import Penetration	-0.152 [0.052]**	-0.316 [0.084]**
Log GDP per capita PPP in High-Income Affiliates	0.020 [0.004]**	0.012 [0.006]**
Log GDP per capita PPP in Low-Income Affiliates	0.011 [0.005]*	0.019 [0.005]**
F-test Lambdas	0.000	0.109
Sargan Test Observations	 2801	0.982 2801
R-squared	0.70	0.39

Robust standard errors in brackets. All specifications include time and industry dummies. * significant at 5%; ** significant at 1%. The "F-stat Lambdas" reports the p-value of the joint significance of the controls for selection. The Sargan Test reports the p-value of Sargan's (1958) test of over-identifying restrictions. It is a test of the joint null hypothesis that the excluded instruments are valid instruments, i.e., uncorrelated with the error term and correctly excluded from the estimated equation. The reported p-value indicates the level of confidence with which we do not reject our model. Instruments used are: import weighted tariffs, education expenditures, aircraft departures, cable television, CO2 emissions, personal computers per capita, telephones per capita, telephone main lines, child labor, distance, capital controls and signing of free trade agreements.

Table 7:
Translog Cost Share Specification: Dependent Variable is US Wage Bill as a Share of Total Expenditures on Labor Across All Locations
Fixed Effect (FE) and IV Estimates

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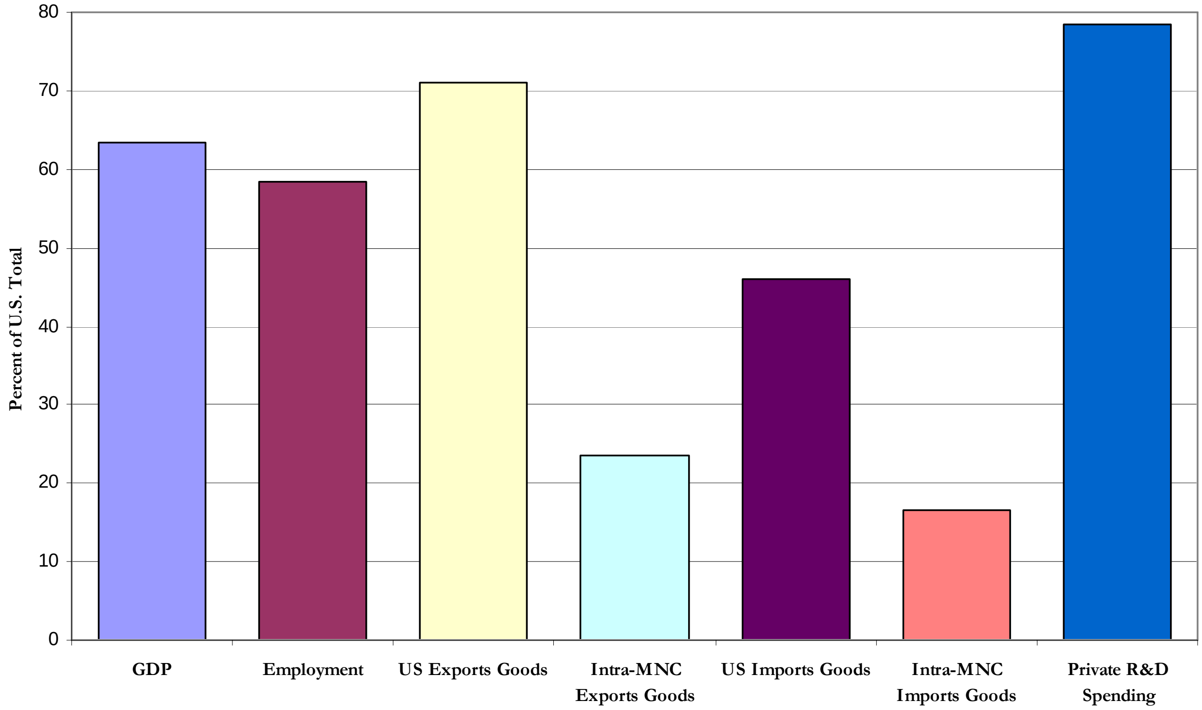
	(1)	(2)	(3)	**Allen Elasticity of Substitution derived from column (2)** σ	**Wage Elasticity of Substitution derived from column (2)** η
	FE	FE	FE/IV		
Log US Wages	-0.846 [0.007]**	-0.892 [0.067]**	-1.110 [0.033]**	-2.110	-1.519
Log of Wages in Low-Income Affiliates	-0.017 [0.005]**	-0.010 [0.005]*	-0.018 [0.007]*	0.72	0.036
Log of Wages in High-Income Affiliates	-0.095 [0.006]**	-0.091 [0.006]**	-0.091 [0.008]**	0.457	0.105
Log US Capital Stock	0.060 [0.003]**	0.057 [0.003]**	0.059 [0.025]**		
Log Capital Stock in High-Income Affiliates	-0.016 [0.001]**	-0.017 [0.001]**	-0.024 [0.005]**		
Log Capital Stock in Low-Income Affiliates	-0.014 [0.001]**	-0.013 [0.001]**	-0.026 [0.006]**		
Log GDP per capita PPP in High-Income Affiliates	-0.000 [0.001]	-0.000 [0.001]	0.001 [0.002]		
Log GDP per capita PPP in Low-Income Affiliates	-0.007 [0.002]**	-0.006 [0.002]**	-0.006 [0.002]**		
Real Intermediate Inputs		-0.000 [0.001]	-0.000 [0.001]		
Import Penetration		0.017 [0.016]	-0.004 [0.024]		
Exports to Foreign Affil. (shr. in sales)		-0.225 [0.046]**	-1.010 [0.385]**		
Imports to Foreign Affil. (shr. in sales)		-0.295 [0.050]**	-0.425 [0.436]		
Constant	0.147 [0.073]*	0.192 [0.073]**	0.404 [0.287]		
F-stat Lambdas Sargan Test	0.000	0.000	0.510 0.916		
Observations	2801	2801	2801		
R-squared	0.39	0.41	0.16		

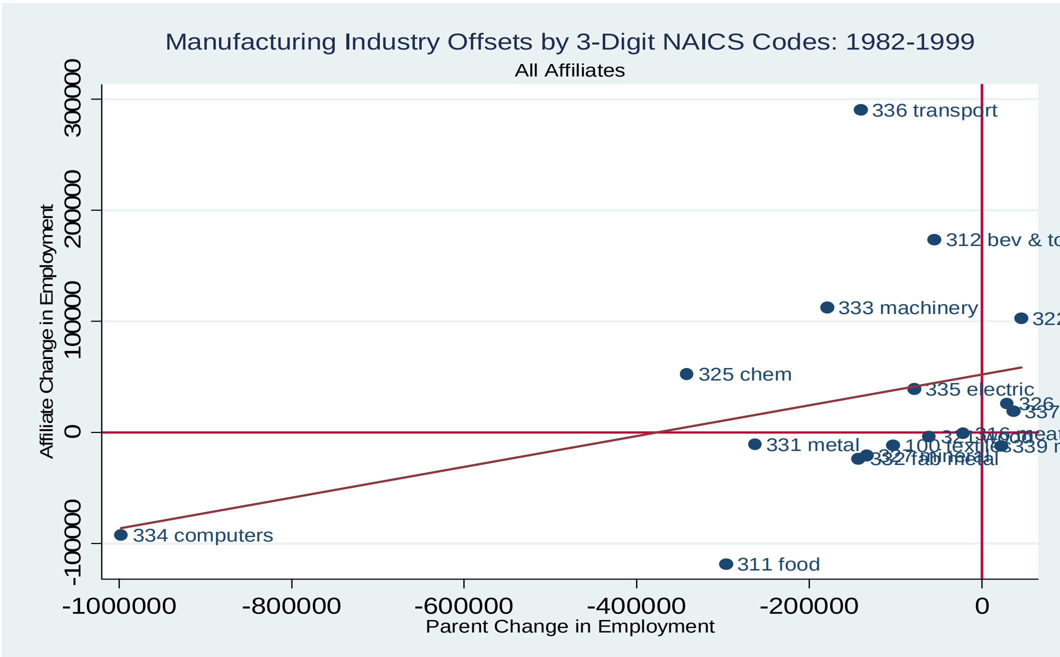
Robust standard errors in brackets. All specifications include time and industry dummies. * significant at 5%; ** significant at 1%. The "F-stat Lambdas" reports the p-value of the joint significance of the controls for selection. The Sargan Test reports the p-value of Sargan's (1958) test of over-identifying restrictions. It is a test of the joint null hypothesis that the excluded instruments are valid instruments, i.e., uncorrelated with the error term and correctly excluded from the estimated equation. The reported p-value indicates the level of confidence with which we do not reject our model. Instruments used are: import weighted tariffs, education expenditures, aircraft departures, cable television, CO2 emissions, personal computers per capita, telephones per capita, telephone main lines, child labor, distance, capital controls and signing of free trade agreements.

Comparison of Manufacturing MNCs to All U.S. Manufacturing*



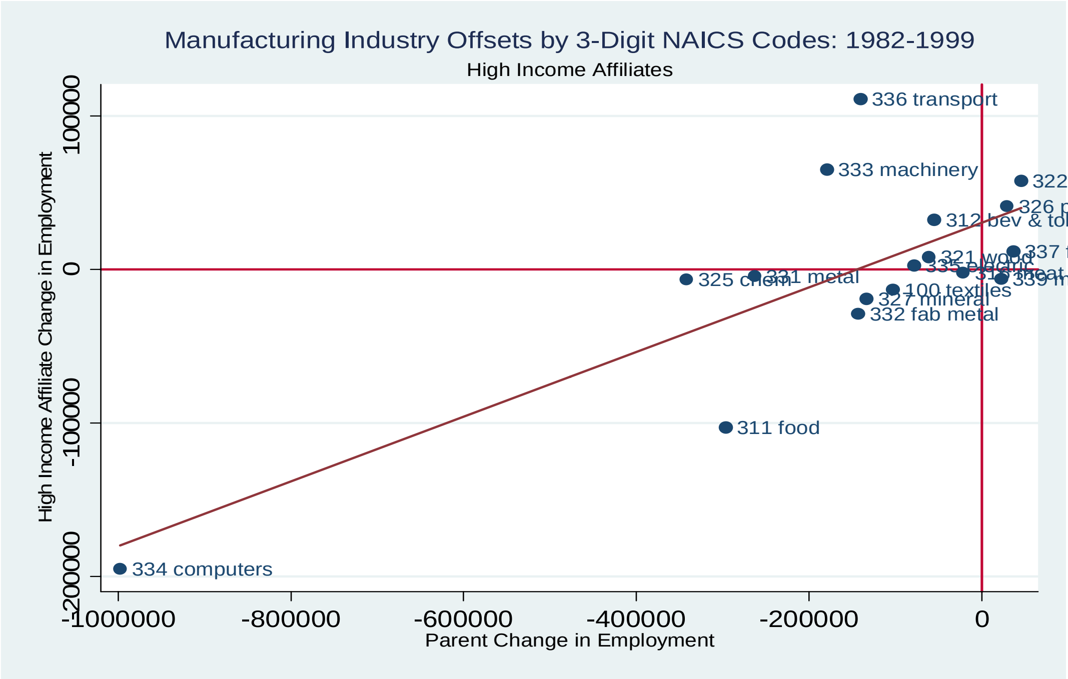
Source: U.S. department of Commerce, BEA and the National Science Foundation: http://w w w .nsf.gov/statistics/inbrief/nsf04307/ 1999 authors calculations. *R&D spending includes all non-bank MNCs and all private R&D spending.

Figure 2: All Affiliates



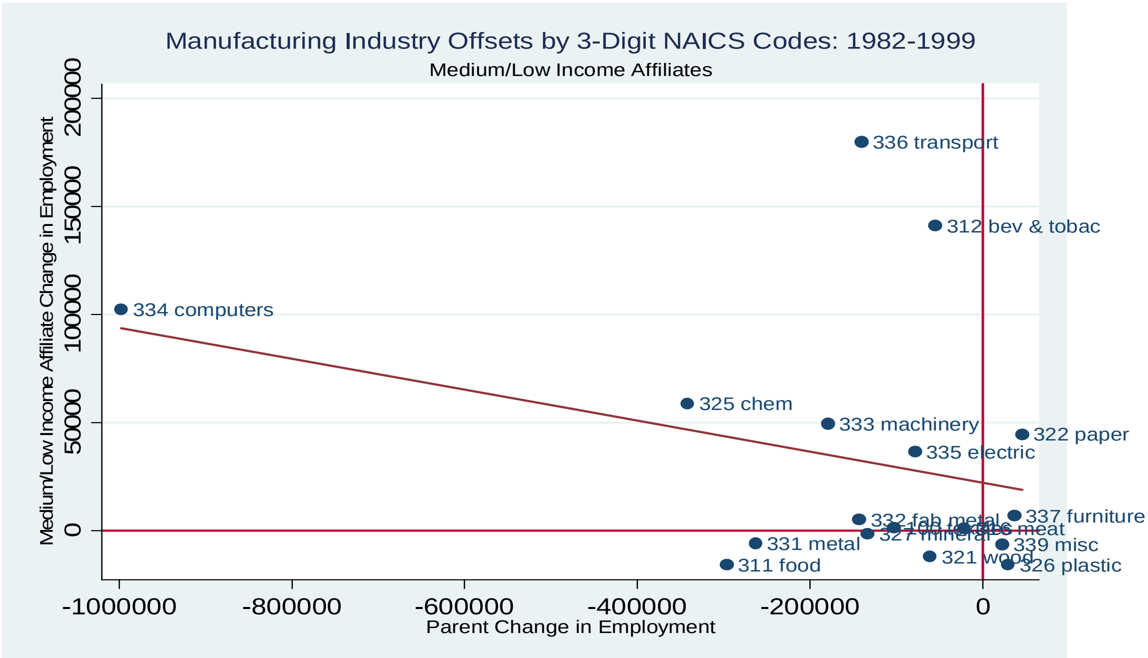
Source: Author's calculations based on BEA's outward FDI data

Figure 3: High Income Affiliates



Source: Author’s calculations based on BEA’s outward FDI data

Figure 4: Medium/Low Income Affiliates



Source: Author's calculations based on BEA's outward FDI data

Appendix Table A.1:
First-Stage Estimation for Endogenous Variables: Full Set of Instruments

	Log Employment in High-Income Affiliates	Log Employment in Low-Income Affiliates	Log Capital Stock in High-Income Affiliates	Log Capital Stock in Low-Income Affiliates	Exports to Foreign Affiliates (share in sales)	Imports to Foreign Affiliates (share in sales)
Import Penetration	-0.188 [0.214]	0.786 [0.301]**	0.463 [0.259]	-0.414 [0.416]	-0.000 [0.008]	0.033 [0.007]**
Log GDP per capita PPP in High-Income Affiliates	-0.012 [0.020]	0.084 [0.029]**	0.033 [0.025]	-0.037 [0.040]	-0.003 [0.001]**	-0.001 [0.001]
Log GDP per capita PPP in Low-Income Affiliates	0.019 [0.024]	-0.389 [0.033]**	0.043 [0.028]	0.616 [0.046]**	-0.000 [0.001]	-0.002 [0.001]**
US R&D Employee Share	-0.961 [0.352]**	-0.529 [0.495]	-1.048 [0.426]*	1.340 [0.685]	0.023 [0.013]	0.082 [0.012]**
High-Income R&D Employee Share	4.073 [0.637]**	-2.805 [0.896]**	4.819 [0.771]**	3.403 [1.239]**	-0.094 [0.023]**	0.014 [0.021]
Low-Income R&D Employee Share	2.510 [1.908]	-3.768 [0.683]**	2.748 [2.308]	6.626 [3.712]	-0.020 [0.010]*	0.034 [0.064]
Tariffs in US	2.241 [1.186]	2.519 [1.667]	3.378 [1.434]**	-4.879 [2.307]**	-0.002 [0.043]	-0.025 [0.040]
Education Expenditures	-0.226 [0.060]**	-0.084 [0.085]	-0.166 [0.073]*	-0.201 [0.117]*	0.005 [0.003]	0.000 [0.002]
Aircraft Departures	-1.042 [0.481]*	1.739 [0.676]*	0.211 [0.582]	-3.000 [0.935]**	0.020 [0.018]	0.015 [0.016]
Cable Television	0.001 [0.001]	-0.001 [0.001]	0.001 [0.001]	-0.001 [0.002]	-0.000 [0.000]	0.000 [0.000]
CO2 Emissions	0.103 [0.030]**	-0.135 [0.043]**	0.093 [0.037]*	0.255 [0.059]**	0.001 [0.001]	-0.001 [0.001]
Telephone Mainlines	0.002 [0.001]**	-0.001 [0.001]	0.003 [0.001]**	0.003 [0.001]*	-0.000 [0.000]	0.000 [0.000]
Industrial Employment	0.017 [0.007]*	0.028 [0.010]**	-0.001 [0.009]	-0.024 [0.014]	-0.000 [0.000]	0.000 [0.000]
Distance	0.549 [0.082]**	-0.180 [0.046]**	0.471 [0.100]**	0.400 [0.160]*	-0.004 [0.003]	-0.007 [0.003]**

Free Trade Agreement	-1.268 [0.217]**	0.358 [0.105]**	-1.605 [0.262]**	0.594 [0.252]*	0.012 [0.006]*	0.004 [0.0019]*
Capital Controls	0.099 [0.132]	-0.042 [0.186]	-0.179 [0.160]	0.023 [0.257]	-0.004 [0.005]	-0.026 [0.004]**
Net P.P.&E. Investment	0.105 [0.034]**	-0.111 [0.048]*	0.150 [0.041]**	0.160 [0.066]*	-0.006 [0.001]**	-0.004 [0.001]**
Child Labor	-0.138 [0.026]**	-0.241 [0.037]**	-0.217 [0.032]**	0.165 [0.051]**	0.006 [0.001]**	0.010 [0.001]**
Observations	2801	2801	2801	2801	2801	2801
R-squared	0.16	0.22	.15	.22	0.06	0.10
First Stage F	13.19	18.79	13.53	21.37	4.38	7.09
Robust standard errors in brackets.* significant at 5%; ** significant at 1%.						

Appendix Table A.2: Description of Variables and Data Sources

Variable Name	Source	Description
Exports to Foreign Affiliates (share in sales)	US Bureau of Economic	goods only; valued f.a.s. at the port of exportation
Imports from Foreign Affiliates (share in sales)	US Bureau of Economic	goods only; valued f.a.s. at the port of exportation
Log Capital Stock	US Bureau of Economic Analysis	Deflated previous periods net book value of property, plant and equipment computed for parents, high-income affiliates and middle/low income affiliates separately.
Log Wage (Industry level)	US Bureau of Economic Analysis	Wages and salaries of employees and employer expenditures for all employee benefit plans in parents computed separately for parents,
Log Employment	US Bureau of Economic Analysis	Log of the number of full-time and part-time employees on the payroll at the end of the fiscal year in all affiliates. However, a count taken during the year was accepted if it was a reasonable proxy for the end-of-year number. Computed separately for parents, high-income affiliates and other affiliates.
Log Non-Production Worker Employment	US Bureau of Economic Analysis	Log of total high-income affiliate employment less production workers computed for high-income and other affiliates.

Log Production Worker Employment	US Bureau of Economic Analysis	Log of number of production workers in high-income affiliates engaged in manufacturing activities - for manufacturing affiliates computed for high-income and other affiliates
R&D Employment Share	US Bureau of Economic Analysis	All employees engaged in R&D, including managers, scientists, engineers, and other professional and technical employees as a share of total employees. Computed separately for parents, high-income and other affiliates
Parent (Affiliate) Share of Labor Expenditures	US Bureau of Economic Analysis	Parent (affiliate) wage bill over parent (affiliate) wage bill plus total affiliate wage bill
Real Intermediate Inputs	US Bureau of Economic	Real value of gross product less sales less imports.
Profit Margin	US Bureau of Economic	Average across all periods of the ratio of net income to sales.
Total Factor Productivity	US Bureau of Economic	TFP firm – TFP max by Industry
US Import Penetration	Bernard, Jensen and Schott (2005)	Imports into the US divided by imports into the US plus total production in the US less exports from the US by year by industry.
Tariffs in US	Feenstra et al. (2002), Feenstra et al. (1997)	Tariff revenues divided by imports by country, by industry, by year.
Capital Controls in Country of Affiliate	International Monetary Fund	0/1 measure of whether a country places restrictions on capital movements (1 being the most restrictive) by country by year.
Aircraft Departures	The World Bank, World Development Indicators	Air transport, registered carrier departures worldwide
Cable Television	The World Bank, World Development Indicators	Cable Television Subscribers (per 1,000 people)
Child Labor	The World Bank, World Development	Labor force, children 10-14 (% of age group)

CO_2 Emissions	The World Bank, World Development Indicators	CO_2 emissions (metric tons per capita)
Education Expenditures	The World Bank, World Development Indicators	Adjusted savings: education expenditure (% of GNI)
Free Trade Agreement with Country of Affiliate	The World Bank, World Development Indicators	=1 if USA has a free trade agreement with affiliate country
Industrial Employment	The World Bank, World Development Indicators	Employment in industry (% of total employment)
Log GDP per capita in High-Income Affiliate	The World Bank, World Development Indicators	Purchasing power parity dollars
Log GDP per capita in Low-Income Affiliate	The World Bank, World Development Indicators	Purchasing power parity dollars
Personal Computers per capita	The World Bank, World Development Indicators	Personal computers (per 1,000 people)
Telephone Mainlines	The World Bank, World Development Indicators	Telephone mainlines (per 1,000 people)
Telephones per capita	The World Bank, World Development Indicators	Fixed line and mobile phone subscribers (per 1,000 people)
Common Language	Andrew Rose	=1 if English is the native language in affiliate country
Distance	Andrew Rose	Distance between Source and Host

Appendix Table A.3 : World Bank Country Classifications

Country Name	World Bank Classification
Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Dem. Rep. Korea, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Taiwan, United Kingdom	High Income: OECD
Aruba, The Bahamas, Bahrain, Bermuda, Cayman Islands, Cyprus, Hong Kong, China, Israel, Kuwait, Netherlands Antilles, Singapore, Slovenia, United Arab Emirates	High Income: nonOECD
Argentina, Barbados, Botswana, Brazil, Chile, Costa Rica, Czech Republic, Dominica, Estonia, Hungary, Latvia, Lebanon, Malaysia, Malta, Mexico, Panama, Poland, Saudi Arabia, Slovak Republic, Trinidad and Tobago, Uruguay, Venezuela, RB	Upper Middle Income
China, Colombia, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Fiji, Guatemala, Guyana ,Honduras, Jamaica, Kazakhstan, Morocco, Namibia, Peru, Philippines, Romania, Russian Federation, South Africa, Sri Lanka, Swaziland, Thailand, Tunisia, Turkey	Lower Middle Income
Dem. Rep. Congo, Eritrea, Ghana, Haiti, India, Indonesia, Kenya, Malawi, Mozambique, Nicaragua, Nigeria, Pakistan, Senegal, Tanzania, Ukraine, Uzbekistán, Vietnam, Rep. Yemen, Zambia, Zimbabwe	Low Income

For the purposes of our analysis, we code as high income countries those classified as either “high income: OECD” or “high income: nonOECD”. All other countries are classified as middle/low income countries.