# FOREIGN-AFFILIATE ACTIVITY AND U.S. SKILL UPGRADING

Bruce A. Blonigen and Matthew J. Slaughter*

*Abstract*—There has been little analysis of the impact of inward foreign direct investment (FDI) on U.S. wage inequality, even though the presence of foreign-owned affiliates in the United States has arguably grown more rapidly in significance for the U.S. economy than trade flows. Using U.S. manufacturing data from 1977 to 1994, we find that inward FDI has not contributed to U.S. within-industry skill upgrading. In fact, the 1980s wave of Japanese greenfield investments was significantly correlated with lower, not higher, relative demand for skilled labor. This casts doubt upon one possible channel of skill-biased technological change that was previously unexplored.

## I. Introduction

The relative wages of more-skilled to less-skilled Americans have risen significantly since the late 1970s.[1] At the same time, within most industries relative labor demands have been shifting toward the more skilled.[2] Many economists have argued that these within-industry labor demand shifts are a primary cause of the rising skill premium, but there is still disagreement about what caused the demand shifts. They are consistent with skill-biased technological change (SBTC), as many researchers have pointed out. However, they are also consistent with explanations related to international trade, and there remains uncertainty about which forces have contributed to skill upgrading. For example, Feenstra and Hanson (1996a, 1996b) find outsourcing to be correlated with skill upgrading, whereas Autor, Katz, and Krueger (1998) conclude outsourcing's effect is not robust to other forces such as computerization.[3]

Most research has focused on trade and technology as demand shifters. The focus on trade is understandable because of the rapidly growing importance of trade in the U.S. economy. However, foreign direct investment (FDI) by multinational enterprises (MNEs) both into and out of the United States has on many measures grown even more rapidly. For example, from 1977 to 1994, U.S. manufacturing imports as a share of U.S. manufacturing shipments rose from 7.0% to 14.2%. During the same period, foreign-affiliate manufacturing sales in the United States as a share of U.S. manufacturing shipments rose from 5.6% to 17.3%.

This growth of foreign-owned manufacturing affiliate presence in the United States has paralleled the rise in U.S. wage inequality. Figure 1 shows the U.S. skill premium (measured as the ratio of average annual wages of nonproduction workers to average annual wages of production workers) and the share of foreign-owned affiliate employment in total U.S. manufacturing employment from 1977 through 1994. The skill premium rose from a low of about 1.52 in 1979 to nearly 1.67 in 1994. At the same time, foreign affiliate employment rose from about 3.7% of total U.S. manufacturing employment in 1977 to 13.5% in 1994 (absolute employment nearly quadrupled, from about 655,000 to over 2.3 million). These parallel trends suggest rising affiliate presence may have contributed to skill upgrading and rising inequality.

In addition to figure 1, several studies have found substantial differences between operating characteristics of foreign-owned manufacturing plants in the United States compared both to plants owned by U.S.-headquartered MNEs and to plants owned by purely domestic firms. With plant-level data for 1989 and 1990, Howenstine and Zeile (1994) find that foreign affiliates in the United States are larger, more capital intensive, and pay higher wages than do domestic plants. Globerman, Ries, and Vertinsky (1994) find qualitatively identical results for foreign affiliates and domestically owned plants in Canada. For U.S. manufacturing, Doms and Jensen (1998) report that foreign-affiliate plants are more productive and pay higher wages than do domestic plants even after controlling for four-digit industry, state, plant age, and plant size.[4] All these studies suggest foreign affiliates may have quite different factor demands, even in the same industry.

Despite the evidence from plant-level studies and the time-series evidence of figure 1, to our knowledge there has been no systematic investigation into inward FDI and foreign affiliate presence as a source of growing U.S. wage inequality. Baldwin (1995) wrote that "there do not seem to be any studies of how the shifts in the pattern of U.S. direct

Received for publication March 23, 1999. Revision accepted for publication April 17, 2000.

* University of Oregon and NBER, and Dartmouth College and NBER, respectively.

For data assistance we thank William Zeile. For helpful comments we thank Bob Lipsey, two anonymous referees, and seminar participants at the 1999 Western Economic Association Meetings. For financial support, Slaughter thanks the Russell Sage Foundation.

[1] Several economists have documented this rise in terms of education, experience, and job classification. Bound and Johnson (1992) find that, between 1979 and 1988, the ratio of the average wage of a college graduate to the average wage of a high-school graduate rose by 15%. Davis (1992) finds that, between 1979 and 1987, the ratio of weekly earnings of males in their forties to weekly earnings of males in their twenties rose by 25%. For all U.S. manufacturing, we find that, between 1979 and 1994, the ratio of average annual wages of nonproduction workers to average annual wages of production workers rose by 10%, from about 1.52 to 1.67.

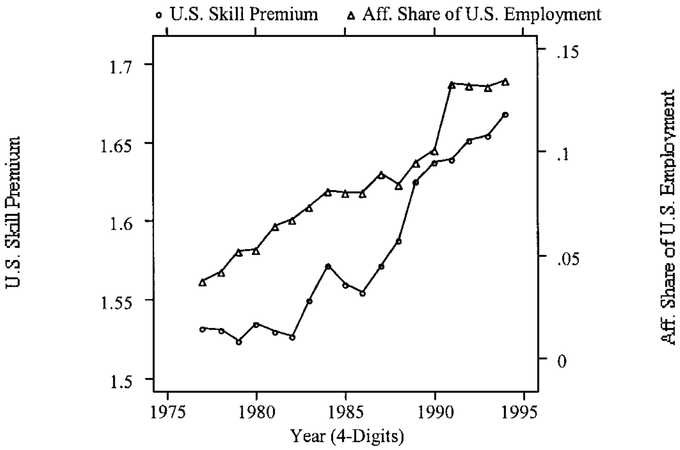
[2] Many studies have found that, even though the relative wage of more-skilled workers has been rising, within most industries relative employment of these workers has risen. This evidence strongly suggests within-industry demand shifts.

[3] The link between SBTC and overall wage inequality depends crucially on whether there is one aggregate output sector or many. In one-sector models, SBTC always raises the skill premium, but in multisector models what usually matters is the sector bias of technological change, not its factor bias. See Haskel and Slaughter (1998).

[4] Doms and Jensen (1998) also group U.S. plants into three categories: plants of U.S. MNEs, plants of large domestically-oriented firms, and plants of smaller firms. They find that plants of U.S. MNEs are the most productive, largest, most capital-intensive, and pay the highest wages, closely followed by U.S. plants of foreign-owned MNEs. Thus, multinational orientation, rather than domestic orientation, is what seems to matter most for these plant characteristics.

*The Review of Economics and Statistics,* May 2001, 83(2): 362–376

FIGURE 1.—SKILL PREMIUM AND FOREIGN-AFFILIATE EMPLOYMENT IN U.S. MANUFACTURING, 1977–1994




Skill premium is measured as the ratio of average annual wages of nonproduction workers to average annual wages of production workers in U.S. manufacturing. Employment share is the share of total U.S. manufacturing employment accounted for by foreign-owned affiliates operating in the United States.
Source: Bureau of Economic Analysis and National Bureau of Economic Research.

investment and direct foreign investment in the United States have affected relative wages," (p. 55). Since Baldwin's survey, both Brainard and Riker (1997) and Slaughter (2000) find little correlation between the foreign activity of U.S. MNEs and U.S. skill upgrading. Complementing these studies of outward FDI, we examine the impact of inward FDI flows and rising foreign-affiliate presence on U.S. skill upgrading in manufacturing from 1977 to 1994.[5]

In addition to the literature on U.S. skill upgrading, our analysis also aims to contribute some empirical evidence on the new class of MNE models in trade theory. Until the mid-1980s, standard trade theory provided few explanations for capital flows into a capital-abundant country such as the United States, besides tariff-jumping motives.[6] During this time period, however, a less-formalized MNE literature existed, centered around the "eclectic paradigm" of Dunning (1981), which emphasized firm-specific assets (such as technological assets) are important causes of MNEs. This literature also argued that MNEs are important channels for international technology transfer. This suggests that MNEs may bring new skill-intensive technologies that induce or accelerate SBTC, even in advanced host countries such as the United States.[7]

Beginning in the mid-1980s, researchers generated a number of new MNE models that incorporated features from new trade theory and industrial organization. (See the survey in Markusen (1995).) These models generate a rich set of MNE and trade patterns across countries that depend on countries' relative endowments and sizes, economies-of-scale effects, and trade and investment policies. These newer models have the potential to formalize the theoretical impact of foreign-affiliate presence on skill upgrading and wage inequality even for an equilibrium like that of the United States in which most of the inward FDI stock is owned by other industrialized countries. However, although these models generally show that inward FDI changes the activity mix of a multinational firm between its home and host country (and hence industry-level factor demands), both skill upgrading and its reverse are possible in these models. This ambiguity means the question of how FDI and foreign-affiliate presence affect host-country within-industry factor demands is largely an empirical one.

To go beyond the aggregate evidence in figure 1 and address the fact that skill upgrading has been predominantly within industries, our econometric analysis uses variation across and within industries. There has been substantial variation across sectors in the within-industry changes in foreign-affiliate presence. For example, our data will show that across all sectors the average 1977–1994 change in the foreign-affiliate employment share was a rise of about ten percentage points, but the standard deviation in this change was fourteen percentage points. To exploit this cross-industry variation, we create an industry-year panel data set for all U.S. manufacturing from 1977 to 1994 by merging data from the National Bureau of Economic Research's (NBER) Manufacturing Productivity Database with data on inward foreign-owned affiliates. Affiliate data come from the Bureau of Economic Analysis, U.S. Department of Commerce (BEA); the International Trade Administration, U.S. Department of Commerce (ITA); and the Japan Economic Institute (JEI). Importantly, much of the MNE data start in 1977 when the U.S. skill premium began climbing. With our data, we use an empirical framework common in this literature to examine whether foreign-affiliate activity affected within-industry skill upgrading.

In addition to examining overall affiliate activity, we have sufficient data to examine the separate impact of different forms of FDI, in particular, new plant (or "greenfield") investment versus acquired establishments. This distinction may be important for a number of reasons. For example, acquired plants may be more likely than new plants to maintain factor demands similar to those of domestic plants. Alternatively, acquisitions may discipline inefficient firms to alter inefficient factor demands (such as by reducing union power). Our data also allow us to focus on Japanese

[5] Examining outward FDI by Japanese MNEs, Head and Reis (1999) reach a different finding from Slaughter (2000) and Brainard and Riker (1997). For a panel of Japanese firms, they find greater foreign employment to be correlated with higher home employment of nonproduction workers relative to production workers. Beyond these studies of FDI and relative labor demand, a number of studies have examined the impact of FDI on the general level of wages in the United States and other countries, including Aitken, Harrison, and Lipsey (1996) and Feliciano and Lipsey (1999).

[6] Although avoiding protection is certainly one possible explanation for some FDI into the United States during our time period of analysis, few would argue that this was more than one of many causes.

[7] A recent paper by Adams (1997) finds that industries in which foreign patents are more important pay a higher relative skilled wage in the United States. However, it is not clear whether this connection occurs directly because of SBTC transferred to foreign-owned affiliates in the United States or other more indirect channels, such as industry-wide spillovers of SBTC.

affiliates, which were particularly controversial over our sample period.

To preview our results, we find little evidence that inward FDI has contributed to U.S. skill upgrading within manufacturing industries. The insignificant relationship between inward FDI and skill upgrading is robust to several sensitivity checks including different measures of foreign-affiliate presence, alternative specifications of our control regressors, various subsamples of our data, and focusing on different types of FDI such as greenfield plants versus acquired ones. We also present limited evidence that trade effects of foreign affiliates working through imported inputs is unlikely to have had any impact on skill upgrading. Thus, despite the plausible a priori relationship, we do not find foreign-affiliate activity to be a source of skill upgrading in U.S. manufacturing.

However, we find one important exception: Japanese greenfield FDI. We examine FDI by Japanese firms specifically, because they were much more likely both to enter with greenfield investments than were other source countries and they exhibit many differences in operating characteristics relative to other foreign affiliates in the United States. We find that greater Japanese greenfield affiliate presence is significantly correlated with lower, not higher, relative demand for skilled workers; greater Japanese presence through acquisitions has no significant effect. The negative correlation is consistent with recent MNE models in which foreign affiliates focus on activities that are less skilled-labor-intensive than the activities of parents. These findings also suggest that, if inward FDI brought new technologies into the United States, the induced technological change was not biased towards skilled labor.

Although we do not have data to examine skill upgrading in nonmanufacturing U.S. industries, we note that foreign-affiliate activity in nonmanufacturing is much lower than in manufacturing. In 1992, the affiliate share of total U.S. nonmanufacturing employment was less than 3%. This fact, along with the small and shrinking share of manufacturing in U.S. economic activity (16.4% of total employment in 1994), suggests our conclusion that foreign-affiliate activity is not a significant force for skill upgrading likely applies to the entire U.S. economy.

The paper has three additional sections. Section II discusses the theoretical connections between foreign-affiliate presence and relative demands for skilled and unskilled labor. Section III presents a brief set of facts about inward FDI, and section IV presents econometric evidence on inward FDI and U.S. labor demand shifts.

## II. Theoretical Motivation

Most previous work on the effect of FDI on wages has examined the issue from a general-equilibrium trade model based on endowment-driven comparative advantage. Feenstra and Hanson (1996a, 1996b, 1997) develop a North-South model to examine the potential effects of FDI inflows on wages in both the host and parent countries. Here, a final good is produced from a continuum of intermediate inputs that vary in the relative amounts of skilled and unskilled labor required. The South has a comparative advantage in unskilled-labor-intensive production. This attracts FDI from the North, which in turn transfers some number of "marginal" inputs from North production to South production. Interestingly, the skill premium rises in both the North and the South, as both regions now produce a more skilled-labor-intensive mix of activities. Empirically, Feenstra and Hanson (1997) find substantial evidence that U.S. FDI into Mexico contributed to rising Mexican inequality. Slaughter's (2000) examination of U.S. MNE outsourcing follows Helpman's (1984) model of MNEs. Helpman's model is based on a two-good, two-factor Heckscher-Ohlin trade model. Here, vertically integrated MNEs may arise when relative-endowment differentials are too large for trade alone to arbitrage international wage differentials. Empirically, Slaughter (2000) finds no systematic correlation between production transfer within U.S. MNEs and U.S. skill upgrading.

Unfortunately, endowment-driven models cannot easily explain the recent wave of inward FDI into the United States. It seems unlikely that inward FDI into the United States has occurred because comparative advantage has changed so that other countries are now outsourcing unskilled-labor-intensive activities to the United States. But, if FDI into the United States is not motivated by standard comparative advantage motivations, it is quite difficult to assess theoretically whether and how this inward FDI should affect wages.

An alternative theoretical literature on the formation of MNEs is summarized by Markusen (1995). These general-equilibrium models start with the observation that a distinguishing characteristic of MNEs is their firm-specific assets such as proprietary technology, marketing skills, and management skills. These assets have a within-firm public-goods aspect to them, so they can be used across all firm plants after incurring a one-time development cost. Thus, these firms can realize economies of scale from multiple plants, which becomes important in a world in which there are trade costs. In fact, introducing these types of features into a general-equilibrium trade model leads to a very rich set of possible configurations of MNEs.

Markusen and Venables (1997) use this type of model to analyze the influence of MNEs on relative wages in the parent and host countries. They use a two-country, two-factor model in which production in the monopolistically competitive sector is composed of three distinct activities: a firm-specific fixed cost using skilled labor, a plant-level fixed cost using a mix of skilled and unskilled labor, and final production which uses only unskilled labor. Intuitively, one can think of the first activity as headquarter services for a multiplant firm. This means that branch-plant activity is less skilled-labor intensive than both headquarter services and the MNE's overall operations. In support of these assumptions, Carr, Markusen, and Maskus (1998) give empirical evidence that foreign affiliates tend to be less skill-intensive and less R&D-intensive than parents. If a firm chooses not to service the foreign market through branch-plant production, it remains a "national" firm and exports to the foreign market.[8] National firms are less skilled-labor intensive than MNEs because they do not require skilled labor to support affiliate production, but production by national firms is more skilled-labor intensive than branch-plant activity, because branch plants do use skilled labor for the MNEs firm-specific costs. An immediate implication is that, as a country sees more foreign-owned branch-level activity at the expense of national firm activity, ceteris paribus, the relative demand for skilled labor will go down. However, the ceteris paribus assumption implies (among other things) that there are no changes in the number of MNEs in the country or the world and no changes in output scale, and these are unlikely satisfied in this general equilibrium framework.

In fact, Markusen and Venables (1997) discuss in great detail the ambiguous relative-wage effects of various parameter changes, such as endowment growth or trade-cost declines. In general, the relative-wage effects of these changes depend on the initial equilibrium and on the underlying parameter change. For example, they show that world endowment growth leads to a greater role for MNEs but also to ambiguous wage effects. If initially there are many national firms and few MNEs, then growth triggers a "regime shift" towards more MNEs. Because MNEs are more skilled-labor intensive than national firms, relative wages rise. However, if the initial equilibrium has mainly MNEs, then growth lowers the skill premium in both countries. Here, growth leads to greater firm-scale effects. Because skilled labor makes the firm-specific assets, firm-scale effects arise mainly with MNE assembly operations that use less skilled labor.[9]

In summary, theory suggests greater MNE activity can either raise or lower the skill mix of activities performed within industries, and thus help raise or lower wage inequality. With respect to the recent U.S. experience, then, there's no clear theoretical prediction about the wage effects of rising inward FDI unless one knows the initial equilibrium and the underlying parameter changes that are increasing multinational activity. This is not a criticism of recent MNE models. They fill an important void in our understanding of the real-world distribution of production and trade. Instead, the ambiguities highlight the need for empirical work to help inform which equilibrium states of the model seem relevant. In our concluding section, we address how our empirical results may serve this purpose.

## III. Data Description and Stylized Facts About Foreign-Affiliate Presence in the United States

To analyze inward FDI, we combine the U.S. data from the NBER with FDI data from several sources. Appendix A describes all our data in detail. The NBER data are a panel of four-digit SIC industry-year observations reporting the value, quantity, and price of output produced and inputs hired within U.S. manufacturing. We combined the NBER data with each of our affiliate data sources, aggregating the NBER industries when necessary.

### *A. The BEA Data*

Through responses to legally mandated surveys, the BEA tracks affiliates of foreign-headquartered MNEs, each of which is defined as one foreign "parent" plus one or more U.S. "affiliates." A parent is an individual or a group such as a trust, corporation, or partnership that controls a business enterprise incorporated abroad. A U.S. affiliate is a business enterprise located in the United States in which there exists "inward foreign direct investment." In turn, inward FDI is defined as direct or indirect ownership or control by a single parent of at least 10% of the voting power of either an incorporated or unincorporated U.S. business enterprise. For the years with publicly available data, 1977 through 1994, we constructed a consistent data series for 56 industries, most of which are collections of three-digit SIC industries. (See appendix table A1.)

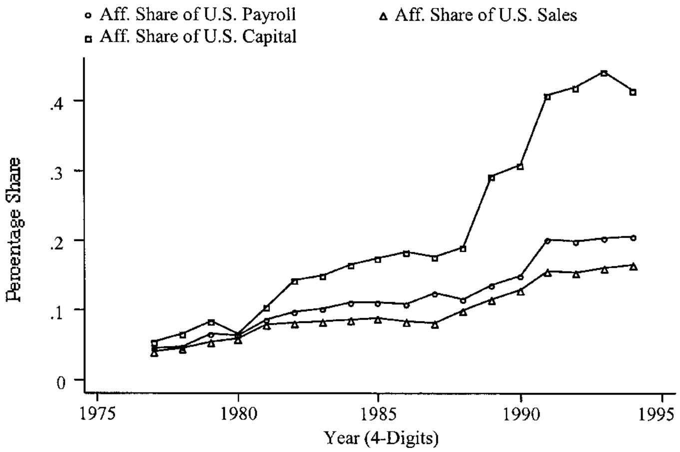
There are notable limitations of these data that potentially affect our analysis. One is that affiliate activity is allocated across industries by assigning each enterprise to the single industry that accounts for the largest share of its total activity. This method may lead to substantial measurement error if enterprises consist of many establishments whose activities span many industries. For example, 55% of a foreign-owned enterprise's activity may be in manufacturing with 45% in wholesale distribution. In the BEA enterprise data, all activity for this enterprise would be classified in manufacturing.

To address this potential problem, we also use two additional BEA data sources on foreign-affiliate activity that classify activity differently. One is "industry-of-sales" data, which are constructed by allocating each enterprise's sales and employment in proportion to its main industries of operation measured in terms of sales. This allocation is done using the same set of 56 industries by which our original enterprise-based data are classified, and these data are available for 1987 through 1994. The other data are establishment based: from 1987 through 1992, a joint project by the BEA and Census matched foreign-affiliate activity at the

[8] Markusen and Venables (1997) assume that transportation of exports requires only unskilled labor; this ensures that MNEs with foreign-branch production are more skill-intensive than exporting national firms.

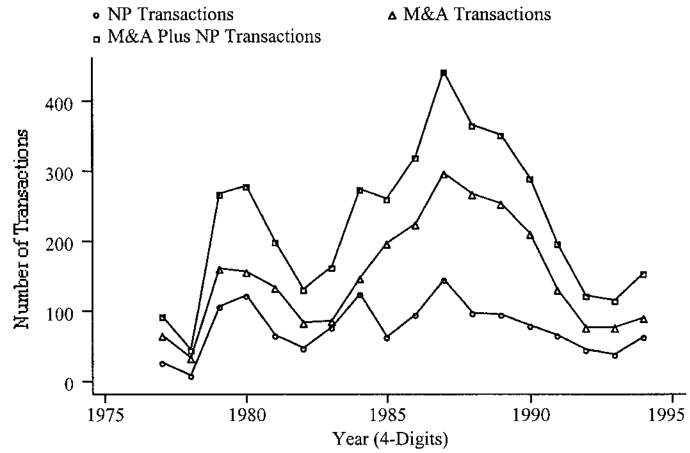
[9] Another example is with respect to trade costs. Rising trade costs generally raise wage inequality in the skilled-labor abundant country as MNE firms replace national firms, and lower wage inequality in the unskilled-labor abundant country. But, if the countries are different enough in size to begin with, then wage inequality may rise in both countries.

FIGURE 2.—FOREIGN-AFFILIATE PAYROLL, CAPITAL, AND SALES IN U.S. MANUFACTURING, 1977–1994




All activity shares are the share of total U.S. manufacturing activity accounted for by foreign-owned affiliates operating in the United States.
Source: Bureau of Economic Analysis and National Bureau of Economic Research.

FIGURE 3.—INWARD FDI TRANSACTION COUNTS IN U.S. MANUFACTURING, 1977–1994




"NP" transactions are new plants. "M&A" transactions are mergers & acquisitions.
Source: International Trade Administration.

level of establishments (not enterprises) and published affiliate activity based on these establishment data at the four-digit SIC level.[10] The tradeoff with these better-measured data is that they are available for only a limited number of years. The majority of our analysis will rely on the BEA enterprise data because they cover a much longer time period. However, after our main analysis, we also present results using the BEA industry-of-sales data and BEA/Census establishment data, which are largely consistent with results we obtain from the BEA enterprise data.

Using the BEA enterprise data, we see that foreign-affiliate activity has increased substantially during the period of rising U.S. wage inequality. Figure 1 shows this affiliate rise for employment as a share of total U.S. manufacturing employment; figure 2 presents the analogous trends for affiliate shares of payroll, capital stock, and sales in U.S. manufacturing from 1977 to 1994. All four shares show an ongoing rise since 1977, with an acceleration in this rise from about 1987 through 1991. We note that the large rise in capital-stock share is at least partly a data artifact: the total U.S. data measure property, plant, and equipment (PPE), but the BEA data measure PPE plus all other assets such as accounts receivable. Unfortunately, the annual BEA data are not sufficiently detailed to separate PPE from all assets in all years.[11]

Because our analysis explores the impact of foreign-affiliate presence on within-industry skill upgrading, it is important to note that there is substantial cross-industry variation in foreign-affiliate presence and growth. As mentioned earlier, the average change in employment shares from 1977 through 1994 was ten percentage points, but with a standard deviation of more than fourteen percentage points.

### B. The ITA Data

Another limitation of the BEA enterprise data is that they do not have disaggregated information on whether foreign affiliates are born and/or expand via a merger or acquisition (M&A), a new greenfield investment, or other types of transactions.[12] As we discussed earlier, different types of FDI may have very different effects on skill upgrading. To allow us to explore this idea, we use data from the ITA. Every year since 1974, the ITA has compiled a census of inward FDI transactions with the following information for each transaction: type of investment, foreign investor, U.S. state location, four-digit SIC industry, and (when available) the dollar value.

The ITA distinguishes seven transaction types: M&A, new plants, joint ventures, plant expansions, reinvested earnings, equity increases, and other. In our analysis, we do not use ITA information on the last three categories both because they account for only a very small share of total ITA observations and because they are fairly uninformative about the type of initial investment. Over our sample period of 1977 through 1994, of all remaining transactions, 52% were M&As, 26% were new plants, 13% were plant expansions, and 9% were joint ventures.[13] Figure 3 plots annual counts for these two largest categories and their sum; the

[10] See appendix A for more details on these alternative BEA data sources, as well as information on how the BEA enterprise data assign an enterprise to a specific industrial sector.

[11] In absolute numbers, total U.S. manufacturing affiliate activity increased from 1977 to 1994 as follows: employment rose from about 655,000 to over 2.3 million, payroll rose from about $11 billion to nearly $109 billion, assets rose from $56 billion to nearly $548 billion, and sales rose from $60 billion to $580 billion.

[12] BEA measures of foreign-affiliate activity by activity type are available annually for all manufacturing beginning in 1980. Greater industry detail by activity type is generally not available due to BEA restrictions not to disclose proprietary firm information.

[13] What transactions data are available from the BEA also show M&As to be the largest transaction category. Klein and Rosengren (1994) note that, from 1979 to 1991, this category accounted for 60% to 89% of annual U.S. FDI inflows.

overall picture is broadly consistent with the BEA trends in figures 1 and 2. Transaction counts peaked during the second half of the 1980s, with M&A activity accounting for most of this surge.

Ideally, we would use the ITA data to analyze whether different types of inward FDI have different effects on skill upgrading. However, these data have a number of disadvantages. First, the ITA generates data from publicly available media sources. This is problematic both because not all FDI transactions are publicly announced and because actual changes may end up differing from announced changes. Second, approximately one-third of the ITA observations do not list dollar values. Third, the ITA counts capture only gross flows into the U.S. affiliate stock: they have no information on exits. Because of these concerns, in our econometric analysis, we use these data only in conjunction with the BEA data. Specifically, we use the ITA counts to decompose changes in the industry-level BEA measures of total affiliate activity among various affiliate types. Below, we discuss this data merge in greater detail.

### C. *The JEI Data*

Our final inward FDI data source is the JEI census of Japanese affiliate plants. Japanese plants in particular are of interest because of the substantial Japanese FDI inflow during our sample period which started from very low levels. Additionally, Howenstine and Shannon (1996) find substantial differences between Japanese and non-Japanese affiliates. Japanese affiliates are much more likely to be greenfield investments, to have a higher share of intermediate inputs in final sales, and to pay slightly lower wages. These findings suggest that Japanese plants may affect U.S. skill upgrading differently than do non-Japanese plants.

Semiannually from 1980 through 1990, the JEI collected the following information on every Japanese manufacturing plant in the United States: four-digit SIC industry, location, age, employment, and M&A or greenfield status. We measure total Japanese affiliate activity using the JEI employment data; we also separate total employment between M&A and greenfield employment. Because of the difficulty in obtaining these data, we use data from only 1980 and 1990.[14] Japanese employment grew by more than 400% during this decade, from around 57,000 to over 262,000, with these totals about evenly split between M&A and greenfield plants. As with the BEA data, the JEI data show substantial cross-industry variation in foreign-affiliate presence and growth. The average change in greenfield employment was plus 1,700 with a standard deviation over 5,000; for M&A employment, the average change was plus 1,800 with a standard deviation of 3,000. Among greenfield plants the largest growth occurred in Motor Vehicles & Equipment (37,000), whereas among M&A plants it was Electronic Components (12,000). Industries such as Agricultural Chemicals and Other Transportation Equipment actually lost employees over the decade.

## IV. Estimation Strategy, Measurement and Empirical Results

### A. *Estimation Strategy and Measurement*

To identify the link between inward FDI and within-industry shifts in U.S. labor demand, we exploit the variation in inward FDI across industries. To proceed, for each industry ($k$) we assume that capital is a quasi-fixed factor and that the industry minimizes the cost of skilled and unskilled labor according to a translog cost function.[15] In each industry, cost minimization leads to an equation explaining the level change over some time period in that industry's skilled-labor share of the total wage bill:

$$\Delta SH_{kt} = \beta_1 \Delta \log \left(\frac{w_s}{w_u}\right)_{kt} + \beta_2 \Delta \log \left(\frac{K}{Y}\right)_{kt} + \beta_3 \Delta \log (Y)_{kt} + \delta(TD)_t + e_{kt}, \quad (1)$$

where

- $k$ indexes industries;
- $t$ indexes time;
- $\Delta SH_{kt}$ is the level change in the skilled-labor share of the total wage bill, where an increase indicates skill upgrading;
- $w_{skt}$ is the skilled wage;
- $w_{ukt}$ is the unskilled wage;
- $K_{kt}$ is capital;
- $Y_{kt}$ is real value-added output;
- $TD_t$ is a full set of time dummy variables; and
- $e_{kt}$ is an additive error term.

The wage regressor accounts for variation in $SH_{kt}$ due to industries substituting away from more-expensive factors. The coefficient $\beta_1$ is positive or negative depending on whether the cross-industry average elasticity of substitution between skilled and unskilled labor is below or above 1. The capital-to-output regressor accounts for variation in $SH_{kt}$ due to capital investment. A positive $\beta_2$ indicates capital-skill complementarity whereby investment stimulates skilled-labor demand. The output regressor controls for industry scale. The time dummies control for any skill upgrading that is common to all industries. Industry fixed effects, accounted for through time-differencing the data, capture any industry-specific technology differences that are common over time.

If one pools all industries and estimates equation (1), then the variation in $SH_{kt}$ not explained by changes in wages,

[14] We thank Keith Head and John Ries for providing the 1990 data in electronic form.

[15] The advantage of the translog functional form is that it imposes fewer restrictions on factor substitutability than either CES, Cobb-Douglas, or Leontief production technologies.

capital, and output is commonly attributed to SBTC. Variations of equation (1) have been used recently by a number of researchers. Berman, Bound, and Griliches (1994) use equation (1) to document the large amount of within-industry SBTC in the United States in recent decades. Feenstra and Hanson (1996a, 1996b), Autor et al. (1998), and Slaughter (2000) expand this methodology by adding new regressors to equation (1), such as outsourcing, computerization, and outward FDI. These studies explain skill upgrading more thoroughly than the assumption of equation (1) that any residual variation in $SH_{kt}$ is attributed by default to SBTC.

Our empirical specification adds to equation (1) measures of inward FDI activity. Following earlier findings that computerization is robustly correlated with skill upgrading, we also add computer use to equation (1). Thus, our baseline estimating equation is given by equation (2):

$$\Delta SH_{kt} = \beta_1 \Delta \log \left(\frac{w_s}{w_u}\right)_{kt} + \beta_2 \Delta \log \left(\frac{K}{Y}\right)_{kt} + \beta_3 \Delta \log (Y)_{kt} + \gamma \Delta (FDI)_{kt} + \eta (COMP)_{kt} + \delta (TD)_t + u_{kt}, \quad (2)$$

where $\mathrm{FDI}_{kt}$ is some measure of inward FDI activity, $\mathrm{COMP}_{kt}$ measures computer use, and $u_{kt}$ is an additive error term. The key question in equation (2) is the sign of $\gamma$. The null hypothesis is $\gamma = 0$: no relationship between affiliate activity and skill intensity. The alternative hypothesis is $\gamma \neq 0$: changes in affiliate activity are associated with changes in skill intensity. A significantly positive (negative) estimate of $\gamma$ will be interpreted as evidence that affiliates contributed to within-industry shifts in demand towards more-skilled (less-skilled) workers.[16]

Estimating equation (2) requires industry-level data on affiliate activity, computer use, capital stocks, output, and employment and wages for both skilled and unskilled workers. FDI sources were discussed in section III; computer use comes from the U.S. Census of Manufactures, and all other data come from the NBER Manufacturing Productivity Database. We measure $\mathrm{COMP}_{kt}$ as the share of computer investment in total investment. Note that this variable enters equation (2) in levels, not in changes, under the assumption that it is the flow of investment that creates changes in $SH_{kt}$.[17] We construct $SH_{kt}$ as the nonproduction wage bill divided by total wage bill of production and nonproduction workers. We construct $w_{skt}$ ($w_{ukt}$) as total nonproduction (production) wage bill divided by total nonproduction (production) employment. $K_{kt}$ is measured as real equipment and plant. Value-added price deflators are not available, so we measure $Y_{kt}$ as real value of shipments.

Before presenting our results, we mention three general estimation issues. First, all results are robust to the exact treatment of the non-FDI regressors in equation (2). Below, we report results for specifications that omit the wage regressor, disaggregate capital between plant and equipment, and include real output and computer use.[18] These results are qualitatively similar to unreported results that include the wage regressor, aggregate plant and equipment, and omit output or computer use. Second, we use weighted least squares, weighting industries by their share of total manufacturing wage bill. Third, all estimates use White-adjusted standard errors.

Table 1 reports summary statistics for our key variables discussed so far; the various $\Delta(FDI)_{kt}$ regressors in table 1 we define in turn below. For consistency, all data are aggregated to the 56 BEA industries. Skill upgrading is visible in the positive mean changes in $SH_{kt}$. Again, there is substantial cross-industry variation in $\Delta SH_{kt}$ that we aim to link with our $\Delta(FDI)_{kt}$ regressors.

### *B. The Effect of Total Affiliate Activity on Skill Upgrading*

We first measure affiliate activity ($FDI_{kt}$) using the BEA enterprise data, our most complete data source on all foreign-affiliate activity in the United States. We construct the ratio of total affiliate activity to total U.S. industry activity in four ways: in terms of employment, payroll, assets, or sales. Rather than measuring the absolute level of affiliate activity, this construction scales how important affiliates are relative to U.S. industry overall. In principle, industry-years in which affiliate activity constitutes a greater share of U.S. industry activity have greater scope for affiliates to affect U.S. industry labor demand. Accordingly, these industry-years have larger measures of $FDI_{kt}$.

We use these BEA enterprise data across 56 industries from 1977 through 1994 to estimate equation (2). Table 2 reports estimation results for one-year differences. Each column reports estimates for one of our $FDI_{kt}$ measures plus a common set of controls. The control regressors in table 2 all have coefficient estimates in line with earlier studies: skill upgrading is positively correlated with capital intensity,

[16] One referee noted that, when we define FDI activity as the share of foreign-affiliate assets, capital enters our equation twice: the *FDI* variable and the ($K/Y$) variable. As an alternative, the referee suggested we decompose the $K/Y$ term into domestic and foreign capital to test whether foreign capital has a different effect on skill upgrading than domestic capital. These tests do not indicate that a greater share of foreign-affiliate manufacturing activity alters the capital-skill complementarity that we find in the data generally, which is consistent with our paper's general conclusions. Details of this test and estimation results are available from the authors upon request.

[17] We also tried alternative measures of "computerization" used by Feenstra and Hanson (1999): these measure changes in the "high-technology" (defined various ways) share of capital by two-digit SIC industries. Specifications with these alternative computerization measures yielded qualitatively identical results to those reported in the paper. We have data on $COMP_{kt}$ (the investment-flow measure) for only 1977, 1982, and 1987. We imputed the 1977 level to years 1978–1981, the 1982 level to years 1983–1986, and the 1987 level to years 1988 and beyond.

[18] The wage regressor is omitted because cross-sectional relative-wage variation might reflect skill-mix differences rather than exogenous wage differences. Standard trade theory with perfect interindustry factor mobility predicts no such cross-sectional wage variation, in which case time fixed effects capture the truly exogenous wage changes.

TABLE 1.—SUMMARY STATISTICS

| Variable | Measure | Observations | Mean | Std. Dev. |
|---|---|---|---|---|
| *Regressand* | | | | |
| U.S. NP Wage Bill/U.S. Wage Bill | Levels | 1008 | 0.394 | 0.116 |
| | First Diffs | 952 | 0.003 | 0.011 |
| | Long Diffs | 56 | 0.047 | 0.042 |
| *Regressors* | | | | |
| ln (U.S. Plant/U.S. Shipments) | Levels | 1008 | −1.637 | 0.331 |
| | First Diffs | 952 | −0.013 | 0.072 |
| | Long Diffs | 56 | −0.221 | 0.433 |
| ln (U.S. Equipment/U.S. Shipments) | Levels | 1008 | −1.388 | 0.483 |
| | First Diffs | 952 | 0.011 | 0.077 |
| | Long Diffs | 56 | 0.179 | 0.456 |
| ln (U.S. Shipments) | Levels | 1008 | 10.393 | 0.854 |
| | First Diffs | 952 | 0.019 | 0.075 |
| | Long Diffs | 56 | 0.315 | 0.611 |
| Computer Investment/Total Investment | Levels | 1008 | 0.044 | 0.043 |
| | First Diffs | 952 | 0.003 | 0.011 |
| | Long Diffs | 56 | 0.046 | 0.033 |
| Affiliate Employment/U.S. Employment | Levels | 864 | 0.127 | 0.178 |
| | First Diffs | 767 | 0.007 | 0.045 |
| | Long Diffs | 42 | 0.109 | 0.139 |
| Affiliate Wage Bill/U.S. Wage Bill | Levels | 859 | 0.163 | 0.217 |
| | First Diffs | 763 | 0.010 | 0.055 |
| | Long Diffs | 42 | 0.161 | 0.190 |
| Affiliate Assets/U.S. Capital Stock | Levels | 860 | 0.223 | 0.263 |
| | First Diffs | 763 | 0.022 | 0.080 |
| | Long Diffs | 37 | 0.379 | 0.368 |
| Affiliate U.S. Shipments/U.S. Shipments | Levels | 871 | 0.108 | 0.108 |
| | First Diffs | 773 | 0.007 | 0.039 |
| | Long Diffs | 42 | 0.115 | 0.114 |
| Japanese Affiliate Employment/U.S. Employment | Levels | 112 | 0.009 | 0.013 |
| | First Diffs | N.A. | N.A. | N.A. |
| | Long Diffs | 56 | 0.013 | 0.015 |

All variables defined in the text. "First Diffs" are one-year differences. "Long Diffs" are full-sample differences (18 years for all variables except the Japanese variable, which is 10 years).
Source: BEA, JEI, NBER, and U.S. Bureau of the Census.

output, and computer use. Although the fit of the equation and control regressors suggests a reasonably specified equation, all four measures of affiliate activity have no significant correlation with industry-wide skill upgrading. Statistical significance aside, three of the four FDI measures are actually negatively correlated with skill upgrading, suggesting that greater affiliate activity is associated with reduced, not increased, skill upgrading.

We next conducted a number of sensitivity checks on the results in table 2. First, our specification with one-year differences assumes that a given year's changes in affiliate activity immediately influence industry-level skill upgrading in that same year. This assumption might be too restrictive. For example, with M&A activity it may take considerable time for a new foreign owner to change operations of a formerly domestic-owned operation. If this is true, one-year changes in affiliate shares may not capture the long-run impact of foreign-affiliate presence on skill upgrading very well. Because most U.S. affiliates were originally "born" via

TABLE 2.—SKILL-UPGRADING REGRESSIONS: BEA DATA, ONE-YEAR DIFFERENCES, 1977–1994

| Regressor | Specification (1) | Specification (2) | Specification (3) | Specification (4) |
|---|---|---|---|---|
| Measure of FDI Activity | employment | wage bill | capital | shipments |
| Δ (FDI Activity) | −0.001 | −0.002 | 0.004 | −0.009 |
| | (−0.100) | (−0.378) | (0.948) | (−0.915) |
| Computerization | 0.024 | 0.025 | 0.028 | 0.026 |
| | (2.299) | (2.345) | (2.522) | (2.424) |
| Δ ln (U.S. Plant/U.S. Ship) | 0.098 | 0.096 | 0.097 | 0.094 |
| | (4.727) | (4.601) | (4.588) | (4.572) |
| Δ ln (U.S. Equip/U.S. Ship) | 0.009 | 0.008 | 0.009 | 0.010 |
| | (1.189) | (1.087) | (1.145) | (1.250) |
| Δ ln (U.S. Shipments) | 0.053 | 0.052 | 0.052 | 0.051 |
| | (3.091) | (2.988) | (2.939) | (2.981) |
| Adjusted $R^2$ | 0.371 | 0.375 | 0.400 | 0.386 |
| No. of observations | 767 | 763 | 763 | 773 |

Each specification is a variation of equation (2) in the text. In all cases the regressand is the change in skilled-labor's share of the wage bill, the wage regressor omitted, and capital disaggregated between plant and equipment. Reported *t*-statistics (in parentheses) are based on White robust standard errors.
Source: BEA, U.S. Bureau of the Census, and NBER.

TABLE 3.—SKILL-UPGRADING REGRESSIONS: BEA DATA, LONG DIFFERENCES, 1977–1994

| Regressor | Specification (1) | Specification (2) | Specification (3) | Specification (4) |
|---|---|---|---|---|
| Measure of FDI Activity | employment | wage bill | capital | shipments |
| Δ (FDI Activity) | 0.007 | 0.011 | −0.001 | 0.076 |
| | (0.134) | (0.303) | (−0.110) | (1.040) |
| Computerization | 0.473 | 0.480 | 0.445 | 0.501 |
| | (2.404) | (2.463) | (3.455) | (2.668) |
| Δ ln (U.S. Plant/U.S. Ship) | 0.054 | 0.055 | 0.034 | 0.061 |
| | (2.204) | (2.194) | (1.693) | (2.372) |
| Δ ln (U.S. Equip/U.S. Ship) | 0.018 | 0.018 | 0.020 | 0.013 |
| | (2.164) | (2.056) | (3.184) | (1.468) |
| Δ ln (U.S. Shipments) | 0.045 | 0.045 | 0.016 | 0.046 |
| | (2.231) | (2.210) | (3.455) | (2.668) |
| Adjusted $R^2$ | 0.537 | 0.538 | 0.584 | 0.561 |
| No. of observations | 42 | 42 | 37 | 42 |

Each specification is a variation of equation (2) in the text. In all cases the regressand is the change in skilled-labor's share of the wage bill, the wage regressor omitted, and capital disaggregated between plant and equipment. Reported *t*-statistics (in parentheses) are based on White robust standard errors.
Source: BEA, U.S. Bureau of the Census, and NBER.

TABLE 4.—SKILL-UPGRADING REGRESSIONS: BEA DATA, VARIOUS DIFFERENCES AND SUBPERIODS

| Regressor | Specification (1) | Specification (2) | Specification (3) | Specification (4) |
|---|---|---|---|---|
| Δ (FDI Activity) | −0.004 | −0.029 | 0.016 | −0.011 |
| | (−0.368) | (−0.474) | (1.276) | (−0.148) |
| Computerization | 0.017 | 0.497 | 0.052 | 0.447 |
| | (0.962) | (2.721) | (2.625) | (2.350) |
| Δ ln (U.S. Plant/U.S. Ship) | 0.061 | 0.046 | 0.132 | 0.055 |
| | (2.282) | (1.857) | (3.016) | (2.257) |
| Δ ln (U.S. Equip/U.S. Ship) | 0.006 | 0.020 | 0.024 | 0.020 |
| | (0.906) | (2.683) | (0.816) | (2.113) |
| Δ ln (U.S. Shipments) | −0.005 | 0.040 | 0.091 | 0.046 |
| | (−0.185) | (2.022) | (3.360) | (2.216) |
| Time Period | 1986–1991 | 1986–1991 | 1977–1985 | 1977–1985 |
| Time Differences | Short | Long | Short | Long |
| Adjusted $R^2$ | 0.196 | 0.531 | 0.485 | 0.538 |
| No. of observations | 265 | 47 | 346 | 40 |

Each specification is a variation of equation (2) in the text. In all cases the regressand is the change in skilled-labor's share of the wage bill, the FDI regressor is in terms of employment, the wage regressor omitted, and capital disaggregated between plant and equipment. Reported *t*-statistics (in parentheses) are based on White robust standard errors.
Source: BEA, U.S. Bureau of the Census, and NBER.

acquisitions (versus greenfield plants), this may be an important consideration.

To examine the potential long-run impact of foreign affiliates, table 3 reports estimation results for equation (2) where each industry is long-differenced over the period from 1977 to 1994. Despite the change in specification, we get qualitatively identical results to our sample with one-year differences. The control variables retain the correct signs and are generally statistically significant, and overall the fit of the regressions is quite high for a cross section with so few observations. Yet we still find no significant correlation between any of the affiliate-activity measures and skill upgrading. Three of the four measures now show positive correlations, but none are even close to statistical significance at standard confidence levels.

As a second check of our results in table 2, table 4 reports results for two different subperiods: 1977 through 1985 and 1986 through 1991. The 1986–1991 subperiod is of particular interest because, during that time, aggregate inward FDI into the United States surged to record levels. For brevity, we report only estimates measuring affiliate activity in terms of employment; the other three measures yielded no qualitative differences. As table 4 reports, using both short and long differences on both subperiods, we again find no clear link between affiliate activity and skill upgrading. In summary, our finding that overall affiliate activity has no significant impact on skill upgrading in the U.S. manufacturing is surprisingly robust to a variety of specifications and data subperiods.

### C. *The Effect of Different Forms of Affiliate Activity on Skill Upgrading*

To this point, we have assumed that foreign affiliates in an industry are homogeneous. However, the different forms of establishing a foreign-affiliate presence may have different implications for skill upgrading. For example, the acquisition of an existing domestic firm will have no impact on industry skill upgrading unless and until the foreign parent changes the affiliate's production technology in a way that affects the affiliate's relative labor demands. This contrasts with a new greenfield or joint-venture affiliate, which may immediately employ a much different technology from that of domestically owned establishments in the

TABLE 5.—SKILL-UPGRADING REGRESSIONS: BEA-ITA DATA, ONE-YEAR DIFFERENCES, 1977–1994

| Regressor | Specification (1) | Specification (2) | Specification (3) | Specification (4) | Specification (5) |
|---|---|---|---|---|---|
| Type of Inward FDI | MA | JV | NP | PE | MA + NP + PE |
| Δ (FDI Activity) | 0.001 | −0.019 | −0.009 | −0.009 | −0.001 |
| | (0.068) | (−0.490) | (−0.462) | (−0.315) | (−0.124) |
| Computerization | 0.023 | 0.023 | 0.023 | 0.023 | 0.023 |
| | (2.074) | (2.089) | (2.047) | (2.071) | (2.071) |
| Δ ln (U.S. Plant/U.S. Ship) | 0.102 | 0.101 | 0.102 | 0.102 | 0.102 |
| | (4.671) | (4.675) | (4.669) | (4.676) | (4.676) |
| Δ ln (U.S. Equip/U.S. Ship) | 0.009 | 0.009 | 0.009 | 0.009 | 0.009 |
| | (1.123) | (1.140) | (1.131) | (1.128) | (1.128) |
| Δ ln (U.S. Shipments) | 0.057 | 0.057 | 0.058 | 0.058 | 0.058 |
| | (3.143) | (3.144) | (3.143) | (3.148) | (3.146) |
| Adjusted $R^2$ | 0.368 | 0.368 | 0.368 | 0.368 | 0.368 |
| No. of observations | 678 | 678 | 678 | 678 | 678 |

Each specification is a variation of equation (2) in the text. In all cases the regressand is the change in skilled-labor's share of the wage bill, the BEA part of the FDI regressor is in terms of employment, the wage regressor omitted, and capital disaggregated between plant and equipment. Reported *t*-statistics (in parentheses) are based on White robust standard errors. "MA" refers to mergers and acquisitions, "JV" joint ventures, "NP" new plants, and "PE plant expansions."

Source: BEA, ITA, U.S. Bureau of the Census, and NBER.

industry. Empirically, Kogut and Chang (1991) and Blonigen (1997) find evidence consistent with a story in which foreign firms are accessing firm-specific assets, such as new technologies, through acquisition of U.S. establishments. To the extent that foreign acquisitions are motivated by these considerations, it's not clear that they necessarily change the acquired establishments' operations.[19]

To examine how the effect of foreign-affiliate activity on skill upgrading may vary by type of initial FDI, we construct a second set of $FDI_{kt}$ measures by combining our BEA enterprise data with the ITA data that details FDI transactions by type. To link these data, we first aggregate the four-digit SIC ITA counts up to the 56 BEA industries. Then, we decompose the change in total foreign-affiliate presence into four FDI types: M&A, greenfield, joint venture, and plant expansion. That is, we apportion the change in the BEA affiliate measures into the four FDI types using the shares of each FDI type in the total ITA transaction counts for each industry in each year. For one-year BEA changes between years $(t - 1)$ and $t$, we used ITA counts during year $t$. For longer full-sample BEA changes, we accumulated ITA counts over the full sample period.

Alternatively, we could simply use the counts of ITA transactions as our measures of yearly changes in affiliate presence by type of FDI. However, this approach would impose strict assumptions on the data that are likely not satisfied. This would assume that transactions across type and industry are equal in size, that is, that each transaction represents the same change in foreign-affiliate presence. A simple look at the ITA transactions for which dollar values are recorded shows that this is not the case: there are systematic differences in transaction sizes across industries and type. M&A transactions, for example, tend to be much larger than all other types, so counts alone would understate the importance of M&A transactions and overstate that of all other types. By taking the BEA measure of affiliate-presence change for an industry and year and then apportioning that change by type of FDI using the ITA data, we no longer assume that transactions are equal in size across industries. But we must still assume that transactions are identical in size across types within an industry. One important reason we turn to the JEI data on Japanese FDI in the next section is because those data allow us to relax this assumption as well.

Table 5 reports results for the BEA-ITA measures of $FDI_{kt}$ by type for one-year differences. For brevity, in table 5, we report results using changes in foreign affiliate activity measured by employment share only; the other measures (in terms of payroll, assets, or sales) yield qualitatively identical results to those reported here. As table 5 shows, isolating the role of different transaction types does not change the picture much. There is no significant correlation between skill upgrading and any particular type of inward FDI measures. The same is true in table 6, which continues with the BEA-ITA data, but reports long-difference estimates.[20]

### D. *Estimating with Alternative BEA Data on Foreign-Affiliate Activity*

As discussed in section III, the BEA enterprise data used to this point may contain substantial measurement error. In this section, we repeat our analysis using our two alternative BEA data sources that more accurately measure foreign-affiliate activity by industry. Again, the tradeoff is that these other sources cover a much shorter time period.

[19] There is also an established literature on acquisitions as a disciplining device, whereby efficient firms acquire inefficient ones. This may have implications for skill upgrading. However, if foreign firms are no more likely to be the acquiring firm in these cases than U.S. firms, there is no expected effect from greater foreign presence in an industry on skill upgrading.

[20] Note that the non-FDI regressors in tables 5 and 6 have nearly identical coefficient estimates and standard errors across the different FDI regressors. This suggests that the ITA allocations across transaction types are quite stable over time (for example, M&A transactions account for about 50% of all transactions every year) such that the sample variation is quite similar across the various BEA-ITA regressors.

TABLE 6.—SKILL-UPGRADING REGRESSIONS: BEA-ITA DATA, LONG DIFFERENCES, 1977–1994

| Regressor | Specification (1) | Specification (2) | Specification (3) | Specification (4) | Specification (5) |
|---|---|---|---|---|---|
| Type of Inward FDI | MA | JV | NP | PE | MA + NP + PE |
| Δ (FDI Activity) | −0.017 | 0.117 | 0.045 | 0.123 | 0.007 |
| | (−0.170) | (0.218) | (0.230) | (0.499) | (0.121) |
| Computerization | 0.461 | 0.476 | 0.479 | 0.492 | 0.472 |
| | (2.375) | (2.475) | (2.359) | (2.512) | (2.397) |
| Δ ln (U.S. Plant/U.S. Ship) | 0.054 | 0.056 | 0.054 | 0.055 | 0.054 |
| | (2.204) | (2.149) | (2.198) | (2.203) | (2.207) |
| Δ ln (U.S. Equip/U.S. Ship) | 0.020 | 0.018 | 0.019 | 0.018 | 0.018 |
| | (2.152) | (2.131) | (2.033) | (1.997) | (2.168) |
| Δ ln (U.S. Shipments) | 0.045 | 0.046 | 0.045 | 0.045 | 0.045 |
| | (2.263) | (2.160) | (2.203) | (2.176) | (2.230) |
| Adjusted $R^2$ | 0.537 | 0.537 | 0.537 | 0.541 | 0.537 |
| No. of observations | 42 | 42 | 42 | 42 | 42 |

Each specification is a variation of equation (2) in the text. In all cases the regressand is the change in skilled-labor's share of the wage bill, the BEA part of the FDI regressor is in terms of employment, the wage regressor omitted, and capital disaggregated between plant and equipment. Reported *t*-statistics (in parentheses) are based on White robust standard errors. "MA" refers to mergers and acquisitions, "JV" joint ventures, "NP" new plants, and "PE plant expansions."

Source: BEA, ITA, U.S. Bureau of the Census, and NBER.

TABLE 7.—SKILL-UPGRADING REGRESSIONS: BEA DATA, VARIOUS INDUSTRY CONSTRUCTIONS, DIFFERENCES, AND SUBPERIODS

| Regressor | Specification (1) | Specification (2) | Specification (3) | Specification (4) | Specification (5) | Specification (6) |
|---|---|---|---|---|---|---|
| Δ (FDI Activity) | −0.012 | 0.009 | −0.014 | −0.052 | 0.001 | −0.085 |
| | (−0.848) | (0.209) | (−0.859) | (−0.755) | (0.042) | (−2.193) |
| Computerization | 0.019 | 0.161 | 0.015 | 0.104 | 0.013 | 0.106 |
| | (1.449) | (2.464) | (1.510) | (2.073) | (1.301) | (2.949) |
| Δ ln (U.S. Plant/U.S. Ship) | 0.030 | 0.030 | 0.020 | 0.015 | 0.019 | −0.022 |
| | (1.338) | (1.364) | (0.701) | (0.502) | (0.553) | (−0.976) |
| Δ ln (U.S. Equip/U.S. Ship) | 0.006 | 0.014 | 0.022 | 0.030 | 0.027 | 0.053 |
| | (0.839) | (1.903) | (1.083) | (1.109) | (1.064) | (2.628) |
| Δ ln (U.S. Shipments) | −0.017 | 0.015 | −0.002 | 0.021 | 0.010 | 0.015 |
| | (−0.744) | (0.592) | (−0.111) | (0.836) | (0.429) | (0.714) |
| BEA Data Basis | Enterprise | Enterprise | Sales | Sales | Establishment | Establishment |
| Time Period | 1987–1994 | 1987–1994 | 1987–1994 | 1987–1994 | 1987–1992 | 1987–1992 |
| Time Differences | Short | Long | Short | Long | Short | Long |
| Adjusted $R^2$ | 0.217 | 0.379 | 0.233 | 0.344 | 0.086 | 0.289 |
| No. of observations | 375 | 51 | 369 | 53 | 496 | 99 |

Each specification is a variation of equation (2) in the text. In all cases the regressand is the change in skilled-labor's share of the wage bill, the wage regressor omitted, and capital disaggregated between plant and equipment. Short differences are one-year differences; long differences span the available time period. Reported *t*-statistics (in parentheses) are based on White robust standard errors.

Source: U.S. Bureau of the Census, and NBER.

The first data source is the BEA industry-of-sales data. These data report affiliate activity in terms of sales and employment; because these data are constructed allocating activity across industries based on sales, we measure affiliate activity ($FDI_{kt}$) as the affiliate share of U.S. sales (results using employment shares are qualitatively identical). These industry-of-sales data span 56 BEA industries from 1987 through 1994; we estimate equation (2) for both one-year and long (1987–1994) differences. Columns 3 and 4 of table 7 report these results. For comparison, columns 1 and 2 of table 7 report analogous results from the BEA enterprise data over the same years and using the same sales-based affiliate-activity measure. All four columns show insignificant effects of foreign-affiliate activity on skill upgrading.

The second data source is the BEA/Census establishment-based data, which are probably the best measured but which also cover the shortest time period, 1987 through 1992. Similar to the BEA enterprise data, these data report employment, wages, and sales. Columns 5 and 6 of table 7 report estimation results for these data at the three-digit SIC level and measuring foreign-affiliate activity with sales (for comparability). The one-year-differences specification shows no link between foreign-affiliate activity and skill upgrading; the long-difference specification shows a borderline significant negative relationship. Overall, table 7 suggests that measurement error is not driving our earlier findings, and confirms the general conclusion of no significant link between foreign-affiliate activity and skill upgrading in U.S. manufacturing industries.[21]

### E. *The Effect of Different Forms of Japanese Affiliate Activity on Skill Upgrading*

As we noted, the ITA data do not have information on transaction sizes, a limitation we can only partially alleviate

[21] We report results for the establishment data at the three-digit SIC level, because this level is closest to the 56 industries in the other BEA data. For these establishment data, we did not find a significant relationship between foreign-affiliate activity and skill upgrading at either the two-digit or four-digit SIC level or when measuring affiliate activity in terms of employment or wagebill.

by linking the ITA data with the BEA data. In contrast, the JEI data described in section III report both size (in terms of employment) and type (M&A or greenfield) of all Japanese affiliate activity in the United States. So, with these data, we no longer need to make restrictive assumptions about the relative size of transactions, which reduces potentially serious bias from measurement error. In addition, a focus on Japan as a source country has the potential to yield more insight on the different effects of M&A versus greenfield activity on skill upgrading, because Japan had a much greater share of greenfield activity in the United States than did most foreign countries. Our JEI data show that Japanese investors had almost identical ratios of employees in greenfield affiliates to employees in acquired affiliates in both 1980 and 1990. This contrasts with Howenstine and Shannon's 1996 finding that other major source countries spent less than 10% of their total U.S. FDI outlays on greenfield operations. Howenstine and Shannon found a number of other significant differences between Japanese and non-Japanese investors in the United States, which suggests Japanese affiliate activity may yield quite different effects on U.S. skill-upgrading than what we have uncovered to this point.

To use the JEI data as our third set of $FDI_{kt}$ measures, we construct the share of Japanese affiliate employment in total U.S. employment by industry-year. We construct three different shares: of total Japanese affiliate activity, of acquired Japanese affiliate activity, and of greenfield Japanese affiliate activity.[22] These measures are similar to the BEA-only measure, as the ratios allow us to scale how important affiliates are relative to overall U.S. industry. We construct these measures using JEI data for 1980 and 1990, and then estimate equation (2) separately on these three measures for the ten-year difference over the 1980s.

Table 8 reports results using the JEI measures of $FDI_{kt}$. As with all previous specifications, the control variables are estimated precisely and with correct sign, and the general fit of the specification is quite high. However, our results for our FDI measures differ markedly. We now estimate a significant negative correlation with U.S. industry-wide skill upgrading for changes in new-plant Japanese affiliate employment; this also shows up to a lesser degree for changes in all Japanese activity. This suggests that greater Japanese inward FDI decreased, rather than increased, skill upgrading within U.S. manufacturing industries over this time period. These results are estimated from JEI data aggregated up to our 56 BEA industries. We obtain qualitatively identical results when we alternatively estimate equation (2) using the JEI measures of FDI at their original four-digit SIC industry level. Results are also robust to the set of controls and to specifications that include both M&A and greenfield regressors separately.

[22] Greenfield activity includes establishments that may be joint ventures with more than one Japanese firm, or between a Japanese firm and another foreign or U.S.-based partner.

TABLE 8.—SKILL-UPGRADING REGRESSIONS: JEI DATA, LONG DIFFERENCES, 1980–1990

| Regressor | Specification (1) | Specification (2) | Specification (3) |
|---|---|---|---|
| Type of Inward FDI | MA | NP | MA + NP |
| Δ (FDI Activity) | −0.003 | −0.008 | −0.007 |
| | (−0.632) | (−3.285) | (−1.619) |
| Computerization | 0.404 | 0.358 | 0.411 |
| | (3.327) | (3.179) | (3.816) |
| Δ ln (U.S. Plant/U.S. Ship) | 0.105 | 0.098 | 0.094 |
| | (4.039) | (3.367) | (3.270) |
| Δ ln (U.S. Equip/U.S. Ship) | 0.012 | 0.008 | 0.009 |
| | (1.668) | (1.440) | (1.684) |
| Δ ln (U.S. Shipments) | 0.061 | 0.056 | 0.052 |
| | (3.248) | (2.793) | (2.691) |
| Adjusted $R^2$ | 0.660 | 0.686 | 0.672 |
| No. of observations | 56 | 56 | 56 |

Each specification is a variation of equation (2) in the text. In all cases the regressand is the change in skilled-labor's share of the wage bill, the wage regressor omitted, and capital disaggregated between plant and equipment. Reported *t*-statistics (in parentheses) are based on White robust standard errors. "MA" refers to mergers and acquisitions, "NP" to new plants.

Source: JEI, U.S. Bureau of the Census, and NBER.

A closer look at the data underlying these regressions finds a few outlier industries. Motor vehicles and equipment had the single largest level rise in greenfield share of industry employment ($\Delta FDI_{kt} = +0.053$), yet this industry was one of the few with a decline in the skilled-labor share of the wage bill ($\Delta SH_{kt} = -0.013$). This observation squares with anecdotal evidence that Japanese FDI in this industry, largely thought to be "VER jumping," focused on relatively unskill-intensive assembly activities. Similar to cars, rubber products had one of the largest rises in greenfield share ($\Delta FDI_{kt} = +0.017$) combined with the single largest decline in wagebill share ($\Delta SH_{kt} = -0.026$). Conversely, the communications-products industry had a relatively small rise in greenfield employment share ($\Delta FDI_{kt} = +0.007$), but the single largest rise in wagebill share ($\Delta SH_{kt} = +0.141$). These three industries in particular help drive the major finding of table 8. However, sensitivity checks showed our finding to be robust to excluding outliers such as these.

## V. Conclusions and Discussion

Our results suggest zero or even a negative correlation between increases in foreign-affiliate activity and skill upgrading in the United States from 1977 through 1994. That is, skill upgrading within U.S. manufacturing industries is not positively correlated with greater foreign-affiliate activity. This suggests that foreign affiliates have not been an important source of SBTC, contrary to any anecdotal evidence. This casts doubt upon one possible force behind SBTC that until now has not been systematically explored.

One concern we had about our results was that three of our four measures of affiliate activity capture part of value added (either labor or capital), whereas our fourth (sales) covers both value added and intermediate inputs. These measures might miss important affiliate effects on skill upgrading working through intermediate inputs. Related work suggests this channel may be important. Feenstra and Hanson (1996a, 1996b) find a strong correlation between skill upgrading and a rising share of imports in total U.S. input purchases, and Zeile (1998) shows that affiliates tend to rely on imported inputs to a much greater degree than do domestically owned firms.

Unfortunately, the publicly available BEA data do not contain sufficiently detailed information on affiliate intermediate-input purchases to test this idea formally. However, what little data are available on this question suggest that affiliate input purchases did not play an important role. From 1977 to 1989, extensive skill upgrading occurred in the majority of U.S. industries, yet the share of imports in total manufacturing-wide affiliate input purchases held constant at 16%. From 1989 to 1994, the all-manufacturing share rose to nearly 19%, but during this time U.S. skill upgrading slowed considerably. We do not have the data to explore cross-industry patterns, but these aggregate data do not indicate a strong link between U.S. skill upgrading and rising affiliate imports of inputs.

Although our general results suggest no relationship between foreign-affiliate activity and U.S. skill upgrading, the strong inverse relationship we find for the particular case of Japanese-greenfield investments may have relevance for MNE theory and may also suggest future research avenues. Our Japanese-greenfield results are consistent with recent models of MNEs in which it is assumed that foreign affiliates focus on activities that are less skilled-labor intensive than the activities of MNE parents. In these models, parents are skill-intensive relative to affiliates because only parents perform firm-wide skill-intensive activities such as R&D and advertising. Because parents of U.S. MNEs account for at least 50% of U.S. activity in terms of employment and sales (Slaughter, 2000), foreign-affiliate expansion into the United States should tend to reduce the skill mix of U.S. industries. However, it is less clear why we find this consistency with MNE theory only with respect to our Japanese-greenfield results. Perhaps it is because these MNE theories are relevant only for greenfield (as opposed to acquisition) FDI, the mode of FDI used much more commonly by Japanese investors than by any other foreign investors. This is an issue that future theory may want to address. Alternatively, our results may suggest that location of less-skilled foreign-affiliate activities in the United States is a strategy particular to Japanese investors. There is obvious room for more empirical work on these issues.

## REFERENCES

Adams, James D., "Technology, Trade, and Wages," National Bureau of Economic Research working paper 5940 (February 1997).

Aitken, Brian, Ann Harrison, and Robert E. Lipsey, "Wages and Foreign Ownership: A Comparative Study of Mexico, Venezuela, and the United States," *Journal of International Economics* 40 (May 1996), 345–372.

Autor, David H., Lawrence F. Katz, and Alan B. Krueger, "Computing Inequality: Have Computers Changed the Labor Market?" *Quarterly Journal of Economics* 113 (November 1998), 1169–1213.

Baldwin, Robert E., "The Effect of Trade and Foreign Direct Investment on Employment and Relative Wages," National Bureau of Economic Research working paper 5037 (February 1995).

Berman, Eli, John Bound, and Zvi Griliches, "Changes in the Demand for Skilled Labor Within U.S. Manufacturing Industries: Evidence from the Annual Survey of Manufacturers," *Quarterly Journal of Economics* 109 (May 1994), 367–397.

Blonigen, Bruce A., "Firm-Specific Assets and the Link Between Exchange Rates and Foreign Direct Investment," *American Economic Review* 87 (June 1997), 447–465.

Bound, John, and George Johnson, "Changes in the Structure of Wages in the 1980s: An Evaluation of Alternative Explanations," *American Economic Review* 82 (June 1992), 371–392.

Brainard, S. Lael, and David Riker, "Are U.S. Multinationals Exporting Jobs?" National Bureau of Economic Research working paper 5958 (1997).

Carr, David L., James R. Markusen, and Keith E. Maskus, "Estimating the Knowledge-Capital Model of the Multinational Enterprise," National Bureau of Economic Research working paper 6773 (October 1998).

Davis, Steven J., "Cross-Country Patterns of Change in Relative Wages," *NBER Macroeconomics Annual* (1992), 239–292.

Doms, Mark E., and J. Bradford Jensen, "Comparing Wages, Skills, and Productivity between Domestically and Foreign-Owned Manufacturing Establishments in the United States" (pp. 235–258), in Robert E. Baldwin, Richard E. Lipsey, and J. David Richardson (Eds.), *Geography and Ownership as Bases for Economic Accounting: NBER Studies in Income and Wealth, Vol. 59.* (Chicago: University of Chicago Press, 1998).

Dunning, John H., *International Production and the Multinational Enterprise* (London: George Allen and Unwin, 1981).

Feenstra, Robert C., and Gordon H. Hanson, "Foreign Investment, Outsourcing, and Relative Wages," (pp. 89–127), in Robert C. Feenstra, Gene M. Grossman, and Douglas A. Irwin (Eds.), *Political Economy of Trade Policy: Essays in Honor of Jagdish Bhagwati* (Cambridge, MA: MIT Press, 1996a).

———, "Globalization, Outsourcing, and Wage Inequality," *American Economic Review* 86 (May 1996b), 240–245.

———, "Foreign Direct Investment and Relative Wages: Evidence from Mexico's Maquiladoras," *Journal of International Economics* 42 (May 1997), 371–393.

———, "The Impact of Outsourcing and High-Technology Capital on Wages: Estimates for the United States, 1979–1990," *Quarterly Journal of Economics* 114 (August 1999), 371–393.

Feliciano, Zadia, and Robert E. Lipsey, "Foreign Ownership and Wages in the United States, 1987–1992," National Bureau of Economic Research research paper 6923 (February 1999).

Globerman, Steven, John C. Ries, and Ilan Vertinsky, "The Economic Performance of Foreign Affiliates in Canada," *Canadian Journal of Economics* 27 (February 1994), 143–156.

Haskel, Jonathan E., and Matthew J. Slaughter, "Does the Sector Bias of Skill-Biased Technical Change Explain Changing Skill Differentials?" National Bureau of Economic Research working paper 6565 (August 1998).

Head, Keith, and John Ries, "Offshore Production and the Home Employees of Japanese Manufacturers," University of British Columbia manuscript (1999).

Helpman, Elhanan, "A Simple Theory of International Trade with Multinational Corporations," *Journal of Political Economy* 92 (June 1984), 451–471.

Howenstine, Ned G., and Dale P. Shannon, "Differences in Foreign-Owned U.S. Manufacturing Establishments by Country of Owner," *Survey of Current Business* 76 (March 1996), 43–60.

Howenstine, Ned G., and William J. Zeile, "Characteristics of Foreign-owned U.S. Manufacturing Establishments," *Survey of Current Business* 74 (January 1994), 34–59.

*Japan's Expanding U.S. Manufacturing Presence,* (Washington, D.C.: Japan Economic Institute, 1980 and 1990).

Klein, Michael W., and Eric S. Rosengren, "The Real Exchange Rate and Foreign Direct Investment in the United States," *Journal of International Economics* 36 (May 1994), 373–389.

Kogut, Bruce, and Sea Jin Chang, "Technological Capabilities and Japanese Foreign Direct Investment," this REVIEW 73 (August 1991), 401–413.

Markusen, James R., "The Boundaries of Multinational Enterprises and the Theory of International Trade," *Journal of Economic Perspectives* 9 (Spring 1995), 169–189.
Markusen, James R., and Anthony J. Venables, "The Role of Multinational Firms in the Wage-Gap Debate," *Review of International Economics* (November 1997), 435–451.
Slaughter, Matthew J., "Production Transfer Within Multinational Enterprises and American Wages," *Journal of International Economics* 50:2 (April 2000), 449–472.
United States Department of Commerce, Bureau of Economic Analysis, *Foreign Direct Investment in the United States: Establishment Data for Manufacturing* (Washington, D.C.: U.S. Government Printing Office, 1987–1992).
United States Department of Commerce, Bureau of Economic Analysis, *Foreign Direct Investment in the United States: Operations of U.S. Affiliates of Foreign Companies* (Washington, D.C.: U.S. Government Printing Office, 1977–1994).
United States Department of Commerce, International Trade Administration, *Foreign Direct Investment in the United States: Completed Transactions* (Washington, D.C.: U.S. Government Printing Office, 1977–1994).
Zeile, William J., "The Domestic Orientation of Production and Sales by U.S. Manufacturing Affiliates of Foreign Companies," *Survey of Current Business* 78 (April 1998), 29–50.

## APPENDIX A

### *NBER Data*

The NBER-CES/Census Manufacturing Industry Productivity Database, developed by Eric J. Bartelsman, Randy A. Becker, and Wayne B. Gray, provides annual production and cost data for all U.S. manufacturing industries from 1958 to 1994. We rely on this database for information on wage bills by sector (total, production worker, and nonproduction worker wage bills), real stocks of plant and equipment capital, and real shipments. Many of the variables in the database come from the Census' Annual Survey of Manufacturers, but information on real capital and price deflators come from other sources. These data and detailed documentation are available from the National Bureau of Economic Research (www.nber.org/nberprod/).

### *BEA Enterprise Data*

Under the International Investment and Trade in Services Survey Act, MNEs are obligated to participate in BEA censuses and surveys. In 1987 and 1992, the BEA conducted censuses of every U.S. business enterprise that was a U.S. affiliate of a foreign person. In the intervening years from 1977 through 1994, the BEA surveyed a subset of all U.S. affiliates and then estimated universe totals. These data can be found in United States Department of Commerce, Bureau of Economic Analysis, *Foreign Direct Investment in the United States: Operations of U.S. Affiliates of Foreign Companies* (Washington, D.C.: U.S. Government Printing Office, 1977–1994). The censuses (also called "benchmark surveys") sample every American affiliate identified both by checking whether each affiliate from the previous census has "died" and by monitoring news services for the "birth" of new affiliates since that census. Substantive data must be reported by only those affiliates whose total assets, sales, or net income/loss exceeds $1 million.[23] The surveys sample larger U.S. affiliates in existence for the most recent benchmark survey. To generate universe estimates from these surveys, the BEA calculates activity growth rates for sampled affiliates and then assumes the same growth rates for all affiliates. Data are required to be reported on a fiscal-year basis following generally accepted U.S. accounting principles. In particular, monetary amounts must be reported in U.S. dollars. The BEA defines parents and affiliates as described in the text. When there is more than one ownership link between the parent and affiliate, the percentages of ownership for each link are determined and then multiplied to determine the parent's overall stake in the affiliate.

To classify the activity of affiliates in its publicly available data, the BEA assigns each to a single industry that accounts for the largest share of its total activity.[24] From 1977 through 1986, the BEA classified industries using the Direct Investment (DI) classification, adapted directly from SIC revision 2 (1972) industry codes. Starting in 1987, the BEA switched to the International Surveys Industry (ISI) classification, based on the SIC revision 3 (1987) industry codes. We concorded the ISI data back to the DI classifications by following both an internal BEA concordance plus a SIC revision 2/revision 3 concordance accompanying the NBER database. This concordance left us with 56 BEA manufacturing industries. Some are individual three-digit SIC industries, others are the sum of several three-digit SIC industries, and a few are single two-digit SIC industries. We aggregated the NBER data up to these 56 industries.

Sales are defined as gross sales minus returns, allowances, and discounts. Employment is defined as the number of full- and part-time employees on the payroll either at fiscal-year end or at some representative time during the year. Compensation is defined as wages, salaries, payments-in-kind, and employee benefit plans. Total assets are defined as current assets (such as accounts receivable) plus noncurrent assets (such as gross plant, property, and equipment).

### *BEA Industry-of-Sales Data*

In 1980 and 1987–1994, the BEA required foreign-owned affiliates in the United States to distribute their sales and employment among three-digit SIC industries for industries in which it had sales and report this in the annual BEA survey or census. This gives the BEA data on affiliates' sales and employment by industry of sales, rather than by the industry to which an affiliate is classified, which is the BEA enterprise data. Thus, for these years, the BEA published sales and employment by industry of sales cross-classified by industry of affiliate in their annual publication, *Foreign Direct Investment in the United States: Operations of U.S. Affiliates of Foreign Companies.* The cross-classification for foreign-affiliate sales are reported in table E-7, and the cross-classification for employment data are reported in table F-10 (G-10 in later years). We use these data on sales and employment by industry of sales to construct alternative measures of the share of foreign-affiliate activity for our analysis in section IV, subsection D.

### *BEA/Census Establishment Data*

The Foreign Direct Investment and International Financial Improvements Act of 1990 led to a joint effort to link BEA data on foreign-owned affiliates in the United States with the Census Bureau's establishment-level data for all companies located in the United States. The result is data on foreign-owned affiliate activity across sectors, where establishments (rather than enterprises) were mapped into specific industrial sectors. These data more accurately map activity into industrial sectors, because establishments are generally much less diversified than enterprises. These data based on establishment-level information were published in United States Department of Commerce, Bureau of Economic Analysis, *Foreign Direct Investment in the United States: Establishment Data for Manufacturing* (Washington, D.C.: U.S. Government Printing Office) for the years 1987 through 1992. We collected data on sales, employment, and payroll by four-digit SIC manufacturing sector from these publications. Although the data are disaggregated down to the four-digit SIC level, we report results at the three-digit level because this level is most consistent with the 56 industry classifications in the BEA enterprise data. There were also many instances of data suppressed (for confidentiality reasons) at the four-digit SIC level.

### *ITA Data*

As reported in the text, each year since 1974 the International Trade Administration, U.S. Department of Commerce (ITA) reports a list of the

[23] Affiliates not meeting this criterion account for negligible amounts of activity: in 1992, they accounted for only about 1% of total affiliate assets, sales, and net employment. The data reported in censuses as covering "all U.S. affiliates" actually refers to only those affiliates meeting this size criterion.

[24] This classification follows a three-step procedure. First, the parent or affiliate is classified in the one-digit industry that accounts for the largest percentage of its sales. Second, within that one-digit industry, it is classified in the two-digit industry that accounts for the largest percentage of its sales. Third, within that two-digit industry, it is classified in the three-digit industry that accounts for the largest percentage of its sales.

TABLE A1.—THE 56 BEA INDUSTRIES

| BEA Industry Name | SIC Industries | BEA Industry Name | SIC Industries |
|---|---|---|---|
| Meat Products | 201 | Primary Metal Industries, Ferrous | 331, 332, 339 |
| Dairy Products | 202 | Primary Metal Industries, Nonferrous | 333–336 |
| Fruits & Vegetables | 203 | Containers, Forgings, & Stampings | 341, 346 |
| Grain Mill Products | 204 | Cutlery, Hand Tools, & Screws | 342, 345 |
| Bakery Products | 205 | Plumbing, Heating, & Structures | 343, 344 |
| Beverages | 208 | Misc. Metal Products | 347–349 |
| Misc. Food Products | 206, 207, 209 | Engines & Turbines | 351 |
| Tobacco Products | 21 | Farm & Garden Machinery | 352 |
| Textile Mill Products | 22 | Construction & Mining Machinery | 353 |
| Apparel Products | 23 | Metalworking Machinery | 354 |
| Lumber & Wood Products | 24 | Special Industry Machinery | 355 |
| Furniture & Fixtures | 25 | General Industrial Machinery | 356 |
| Pulp, Paper, & Board Mills | 261, 262, 263, 266 | Office & Computing Machinery | 357 |
| Paperboard & Misc. Paper Products | 264, 265 | Refrigeration & Service Machinery | 358 |
| Printing & Publishing | 27 | Misc. Machinery | 359 |
| Industrial Chemicals | 281, 282, 286 | Household Appliances | 363 |
| Drugs | 283 | Light & Wiring Equipment | 364 |
| Soap & Cleaners | 284 | Radio, TV, & Communication Prods | 366 |
| Agricultural Chemicals | 287 | Electronic Components | 367 |
| Paint & Misc. Chemical Products | 285, 289 | Misc. Electrical Products | 369 |
| Integrated Petroleum Products | 291 part | Motor Vehicles & Equipment | 371 |
| Petroleum Refining | 291 part | Other Transport Equipment | 372–379 |
| Petroleum and Coal Products | 295, 299 | Scientific & Measuring Instruments | 381, 382 |
| Rubber Products | 301–306 | Optical & Ophthalmic Goods | 383, 385 |
| Misc. Plastic Products | 307 | Medical Instruments & Supplies | 384 |
| Leather Products | 31 | Photographic Equipment & Supplies | 386 |
| Glass Products | 321–323 | Watches, Clocks, & Watchcases | 387 |
| Stone & Clay Products | 324–329 | Misc. Manufacturing Industries | 39 |

SIC Codes are for the Standard Industrial Classification, Revision 2 (1972).

year's FDI transactions, including the type of investment, the foreign investor and country, the four-digit SIC of the U.S. investment, the U.S. state location, and the dollar value of the transaction when available. The types of investment recorded are acquisitions and mergers, new plants, joint ventures, plant expansions, reinvested earnings, equity increases, and other. These data represent a compilation of material from publicly available sources, including newspapers and business and trade journals, as well as from Federal regulatory agencies, such as the Securities and Exchange Commission, Federal Trade Commission, and the Federal Reserve Board. Although this means that the universe of FDI transactions in the United States is not accounted for in the data, the ITA and others have found that they track the BEA data reasonably well.

This paper uses counts of FDI occurrences (by transaction type and four-digit SIC) listed in the ITA data for the years 1977 through 1994. To concord counts of transactions listed in the ITA database to our 56 BEA sectors, a number of data issues were addressed. First, for reasons cited in the text, we eliminated observations classified as reinvested earnings, equity increases, or "other." Second, counts recorded from 1988 through 1994 are recorded using revision 3 of the SIC and were concorded into revision 2 of the SIC. Next, a small fraction of the counts (approximately 100 observations out of more than 5,000) had no record of the type of transaction. For these observations, we simply distributed a transaction across the four types according to their average distribution for the sample: 52% to AM, 9% to JV, 26% to NP, and 13% to PE. There were also twelve observations with no type recorded and which were only listed at a two-digit SIC. For these observations, we distributed across type (by distribution above) and equally across the first four-digit codes within the corresponding three-digit sectors. For example, if the observation listed a transaction in SIC 28, we distributed equally into SIC 2812, 2821, 2831, 2841, 2851, 2861, 2873, 2891. There were approximately fifty observations that had type of transaction specified, but were only listed at a two- or three-digit SIC code. For the two-digit SIC observations, we used the same procedure to distribute the specified transaction equally across the first four-digit codes within the corresponding three-digit sectors. For the three-digit observations, we distributed the transaction equally across all four-digit SIC in the corresponding three-digit industry. Finally, there were a handful of transactions (less than ten) that were deleted because of recorded SICs in the ITA data that do not exist (such as coding problems). Once these data steps were taken, we concorded the four-digit SIC industries (revision 2) into the 56 BEA sectors we use for the paper's empirical analysis.

*JEI Data*

Our data on Japanese manufacturing affiliate presence in the United States comes from survey data of Japanese plants in the United States conducted by the Japan Economic Institute (JEI) and published semiannually from 1980 through 1990 by JEI in *Japan's Expanding U.S. Manufacturing Presence.* The appendix of this report lists all Japanese plants in the United States and includes information on four-digit SIC (revision 3), location of U.S. plant, plant-level employees, year of establishment, and whether the plant was acquired or greenfield investment.

Keith Head and John Ries provided us with an electronic form of the 1990 update, the final year published by JEI. After eliminating observations for which Japanese ownership was less than a 50% share, we concorded the 1990 employee levels (listed separately by greenfield or acquisition) into revision 2 of the SIC and then into the 56 BEA sectors. Construction of the 1980 employee levels was more problematic. We created an electronic form of the 1980 survey and eliminated plants with Japanese ownership less than 50% share. We noticed that there were 1990 plants with establishment dates of 1980 or earlier, for which there was no record in the 1980 survey. These were plants that were presumably missed in the initial 1980 survey. A number of these plants appear in the 1981, 1983, or 1984 updates, and so we assumed the employee numbers in these updates were the same as 1980 levels. A smaller number of observations on 1980 plants did not have records until surveys or updates after 1986. For these, we first calculated the average growth from 1980 to 1990 for all plants for which we had employee numbers in our sample. The average growth rate was 9.4% over the ten years. A simple interpolation implies growth of 5.6% from 1980 to 1986. We used these growth rates to get 1980 employee levels from 1986 and 1990 employee levels. Finally, there were a small number of observations that had no employees listed in 1980 and also did not show up in later surveys. We imputed 1980 employee numbers for these plants by taking the average 1980 employees for other plants in the same four-digit SIC or, if necessary, the same three-digit SIC. In the end, about one-eighth of our observations in 1980 had employee levels estimated in some manner described above, because we didn't have information on 1980 employee levels directly from the 1980 survey or 1981 update. The final step was concording the 1980 employee levels, listed separately by greenfield or acquisition and by SIC codes, into the 56 BEA sectors.