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Trade, Offshoring, and U.S. Multinational Corporation Employment in the U.S. Manufacturing Sector, 1999–2008[1]

Samira Salem, Laura Bloodgood, Isaac Wohl, Cathy Jabara, and Nathanael Snow[2]

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ABSTRACT

A decline in U.S. manufacturing jobs over the last several decades has intensified the spotlight on the role that international trade and offshoring play in determining employment. Despite a growing literature on the subject, the impact of trade and offshoring on manufacturing sector employment is not clear. This study uses qualitative and quantitative analysis to investigate the relationship between trade, offshoring, and U.S. manufacturing employment between 1999 and 2008. As part of the investigation, we examine whether employment is affected by the level of income in countries that originate imports into the United States and/or that benefit from offshoring by U.S. companies. Using a dynamic econometric model and industry-level data, we obtained results that partially support findings in the literature suggesting that location matters when it comes to offshoring. In our preferred specification, we find that offshoring to high-income countries is complementary with U.S. employment (U.S. employment in manufacturing is higher when affiliate employment in high-income countries is higher), while offshoring to low-income countries has little effect on U.S. employment in the manufacturing sector. With regard to trade, higher import penetration is associated with lower U.S. manufacturing employment. However, the data do not permit us to distinguish meaningfully between imports from high-income and low-income countries.

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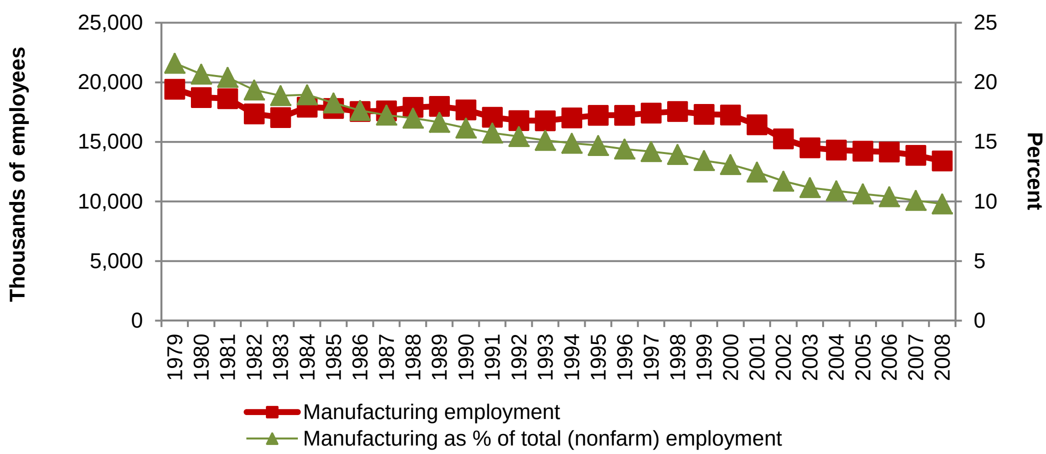
Introduction

The United States lost 3.9 million manufacturing jobs between 1999 and 2008, significantly accelerating job loss in the sector as compared to the two previous decades (figure 1). Meanwhile, total nonfarm employment expanded by 6 percent, imports of manufactured goods increased substantially, and the foreign activities of U.S. multinational corporations (MNCs)[3] continued to expand. Declining manufacturing employment and intensified globalization[4] are not unique to the United States; this phenomenon is common across industrialized countries.[5] Nonetheless, these trends have aroused U.S. public concern[6] as well as fueled the ongoing academic and policy debates over the effects of globalization on manufacturing and labor markets.[7]

FIGURE 1 Manufacturing employment, 1979–2008



Source: Bureau of Labor Statistics (BLS), Current Employment Statistics.

[3] By the term "U.S. MNCs", we refer to U.S. parent firms and their foreign affiliates.

[4] Throughout this paper we use a narrow definition of globalization that considers only trade and offshoring activities.

[5] Pilat et al., "The Changing Nature of Manufacturing in OECD Economies," 2006.

[6] A 2009 Gallup opinion poll reports that slightly more Americans (47 percent) perceive foreign trade as a threat to the economy than as an opportunity (44 percent). Similarly, a January 2008 poll by Fortune/Abt SRBI finds that 78 percent of respondents agreed that increased trade has made things worse for American workers (Brohinsky and Schulman, "Abt SRBI Survey Finds Americans Cutting Spending," 2008).

[7] Concerns over globalization and its effect on employment and the capacity of the U.S. manufacturing sector have led to a series of government and private sector proposals to revitalize manufacturing and bring jobs back to the sector. Efforts focused on manufacturing and jobs include the National Export Initiative (http://export.gov/nei/index.asp); Select USA (http://selectusa.commerce.gov/); the MIT Commission on Production in the Innovation Economy (PIE) (http://web.mit.edu/ipc/research/production/pie.html); and the Reshoring Initiative (http://www.reshoringmfg.com/).

Critics of globalization argue that unfettered exposure of the U.S. economy to global markets leads to deindustrialization—a loss of U.S. manufacturing capacity[8] and a transfer of manufacturing jobs abroad. Yet other views point to productivity growth as the main culprit in the secular decline in manufacturing employment. However, proponents of globalization argue that integration into the global marketplace offers net benefits. While generally acknowledging that there are some losers, globalization proponents claim that, on balance, trade enhances welfare, and increases economic efficiency. At the same time, they suggest that offshoring activities can improve the profitability, productivity, and thus the competitiveness of domestic firms. Further, they posit that in some cases foreign and domestic employment can be complementary.

Despite a growing literature addressing the subject, the impact of trade and offshoring on manufacturing sector employment is not clear. Studies examining the influence of trade on manufacturing employment outcomes suggest that increasing trade depresses employment in the short run, but the magnitude of its effect and the channels through which it operates remain unsettled. In contrast, the literature examining the links between offshoring and manufacturing employment has found evidence of both a "substitution effect" whereby job creation at foreign affiliates is associated with domestic job losses and a "complementarity effect" in which hiring abroad is associated with more jobs at home.

Research on both sets of elements—trade and employment and offshoring and employment—has found that the location of foreign engagement (i.e., low- versus high-income countries) matters when it comes to employment outcomes. The research points to trade with low-income countries being negatively associated with employment. However, the picture is more mixed as regards offshoring: studies have found that affiliate employment in low-income countries substitutes for domestic employment, whereas affiliate employment in high-income countries complements domestic employment.

The evidence on the relationship between globalization and employment, while not conclusive, has generated some useful insights upon which to build. This study aims to do just that, as well as

[8] Some, like Pisano and Shih (2009), argue that as a result of decades of offshoring manufacturing production, the U.S. capacity to innovate and create high-tech products is declining. Pisano and Shih, "Restoring American Competitiveness," 2009. Others, such as Yudkin (2011), suggest that globalization has compromised national security because it has diminished U.S. manufacturing capacity. Yudkin, "Manufacturing Insecurity," 2011.

contribute to the literature, by updating published results with more recent data.[9] In particular, we examine the relationship between trade, offshoring, and manufacturing employment between 1999 and 2008. This study seeks to address the following set of questions:

- How are increased trade flows and/or offshoring associated with declining manufacturing employment?
- Alternatively, does globalization help create jobs at home, offsetting job losses due to other factors?
- Does the origin of imports and the location of offshoring activities (i.e., low-income versus high-income countries) matter to employment outcomes in the manufacturing sector?

In exploring these questions, we consider the role that trade and offshoring[10] play in manufacturing employment outcomes of U.S. MNC parents (as opposed to employment in the entirety of the manufacturing sector). U.S. MNC parents tend to be the most trade-exposed and to constitute a significant employer in the manufacturing sector, employing 52–53 percent of the manufacturing workforce over the period under examination.

This analysis uses both qualitative and quantitative methods to examine the relationship between trade, offshoring, and manufacturing employment trends. Using industry-level data publicly available from the U.S. Department of Commerce (USDOC), the USDOC's Bureau of Economic Analysis (BEA), the U.S. Census Bureau, the National Bureau of Economic Research (NBER)–U.S. Census Bureau Center for Economic Studies (CES), and the U.S. Bureau of Labor Statistics (BLS), we examine sectoral and industry-level employment trends in U.S. manufacturing, alone and in relation to two other factors: trade flows, and trends in employment among U.S.-owned foreign affiliates. We use a dynamic model and

[9] As explained later in this paper, most studies rely on firm-level data from benchmark U.S. Direct Investment Abroad surveys (taken every five years by the Bureau of Economic Analysis, which is part of the U.S. Department of Commerce). This study, on the other hand, uses industry-level data from both benchmark and nonbenchmark years.

[10] The literature on offshoring uses various definitions of this term and various measures. For a discussion, see OECD, *Employment Outlook*, 2007 and Crinò, "Offshoring, Multinational, and Labour Market," 2009. We define offshoring as the decision by a U.S.-based company to establish a manufacturing affiliate outside of the United States. This study does not consider arms'-length contracting or "outsourcing," whereby a U.S. company contracts manufacturing activities to a separate, foreign firm.

industry level panel data to estimate the effects of trade and offshoring on U.S. manufacturing employment.[11] We employ instrumental variables (IVs) to control for simultaneity bias.

Our findings partially support those in the literature that suggest that the destination of offshoring activities matters when it comes to U.S. parent employment outcomes. In our preferred specification we find that offshoring to high-income countries has a complementary effect (i.e., U.S. employment in manufacturing rises when affiliate employment in high-income countries rises) on U.S. parent employment in the manufacturing sector. Unlike previous researchers, however, we find that offshoring to low-income countries has little effect on U.S. parent employment in the manufacturing sector. We also find that increased imports are associated with lower U.S. manufacturing employment; however, the data do not permit us to make a meaningful distinction between imports from high-income and low-income countries.

The first section of this paper examines trends in employment, trade, and offshoring from 1999 to 2008 in the overall U.S. manufacturing sector and in the U.S. MNC segment of the sector. The second section presents the conceptual framework. It is divided into two parts: the first half is a focused review of the empirical literature on the relationship between trade, offshoring, and manufacturing. The second half describes our empirical framework and our data. In the third section, we present the results of our main empirical findings on the relationship between trade, offshoring, and manufacturing employment. The conclusion summarizes our results.

U.S. Manufacturing: Trends in Employment, Trade, and Offshoring

This section surveys recent trends in the manufacturing sector. It presents descriptive evidence on changes in the manufacturing sector related to employment, trade, and offshoring and highlights basic trends at the sectoral and industry levels with special attention to trends that may have contributed to job losses in the sector. Data on MNCs' activities are relatively limited and do not allow a full analysis of

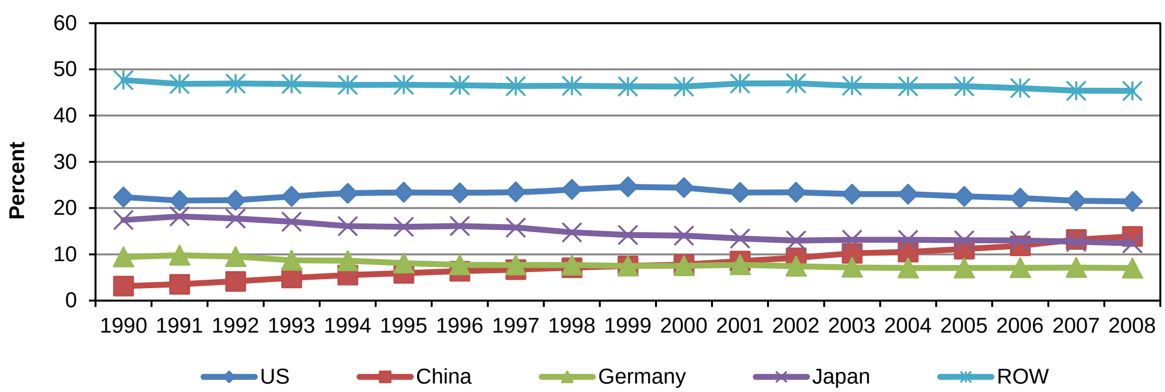
[11] It is important to note that we use a partial equilibrium approach. It efficiently captures employment changes in relation to changes in trade flows, productivity, etc., but does not capture the employment effects that result from sectors outside of the model. Also, as discussed later, following a number of studies in the literature, we use a dynamic model because it allows us to consistently estimate the parameters of interest. See table A5 in the Data Appendix for a list of countries included in the high- and low-income categories.

important trends that may be influencing employment outcomes in the manufacturing sector. In order to discuss these developments, the initial part of the trend analysis examines the entirety of the manufacturing sector. Given the large size of the MNC presence in the sector, it is not unreasonable to assume that the overall sectoral trends approximate trends affecting MNC parent employment. The second part of this section complements the first by examining trends in data on MNCs' activities, including offshoring.

The State of U.S. Manufacturing

The U.S. share of global manufacturing value added remained stable (around 20 percent) over the 1990–2008 period, making it the global leader in manufacturing, even as China's share rapidly increased (figure 2). However, the United States' position as an exporter of finished manufactured goods eroded. In 1999, the United States was the world's leading exporter of manufactured goods. By 2008, the value of U.S. exports of manufactured goods trailed behind that of goods from China and Germany, both of whose exports increased dramatically between 1999 and 2008 (figure 3).[12]

FIGURE 2 Share of global manufacturing value added

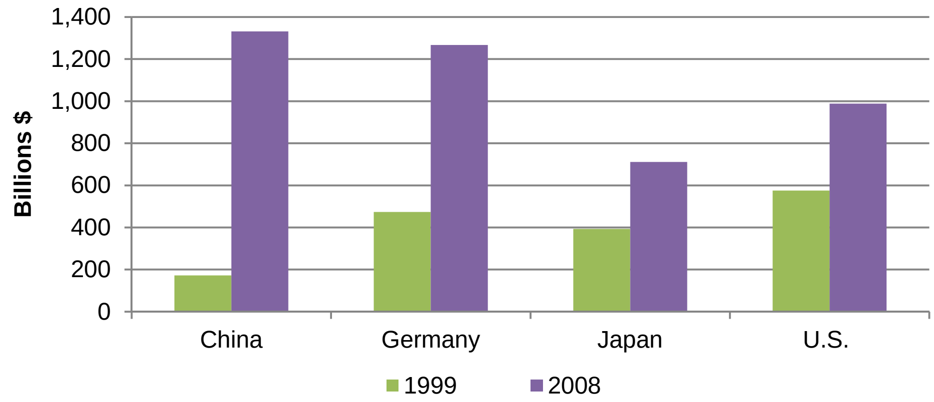


Source: UN Statistics National Account Main Aggregate Database.

Note: Value added data are in constant (2005) U.S. dollars.

[12] Remarkably, German exports of manufactured goods grew sharply—and its manufacturing value added increased—despite a decline in its share of global manufacturing value added over the period.

FIGURE 3 Manufacturing exports, 1999 and 2008



Source: Authors' calculations. WTO, Merchandise Trade by Commodity, Time Series; BLS, Export Price Index.

Note: Export data are in constant (1999) U.S. dollars.

On the domestic front, value added by both U.S. manufacturing and U.S. services grew steadily between 1999 and 2008 (table 1). However, when compared to gross domestic product (GDP), the contribution of the manufacturing sector remained fairly flat over this period, while the share of services GDP to total GDP increased.

TABLE 1 Manufacturing and services sector value added and GDP

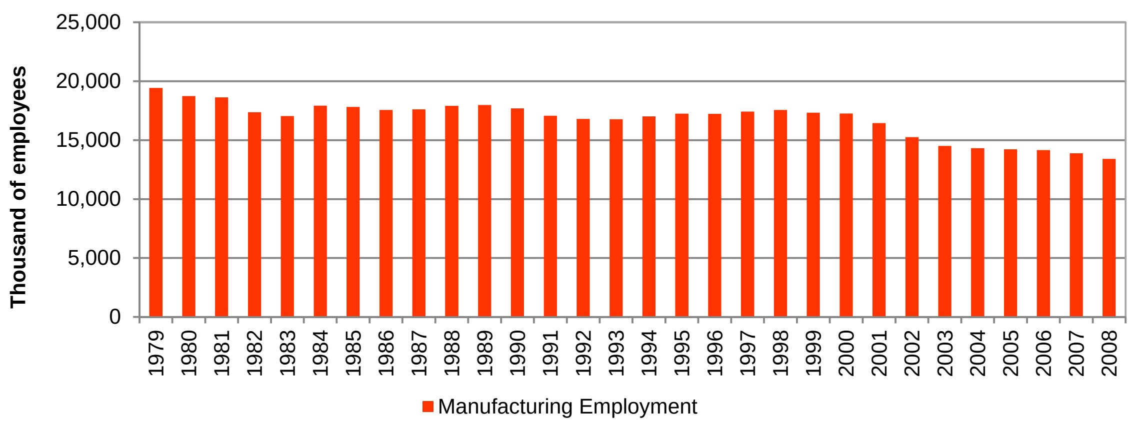
Year	Manufacturing real value added	Services real value added	Real GDP	Manufacturing value added as a share of GDP	Services value added as a share of GDP
	Billion $				
1999	1,312.70	7,103.20	1,0779.90	12.18	65.89
2000	1,396.50	7,421.50	1,1226.00	12.44	66.11
2001	1,332.10	7,618.90	1,1347.10	11.74	67.14
2002	1,365.30	7,762.60	1,1553.00	11.82	67.19
2003	1,404.80	7,960.80	1,1840.60	11.86	67.23
2004	1,517.90	8,233.20	1,2263.80	12.38	67.13
2005	1,568.00	8,553.70	1,2638.40	12.41	67.68
2006	1,636.60	8,820.10	1,2976.20	12.61	67.97
2007	1,709.80	9,040.30	1,3254.10	12.90	68.21
2008	1,647.40	9,092.00	1,3312.10	12.38	68.30

Source: BEA, Industry Economic Accounts.

Manufacturing Employment, the Business Cycle, Structural Change, Productivity, and Trade

While U.S. manufacturing value added and exports have grown, manufacturing employment has contracted. U.S. manufacturing employment reached a peak of 19.4 million workers in 1979. By 1999, U.S. manufacturing employment had fallen to 17.3 million workers, representing a loss of 2.1 million workers over the 20-year period (figure 4). Between 1999 and 2008, U.S. manufacturing employment fell further to 13.4 million workers. What is significant about this is that the reduction in manufacturing employment occurred in the context of increasing total (nonfarm) employment and that manufacturing employment fell much faster in this period than in the previous two decades. Indeed, in just under a decade, the manufacturing sector shed 4 million jobs, twice the number of jobs lost in the 20 years between 1979 and 1999.[13] The following discussion considers factors that may have contributed to this trend.

FIGURE 4 Manufacturing employment, 1979–2008



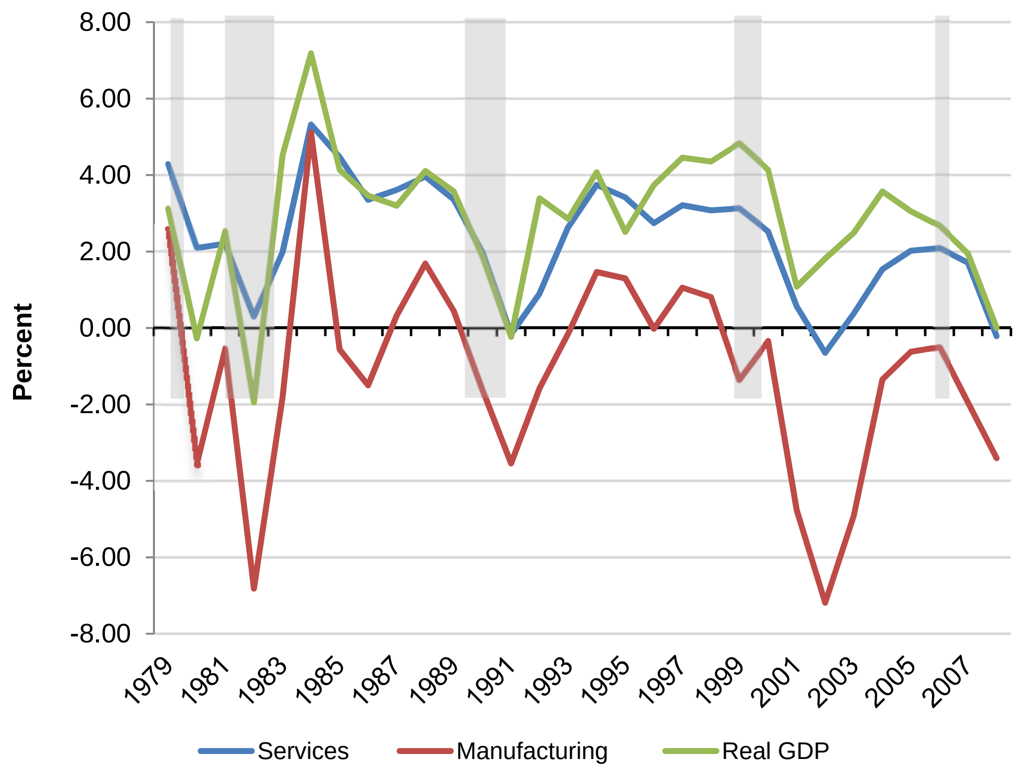
Source: BLS, Current Employment Statistics.

Business Cycle

The rate of manufacturing sector job loss accelerated during recessions, while recovery periods have shown jobless growth or weak employment growth (figure 5). By contrast, services sector employment quickly recovered following recessions and consistently grew during these recovery periods.

[13] As will be discussed in the next subsection, domestic employment in U.S. manufacturing multinational corporations (which represent a significant group of manufacturing firms) followed a similar path.

FIGURE 5 Annual percent change in U.S. employment



Source: BLS, Current Employment Statistics and National Bureau of Economic Research (NBER).

Note: The shaded areas represent periods of recession as defined by the NBER.

It is important to point out that the manufacturing sector lost jobs in both good times and bad, suggesting that factors outside of the business cycle are also influencing employment outcomes.

As will be discussed in the section on industry-level trends, the declining manufacturing employment trend between 1999 and 2008 was not the result of a couple of large industries shedding jobs. Rather, employment fell in all manufacturing industries. By contrast, high employment growth in a handful of services industries, including health services (31 percent), education services (27 percent), leisure and hospitality (16 percent) and professional and business services (11 percent), drove the services sector employment growth.[14] Employment in the rest of the services industries did not perform as well over the period.[15]

Structural Shifts in the Manufacturing Sector

A number of analysts have pointed to a structural shift in the nature of manufacturing employment as a source of declining employment levels. Specifically, employers in the sector have increasingly outsourced nonproduction support functions (e.g., payroll processing, maintenance, food services) to service providers.[16] Significantly, these workers are not counted as part of the manufacturing sector workforce; rather, they are part of the services sector workforce.[17] Between 2003 and 2008, the ratio of nonproduction workers to production workers declined from .421 to .385, accounting for a small part (approximately 500,000 workers) of the decline in manufacturing employment (table 2).

TABLE 2 Manufacturing employment, productivity, and trade

Year	Manufacturing employment as a percentage of total employment	Ratio of non-production to production workers	Ratio of unskilled to skilled workers	Manufacturing productivity (output per hour)	Nonfarm[a] productivity (output per hour)	Manufacturing imports	Manufacturing exports	Manufacturing trade balance
				% change		Billion $		
1999	13.4	.373	([b])	4.9	3.7	894.6	580.6	–314,018
2000	13.1	.377	1.11	4.4	2.6	1,040.3	644.4	–395,887
2001	12.5	.395	1.09	1.9	1.5	972.7	597.1	–375,568
2002	11.7	.404	1.07	7.3	4.3	995.1	562.8	–432,269
2003	11.2	.421	1.05	6.3	3.1	1,060.2	577.2	–483,057
2004	10.9	.415	1.00	2.3	2.7	1,230.9	642.5	–588,432
2005	10.6	.407	0.99	4.7	1.5	1,373.0	710.5	–662,498
2006	10.4	.394	0.99	0.8	1.2	1,512.1	820.5	–691,565
2007	10.1	.389	0.96	4.2	1.3	1,585.3	909.5	–675,847
2008	9.8	.385	0.90	-0.4	0.4	1,627.6	998.3	–629,286

Sources: BEA, Industry Economic Accounts; U.S. Department of Commerce; compiled from official statistics from the U.S. Department of Commerce; BLS; Council of Economic Advisors, *Economic Report of the President,* 2011.

[a]The nonfarm business sector is broad and, according to the BLS, accounts for approximately 77 percent of GDP. It includes private business in various sectors and excludes government and agriculture.
[b]Data from 1999 were not available. We define unskilled workers as those with high school and less than high school education, while skilled workers include those with at least some college or an associate's degree.

[14] BLS, Current Employment Statistics. http://www.bls.gov/ces/data.htm (accessed September 30, 2011).
[15] For example, according to the BLS' Current Employment Statistics, over the 1999–2008 period, employment grew by 6 percent in financial services, 5 percent in transportation and warehousing, 2 percent in trade, transportation, and utilities, 2 percent in retail trade, and 1 percent in wholesale trade. During the same period, employment fell in utilities (8 percent), and information (13 percent).
[16] U.S. Congressional Budget Office (CBO), "What Accounts for the Decline in Manufacturing Employment?" 2004.
[17] Ibid.

Industry observers and research also suggest that companies are investing in retooling manufacturing processes and developing new manufacturing techniques. For example, the Manufacturing Institute (2009)[18] concluded that the adoption of "lean manufacturing" and "Six Sigma" quality programs resulted in increased efficiency and productivity, enabling the sector to produce similar output levels (and sometimes better quality products) with a smaller, but more highly skilled workforce.[19] Indeed, the ratio of unskilled to skilled manufacturing workers decreased from 1.11 in 1999 to .90 in 2008 while value added increased slightly (table 2).

Productivity Growth

In the period under examination, the average labor productivity growth rate in the manufacturing sector was 4 percent, surpassing that of the nonfarm business sector, which averaged 2.5 percent (table 2).[20] Rapid productivity growth is frequently cited as an important factor explaining employment declines in the manufacturing sector. Critics of those who link productivity growth and employment declines grant that this relationship might hold in the short run and for certain industries, but stress that macroeconomic policies determine employment levels in the long run.

Nordhaus (2005) examines the relationship between productivity shocks and employment changes in the U.S. in two overlapping periods 1955–2001 and 1998–2003. He finds that faster productivity growth led to higher U.S. manufacturing employment because it resulted in lower prices and higher demand.[21] This result is especially prominent in the more recent period. However, Nordhaus points

[18] The Manufacturing Institute, "The Facts about Modern Manufacturing," 2009.

[19] A number of studies (Revenga 1992; Bernard and Jensen 1995; Katz and Murphy 1992) have examined "skills-biased technical change" (SBTC), which refers to a change in the production technology that favors skilled labor over unskilled labor. They have generally found that with SBTC, skilled labor's productivity is increased, expanding demand for skilled labor. This prompts a rise in the skill premium (wage) of skilled labor relative to that of unskilled labor. Revenga, "Exporting Jobs?" 1992; Bernard and Jensen, "Exporters, Jobs, and Wages in U.S. Manufacturing," 1995; Katz and Murphy, "Changes in Relative Wages, 1963–1987, 1992.

[20] It is important to note that recent research by Houseman et al. (2010) suggests that measured productivity rates are somewhat inflated. The authors find that growth in multifactor productivity in manufacturing has been overstated by 0.1–0.2 percentage points and real value added growth by 0.2–0.5 percentage points between 1997 and 2007. They suggest that there are two reasons for the inflated productivity numbers: first, one industry, the electronic products industry, has been responsible for driving the output and productivity growth numbers; and second, price declines associated with low-cost foreign input suppliers are not captured in price indexes. The authors suggest that this "offshoring bias" may have accounted for one-fifth to one-half of the growth in real valued added in industries other than the computer industry. Houseman et al., "Offshoring and the State of American Manufacturing," 2010.

[21] Nordhaus, "The Sources of the Productivity Rebound and the Manufacturing Employment Puzzle," 2005.

out that the partial effects of rapid domestic productivity growth were trumped by even faster productivity growth and price declines from foreign competitors.

The McKinsey Global Institute conducted a study that examines the relationship between productivity growth and employment changes, using Bureau of Economic Analysis data.[22] The study finds that productivity growth and employment complement each other in the long run, but this may not always hold true in the short run. Specifically, the study reports that here have been increases in productivity and employment between 1929 and 2009 for every 10-year rolling period. However, it finds that 69 percent of periods have recorded both productivity employment growth since 1929. Overall, productivity growth may complement employment in the long, but this may not be the case in the short run.

Domestic Demand

Another factor that should be considered is domestic demand. A 2008 Congressional Budget Office (CBO) report examining the decline in U.S. manufacturing employment since 2000 suggests that changes in domestic demand explain only a small part of the employment decline during 2000–08.[23] The report finds that while domestic demand for manufactured goods fell during the 2000–2001 recession and was slow to recover, by 2007 it had nearly returned to the expansionary path of the 1990s. While certain industries such as computers and electronics, manufactured wood products, furniture, and automobile, experienced a decline in domestic demand at different times during this period, which may have contributed to short-term employment, the report concludes that changes in domestic demand are not responsible for the long-term decline in U.S. manufacturing employment.

Trade

In the context of a relatively smaller manufacturing sector, declining manufacturing employment, and increasing productivity, manufacturing trade flows have continued to grow. As previously mentioned, these parallel trends have fueled concerns by critics of globalization that increased engagement in foreign markets is compromising the U.S. manufacturing base and shifting U.S. manufacturing jobs abroad. The

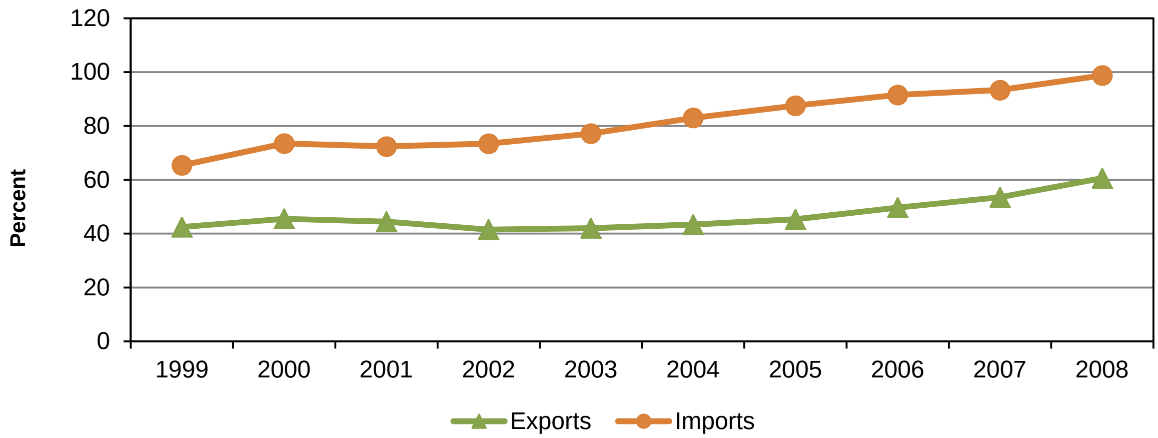
[22] The Mckinsey Global Institute, “Growth and Renewal in the United States,” 2011.

[23] U.S. CBO, “Factors Underlying the Decline in Manufacturing Employment since 2000,” 2008. The CBO defines domestic demand as the sum of “value added” (output minus the value of imports) plus imports less exports.

relationship between trade and employment is complex (as is evidenced by the continued debate) and it merits some attention.

Figure 6, which shows tremendous growth in manufacturing imports and exports as a share of manufacturing GDP, underscores the growing importance of trade within the manufacturing sector. Between 1999 and 2008, U.S. manufacturing imports grew from $894 billion to $1.6 trillion (an increase of 82 percent), outpacing exports, which grew from $558 billion to $998.3 billion (79 percent) (table 2). The manufacturing trade deficit doubled during this period. Table 2 reveals that imports and exports fell during the 2001–02 recession. However, imports recovered faster than exports, which did not return to prerecession levels until 2004. The recovery, however, put both imports and exports on a smooth upward path.

FIGURE 6 Manufacturing exports and imports as a share of manufacturing GDP, 1999–2008



Source: Compiled from official statistics of the U.S. Departement of Commerce; Council of Economic Advisors, Economic Report of the President.

Examining U.S. manufacturing imports over the 1999–2008 period reveals that high-income countries remained the dominant source, although their share of U.S. manufacturing imports fell by 13 percent (from 67 percent to 54 percent) (table 3). By contrast, China's share of U.S. manufacturing imports more than doubled between 1999 and 2008, growing by 11.3 percent—nearly equivalent to the share lost by high-income countries. The share of U.S. imports held by low-income countries (excluding China) grew slightly (1.3 percent), remaining close to one-quarter of total manufacturing imports.

TABLE 3 U.S. manufacturing imports by country group[a]

	1999		2008		
	U.S	Percent	U.S.	Percent	Change in share
	Billion $		Billion $		
All	894.6	100	1,627.6	100.0	0
High-income	596.5	67	880.7	54	–12.6
Low-income (excluding China)	218.5	24	418.1	26	1.3
China	79.6	9	328.7	20	11.3

Source: Compiled from official statistics of the U.S. Department of Commerce

[a]The World Bank 2011 country classification was used to designate countries as high and low income. For purposes of this table only, countries classified as high income by the World Bank are similarly classified as high income. We designate all other (non-high-income countries) countries as low income. Online at: http://data.worldbank.org/about/country-classifications/country-and-lending-groups.

In sum, in the context of growing total (nonfarm) employment, employment in the U.S. manufacturing sector fell significantly between 1999 and 2008. The sector lost jobs during recessions and during recovery periods, suggesting that the decline cannot be explained by the business cycle alone. Industry observers and research have pointed to other contributing factors, including increased outsourcing of nonproduction support functions to service providers and temp agencies, which we noted accounted for a small part of the decline. In addition, new manufacturing processes have contributed to high productivity growth rates (relative to other sectors of the economy), which has changed the composition of the workforce in favor of more skilled labor and may have depressed employment.

Over the same period, manufacturing trade has continued to grow. Both imports and exports have expanded, with import growth outpacing exports. Critics of globalization argue that the convergence of these factors suggests causality; however, the relationship between trade and employment is more complex. The following subsection and the regression analysis examine the relationship between trade and employment in more detail.

Industry-level Trends

Disaggregating the U.S. manufacturing sector by industry provides a more nuanced view of the underlying employment shifts.[24] According to table 4, during 1999–2008 the top 10 trade-exposed industries ("most trade-exposed"), as measured by both average import penetration ratio and average

[24] There are 21 North American Industry Classification System (NAICS) 3-digit categories. However, in this section we arrive at 20 industries because we exclude the petroleum and coal industry from our calculations due to its irregular behavior. Also, in order to maintain consistency between data sources, we combine NAICS 311 and 312 into one industry group; NAICS 313 and NAICS 314, into a second industry group; and NAICS 315 and NAICS 316 into a third industry group.

TABLE 4 Changes in trade exposure[a] and trade by manufacturing industry, 1999–2008[b, c, d]

	Export share, 2008	Import penetration, 2008	Export share, average 1999–2008	Import penetration, average 1999–2008	Exports 2008	Changes in exports, 1999–08	Imports 2008	Change in imports 1999–08
					Billion $	Percent	Billion $	Percent
Textile mills and textile product mills	0.16	0.27	0.12	0.20	5.40	34	11	71.40
Apparel and leather and allied products	0.18	0.81	0.14	0.67	2.67	-47	53	40.72
Computer and electronic product manufacturing	0.26	0.45	0.25	0.38	136.44	-1	310	51.50
Electrical equipment, appliance, and component manufacturing	0.21	0.34	0.18	0.30	34.65	57	66	92.47
Transportation equipment and motor vehicle and parts	0.23	0.27	0.18	0.26	202.02	60	255	30.88
Primary metal manufacturing	0.16	0.26	0.12	0.23	54.73	208	994	170.46
Miscellaneous manufacturing	0.21	0.39	0.16	0.35	20.41	144	49	91.39
Machinery	0.27	0.26	0.24	0.24	133.70	84	125	75.70
Food, beverages, and tobacco products	0.06	0.07	0.05	0.06	26.64	84	28	116.48
Wood products	0.05	0.15	0.04	0.11	5.04	6	16	111.13
Paper products	0.11	0.12	0.09	0.11	10.84	57	12	46.24
Printing and related support activities	0.06	0.06	0.05	0.05	6.47	37	6	63.45
Chemical products	0.18	0.20	0.15	0.15	165.81	143	186	191.87
Plastics and rubber products	0.10	0.14	0.09	0.11	11.88	61	17	108.63
Non-metallic mineral products	0.07	0.14	0.06	0.13	9.09	44	18	37.32
Fabricated metal products	0.08	0.13	0.07	0.11	32.46	68	52	117.62
Furniture and related products	0.05	0.25	0.03	0.21	3.99	61	26	97.95
Average	0.14	0.25	0.12	0.22	50.72	64.71	130.82	89.13
10 most trade-exposed	0.20	0.40	0.16	0.34	65.19	93.60	334.80	87.34
10 least trade-exposed	0.10	0.15	0.09	0.13	40.59	64.50	48.60	96.64

Source: Compiled from official statistics of the U.S. Department of Commerce and from the Manufacturing Industry Database of the National Bureau of Economic Research (NBER) and the U.S. Census Bureau's Center for Economic Studies (CES).

[a]Export share is calculated as exports/shipments and import penetration is calculated as imports/(imports + shipments).

[b]For purposes of the trade exposure calculation, we used the 4-digit North American Industry Classification System (NAICS) category (3231) for "Printing and related support activities" whereas all other references to this category use data from the 3-digit NAICS category (323). This roughly approximates trade exposure at the 323 level. Similarly, we took the average of NAICS codes 3261 and 3262 to construct NAICS 326 or "Plastics and rubber products" and we took the average of NAICS codes 3221 and 3222 to construct NAICS 322 or "Paper products".

[c]In order to maintain consistency in the aggregation of the data between tables 4 and 5, we constructed the category "Textile mills and textile product mills" by taking the average of NAICS 313 and 314, we did the same for "Apparel and leather and allied products," where NAICS 315 and 316 were averaged and "Food, beverages and tobacco," where we took the average of NAICS 311 and 312.

[d]The petroleum and coal industry is not included because it appears to be an outlier with regard to trade.

export share, were textile mills and textile product mills; apparel and leather and allied products; computer and electronic products; electrical equipment, appliances, and components; transportation equipment; primary metal manufacturing; and miscellaneous manufacturing. Meanwhile, the 10 least trade-exposed industries included machinery; food, beverages, and tobacco; wood products; paper products; printing and related support activities; chemical products; plastics and rubber products; nonmetallic mineral products; fabricated metal products; and furniture and related products.

From 1999 to 2008, industries in the most trade-exposed group experienced significantly higher export growth than those in the least trade-exposed group (65.2 percent as compared to 40.6 percent) while the most trade-exposed industries' import growth (87.3 percent) was slower than that of the least trade-exposed industries (96.6 percent). However, the 2008 imports of the most trade-exposed group of industries ($334.8 billion) dwarfed those of the least trade-exposed ($48.6 billion).

All of the major industries reduced the size of their workforce substantially (by an average of 32 percent) between 1999 and 2008, and value added per employee increased in just over half of the industries represented (table 5). The standouts were the computer and electronic products industry and the transportation equipment and motor vehicle and parts industry, which increased labor productivity (as measured by value added per employee) by 435 and 249 percent, respectively.

Table 5 shows that on average, industries in the most trade-exposed group lost 45 percent of their workforce, surpassing the 20 percent job loss in the least trade-exposed group. In addition, industries in the most trade-exposed group were not as productive as the least trade-exposed. However, they registered the highest growth in labor productivity (81 percent), significantly outpacing the least trade-exposed group of industries, which experienced a decline in labor productivity (-3.4 percent).

In summary, the industry-level examination of the manufacturing sector revealed that the declining manufacturing employment trend between 1999 and 2008 was not the result of a couple of large industries shedding jobs. In fact, employment fell in all manufacturing industries. Labor productivity growth increased in just over half of the industries and these were overwhelmingly the most trade-exposed industries. Our analysis supports findings in the trade and employment literature (discussed in the next section) regarding trade exposure and employment. Specifically, this analysis suggests that the level of trade exposure (especially import penetration) may be negatively associated with employment in the sector. No clear picture regarding the relationship between labor productivity growth and employment emerge from this analysis. However, when this relationship was disaggregated by the level of trade exposure a more meaningful pattern seemed to emerge. Part of the econometric analysis that follows later in the paper will test the relationship between trade exposure, productivity, and U.S. parent employment in the manufacturing sector.

TABLE 5 Changes in employment and value added, by manufacturing industry, 1999–2008[a]

	Employment, 1999	Change in employment (1999–2008)		Value added per employee		Change in valued added, 1999–08
		Thousands of workers	%	1999	2008	Change in valued added per employee
	Thousands of workers			Chained 2005 $		Percent
Textile mills and textile mills products	629.5	–331.1	–98.58	42,732.3	26,052.4	–39.0
Apparel and leather and allied products	615.4	–383.3	–118.99	31,524.2	23,886.9	–24.2
Computers and electronic products	1,780.5	–536.3	–30.12	28,699.8	153,440.0	434.6
Electrical equipment, appliances, and components	588.0	–163.7	–27.84	68,707.5	78571.4	14.4
Transportation equipment and motor vehicle and parts	2,088.6	–480.6	–23.01	21,904.6	76,462.7	249.1
Primary metal manufacturing	625.0	–183.0	–29.28	102,240.0	64,640.0	–36.8
Miscellaneous manufacturing	724.0	–95.1	–13.14	76,933.7	107,734.8	40.0
Machinery	1,468.3	–280.7	–19.12	75,46.42	83,089.29	10.1
Food and beverage and tobacco products	1,758.1	–78.8	–9.2	100,676.9	108,071.2	7.3
Wood product	620.3	–164.3	–26.49	52,716.4	57,875.2	9.8
Paper products	615.6	–170.7	–27.73	101,039.6	82,358.7	–18.5
Printing and related support activities	814.6	–220.5	–27.07	150,503.3	155,290.9	3.2
Chemical products	982.5	–135.4	–13.78	172,519.1	186,768.5	8.3
Plastics and rubber products	947	–217.6	–22.98	69,060.2	63,886.0	–7.5
Non-metallic mineral products	540.4	–75.8	–14.02	85,680.5	69,765.7	–18.6
Fabricated metal products	1,728.4	–200.9	–11.62	70,932.7	73,189.1	3.2
Furniture and related products	667.6	–188.0	–28.16	51827.44	42840.02	–17.3
Average	1,7193.8	–3932.8	–31.83	76,656.45	85,524.9	36.4
10 most trade-exposed	1064.9	–310.1	–45.01	56,025.5	76,734.7	81.0
10 least trade-exposed	963.8	–161.3	–20.12	94,995.1	93,338.4	–3.4

Source: BEA, Industry Economic Accounts, and Bureau of Labor Statistics, Current Employment Statistics.

[a]The petroleum and coal industry is not included in any of the calculations.

The next section moves away from a discussion of the U.S manufacturing sector in its entirety and focuses on the MNC segment of the manufacturing sector. Doing so allows us to gain a better understanding of their offshoring activities and how they are linked to MNC parent employment. The insights gleaned will be incorporated into our subsequent econometric analysis.

Offshoring and Manufacturing[25]

There are a number of reasons why a U.S. company would make the decision to manufacture goods overseas through a foreign affiliate. A primary reason is that companies plan to sell their goods in foreign markets, and decide to manufacture in or close to their destination market. This might help the parent company to customize goods for the local market, save on transport costs, or meet other goals. For some companies, the desire to take advantage of labor costs that are lower than those in the U.S. drives their decision to produce goods overseas. For other firms, it is advantageous to manufacture close to a source of raw materials or intermediate inputs. The finished goods may or may not be exported back to the United States for final sale. Ultimately, the decision to offshore may reflect more than one of these motivations.

Overall, the number of foreign manufacturing affiliates of U.S. MNCs has shown a steady increase between 1999 and 2008, as have sales by those foreign affiliates. U.S. manufacturing employment has declined over the period, but U.S. employment by foreign-owned affiliates accounts for less than one-fourth of lost U.S. manufacturing jobs. The majority of sales by foreign affiliates occur in the country where the affiliate is located, and less than 15 percent of those sales represent exports to the United States. Even while U.S. parent firms establish foreign affiliates and employ manufacturing workers abroad, foreign-owned manufacturing firms have established affiliates in the U.S. that provided more than 2 million U.S. manufacturing jobs in 2008.

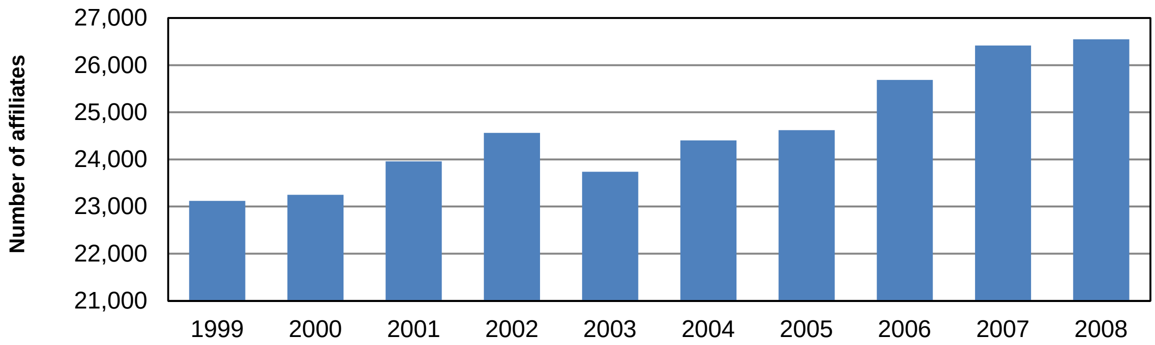
U.S. MNCs' Foreign Activities Expanding

The number of foreign affiliates owned by U.S. parents grew rapidly between 1999 and 2008, rising by 15 percent overall to a total of 26,548 reported in 2008 (figure 7).

The number of foreign affiliates increased fastest in Europe and Africa, rising by 20 percent and 22 percent, respectively. In 2008, foreign affiliates in Europe accounted for slightly more than one-half of the total (figure 8). The number of foreign affiliates in Canada declined by 1 percent during the period,

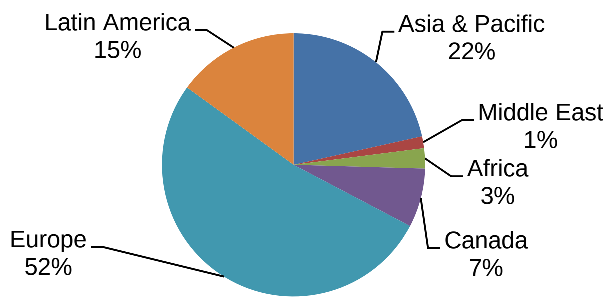
[25] Except where noted, data for U.S.-owned foreign affiliates and U.S. parent firms in this section rely on BEA data that includes all foreign affiliates for which U.S. parents control at least 10 percent of the affiliate's equity. Data used for the regression analysis presented at the end of the paper rely primarily on BEA data regarding majority-owned affiliates, due to issues related to the availability of particular details in the two sets of data. Trends are broadly comparable, although individual data points may not match exactly.

FIGURE 7 Number of U.S.-owned affiliates abroad, 1999–2008



Source: U.S. Department of Commerce, BEA.

FIGURE 8 Number of U.S.-owned affiliates, by region, 2008

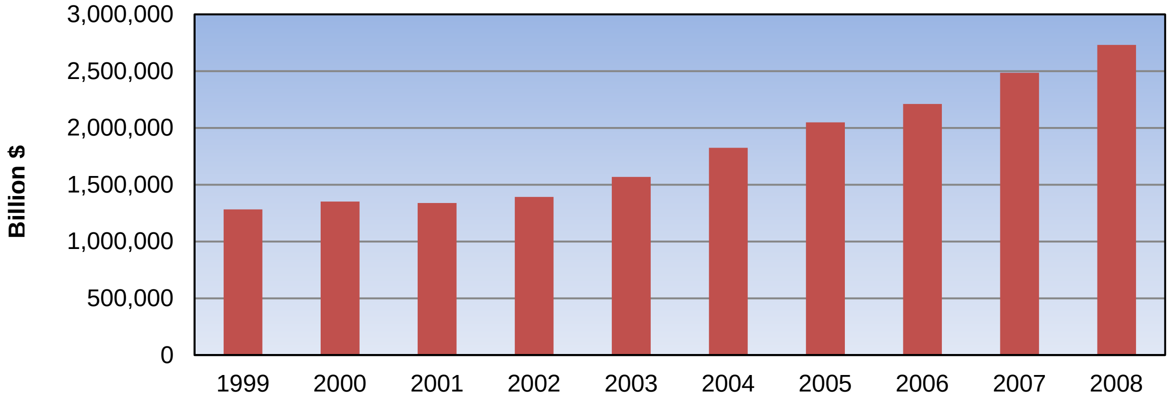


Source: U.S. Department of Commerce, BEA.

while foreign affiliates in Latin America grew by 2 percent. Foreign affiliates in the Asia-Pacific region increased by the same 15 percent as did the total.

The distribution by region of affiliate sales mirrors the data for distribution of the number of foreign affiliates quite closely. Overall, sales by foreign affiliates increased from $1.28 to $2.73 trillion (134 percent) between 1999 and 2008 (figure 9). Sales by foreign affiliates grew fastest in the Middle East (309 percent growth), although they began from the lowest starting point.

FIGURE 9 Sales by U.S.-owned manufacturing affiliates abroad



Source: U.S. Department of Commerce, BEA.

Destination of Affiliate Sales

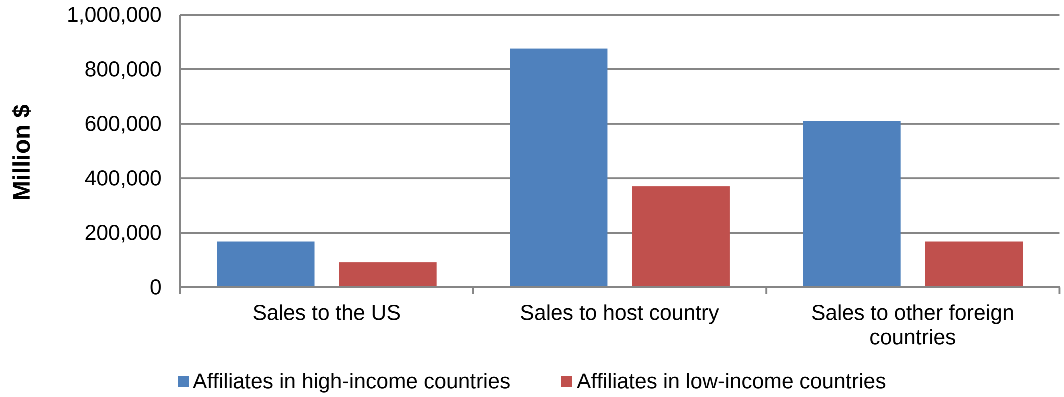
It is possible to disaggregate sales by foreign affiliates according to the destination of those sales—i.e., whether affiliates supply their host country markets, export goods back to the United States, or export from the host country to third countries.[26] Figure 10 shows that for foreign affiliates in both low- and high-income[27] countries, the majority of affiliate sales take place in the host country and the smallest share is exported to the United States.[28] When we compare sales to the United States by foreign affiliates located in high-income countries vs. low-income countries, we find that foreign affiliates in low-income countries are somewhat more likely to export to the United States and to make sales in the host country, and somewhat less likely to export to third countries (table 6). It is not clear from these data, however, whether foreign affiliates located in low-income countries account for a large share of those countries' overall exports to the United States.

[26] Figure 12 relies on BEA data for majority-owned foreign affiliates, because detailed data for the destination of sales are not available for all U.S.-owned foreign affiliates. Such exports to the United States would seem to argue for a direct substitution of U.S. employment.

[27] From this point forward, the designation of high- and low-income countries is no longer strictly based on World Bank classification. This is because the publicly available data tables from the BEA's U.S. Direct Investment Abroad (USDIA) survey provide data disaggregated by industry or country, but not both. As a result, there is too little country-level detail to strictly follow the World Bank classification in constructing high- and low-income country groups. Instead, we used regional-level data provided by BEA's USDIA combined with available country-level data to construct the high-income and low-income country groups. See the Data Appendix for an explanation of how we construct the high-and low-income country categories.

[28] Such exports to the United States would seem to argue for a direct substitution of U.S. employment. However, it is also possible that affiliate exports to the United States include intermediate inputs that are used in goods manufactured in the United States or they represent final goods that contain U.S.-produced intermediate products.

FIGURE 10 Manufacturing sales by U.S.-owned affiliates, by destination, 2008



Source: U.S. Department of Commerce, BEA.

TABLE 6 Disaggregation of affiliate sales by destination, 2008 (%)

	Sales to the U.S.	Sales to the host country	Sales to other foreign countries
High-income country affiliates	10	53	37
Low-income country affiliates	14	59	27

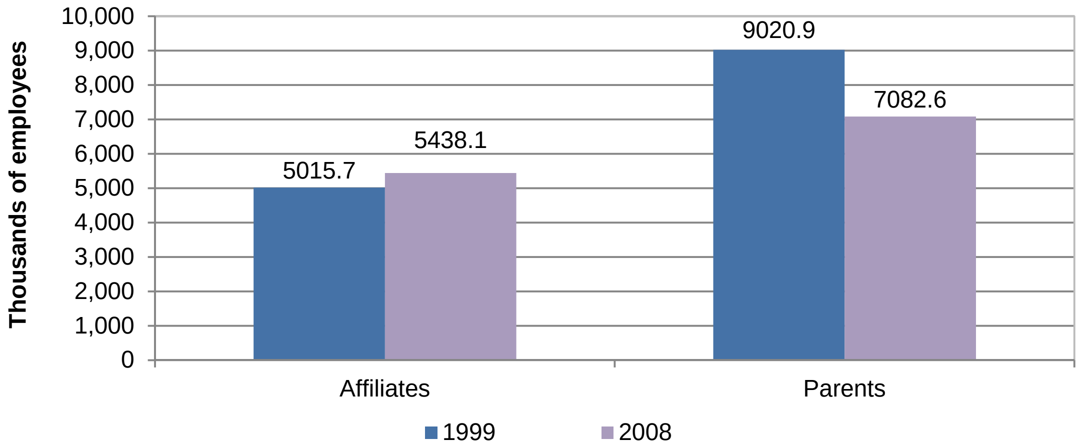
Source: U.S. Department of Commerce, BEA.

Multinational Corporations' Employment at Home and Abroad

From 1999 to 2008, U.S. MNCs accounted for slightly more than one-half of overall U.S. manufacturing employment. During this period, U.S. parent companies reduced their U.S. manufacturing employment by 1.9 million jobs; this represents nearly half of the 3.9 million jobs lost in the manufacturing sector over this period. During the same period, U.S. MNCs' foreign affiliates increased employment by 422,000 jobs (figure 11).[29] The increase in employment by foreign affiliates is much smaller than the total decrease in U.S. manufacturing jobs, so U.S. firms do not appear to simply be substituting foreign for domestic employees. The data may be consistent with U.S. manufacturers losing overall market share to foreign companies; the data may also be consistent with U.S. companies contracting out their manufacturing functions to unaffiliated foreign firms through outsourcing, rather than U.S. parents manufacturing overseas directly through their own affiliates.[30]

[29] U.S. parent manufacturing employment data are not available from 2000 to 2003.
[30] If U.S. firms were contracting to other manufacturing operations in the United States, those jobs would be counted as part of total U.S. manufacturing employment.

FIGURE 11 Manufacturing employment, parents, and foreign affiliates



Source: U.S. Department of Commerce, BEA.

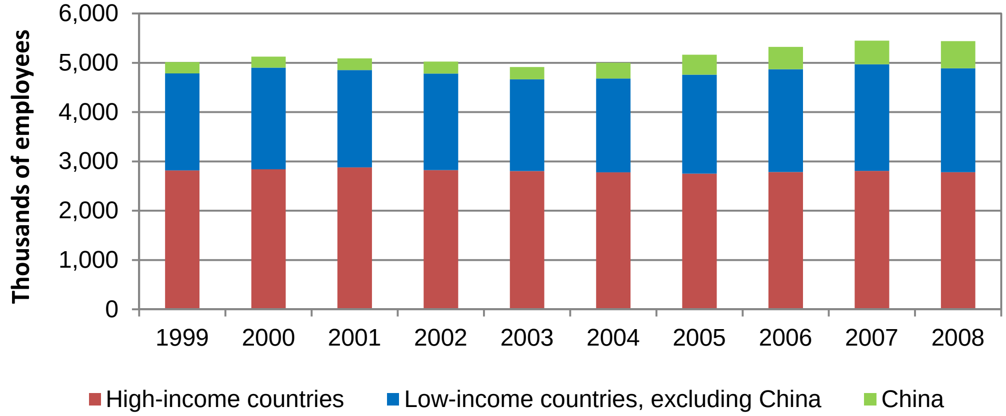
Even though U.S. parents have decreased their direct manufacturing employment in the United States while increasing employment in their foreign affiliates, it is important to consider that the foreign activities of U.S. MNCs may still support domestic employment. For example, a 2011 study by Alejandro et al. (2011) finds that in 2008, services activities abroad in the form of intra-firm exports supported nearly 700,000 U.S. jobs.[31]

In 2008, MNCs' affiliate employment was nearly evenly split between high-income (51 percent) and low-income countries (49 percent) (figure 12). Interestingly, China's share increased from 5 percent to 10 percent of all affiliate manufacturing employment between 1999 and 2008, with all other low-income countries accounting for 39 percent in 2008. Two important trends drive the increase in China's affiliate employment: the country is a source of inexpensive labor for U.S.-based manufacturers, and it is also one of the world's fastest-growing markets for many manufactured goods. Chinese factories are closely integrated into Asia's regional production process, so firms manufacturing in China may be assembling inputs produced in other Asian countries. U.S. firms thus have strong incentives to establish manufacturing facilities there.

To fully place into context the trends related to offshoring of U.S. manufacturing employment, it is important to recognize that U.S. affiliates of foreign-owned manufacturers also

[31] Alejandro et al. "U.S. Multinational Services Companies," 2011.

FIGURE 12 Foreign affilate employment, by country group



Source: U.S. Department of Commerce, BEA.

employ significant numbers of U.S. workers. In 2008, foreign-owned manufacturing affiliates in the United States directly employed 2.1 million workers, accounting for nearly one in seven U.S. manufacturing jobs. Further, the decline in U.S. manufacturing employment has been slower for foreign-owned firms than for all U.S. manufacturers, leading to a small increase in the proportion of U.S. manufacturing workers employed by foreign-owned firms (table 7).

TABLE 7 Employment by foreign-owned manufacturing affiliates as a share of overall U.S. manufacturing employment

	1999	2008	Change over period
			Percent
Overall U.S. manufacturing employment (1,000)	17,322	13,406	–23
Employment by foreign-owned manufacturing affiliates in the United States (1,000)	2,618	2,116	–19
Employment by foreign-owned manufacturing affiliates in the United States as a share of all manufacturing employment (%)	15.1	15.8	

Source: BEA and BLS, Current Employment Statistics.

Industry-level Trends: Offshoring and Employment[32]

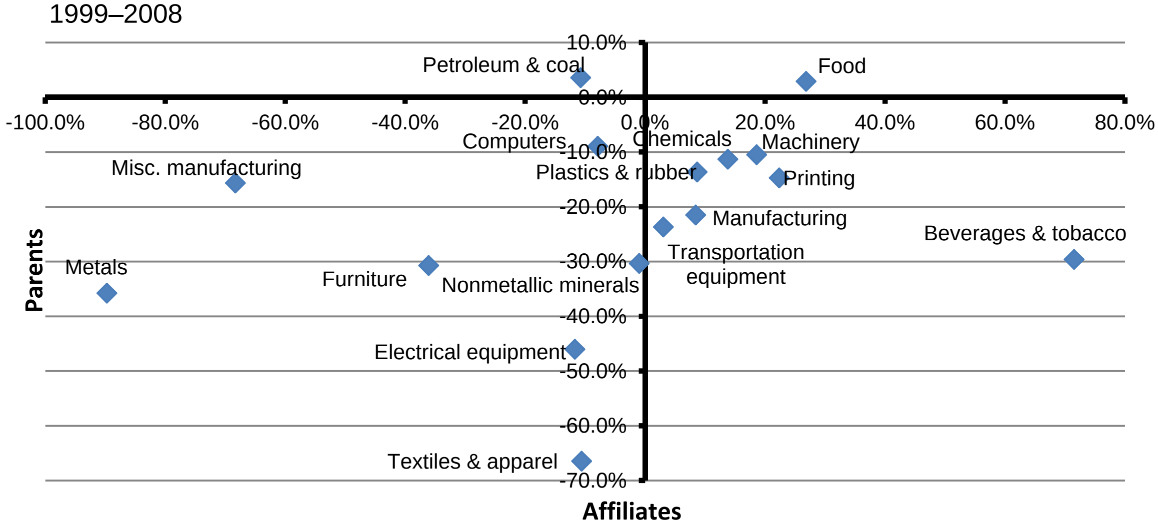
A look at specific industries within the broader manufacturing sector illustrates marked differences in industries' investment decisions. Figures 13–15 plot the percent change in U.S. parent

[32] Data on U.S.-owned foreign affiliates are produced by the BEA. Data are not available for all of the industry breakouts cited above, so the categories do not match exactly.

manufacturing employment vs. foreign affiliate employment between 1999 and 2008.[33] The top right and bottom left quadrants suggest complementarity between parent and foreign affiliate employment, as both are increasing or decreasing, respectively. The top left and bottom right quadrants suggest substitution, as parent and affiliate employment move in opposite directions.

Figure 13 shows the changing employment trends for U.S. parent manufacturing firms vs. their foreign affiliates between 1999 and 2008. Overall, the figure shows that for most manufacturing industries, parent employment in the United States has declined over the period. The only exceptions are the food manufacturing industry and the petroleum and coal industry, both of which tend to rely heavily on manufacturing in the markets where the final goods are expected to be sold. In contrast, employment in foreign affiliates of U.S. parents has increased for one-half of manufacturing industries. Substitution of foreign employment for home employment is a factor in machinery, printing, chemicals, plastics and rubber, and transportation equipment, and is most pronounced in the beverage and tobacco industries.

FIGURE 13 Percent change in manufacturing employment, all U.S. parents vs. foreign affiliates, 1999–2008

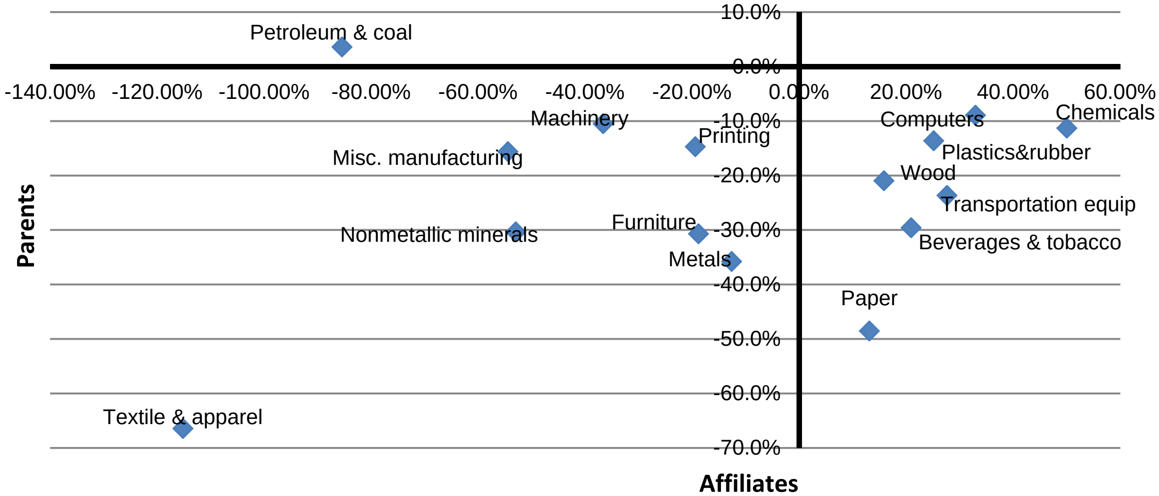


Source: U.S. Department of Commerce, BEA.

When we examine the same trends separately for foreign affiliates located in low-income vs. high-income countries (figures 14 and 15), we see a somewhat different picture. As might be expected, lower-technology industries that likely rely on lower labor costs experienced employment growth at

[33] The figures follow the methodology of Harrison and McMillan (2007).

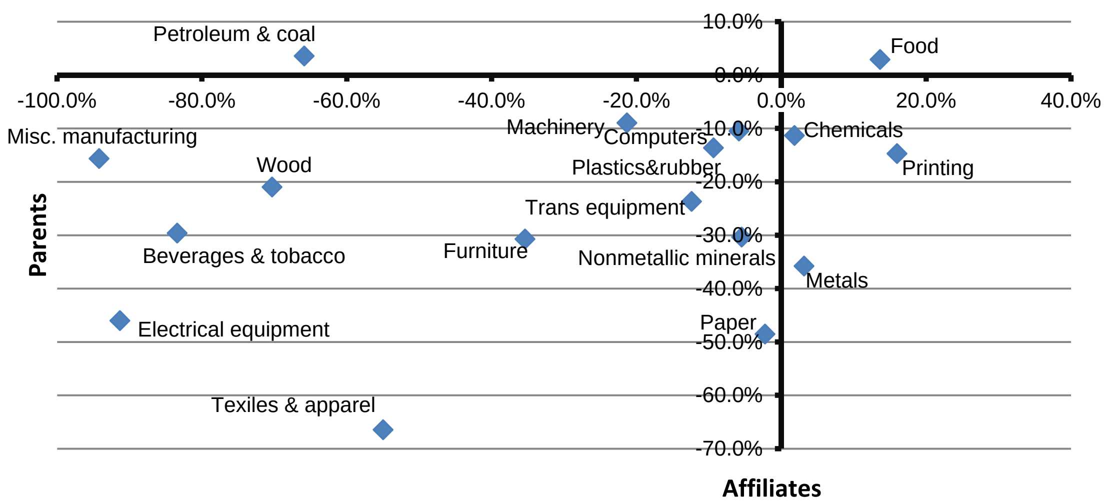
FIGURE 14 Percent change in manufacturing employment, parents vs. affilates in low income countries,1999–2008



Source: U.S. Department of Commerce, BEA.

Note: The food and electrical equipment industries are not included due to outlier data.

FIGURE 15 Percent change in manufacturing employment, parents vs. affiliates in high-income countries, 1999–2008



Source: U.S. Department of Commerce, BEA.

foreign affiliates in low-income countries that substituted for declining parent employment. Examples include foreign affiliates in the paper, wood, plastics and rubber, and beverages and tobacco industries.

Foreign affiliates in several higher-technology industries followed the same trend. For both high- and low-technology industries, this may reflect a search for lower labor costs, a desire to manufacture products directly in the world's fastest-growing markets, or both. Many low-income countries are also among the fastest-growing markets. Manufacturers have found that the ability to conduct research and development that focuses on customizing products to local market preferences can be an important driver of local sales. Transportation equipment, computers and electronic products, and electrical equipment are all high technology industries that exemplify this trend.

Overall, half of the industries experienced employment growth at affiliates in low-income countries that substituted for declining parent employment and half of the industries witnessed declining employment at affiliates in low-income countries and U.S. parents. By contrast, changes in affiliate employment in high-income countries complemented changes in parent employment for the majority of industries. Specifically, both affiliates and U.S. parents experienced falling employment in textiles and apparel, electrical equipment, beverages and tobacco, wood, miscellaneous manufacturing, furniture, transportation equipment, plastics and rubber, computers, and machinery.

Several manufacturing industries witnessed declining employment in affiliates in both low- and high-income countries, notably textiles and apparel, nonmetallic minerals, furniture, miscellaneous manufacturing, and machinery. It may be that U.S. parents' global market share in these industries has declined, in favor of foreign-owned companies; they may also be contracting out rather than producing through foreign affiliates.

Overall, the figures show that parent firms' manufacturing employment declined for most industries, but at different rates. Textiles and apparel, paper, and electrical equipment recorded the steepest declines. Affiliate employment varied based on the location of the affiliate. For foreign affiliates in low-income countries, industries that are labor-intensive or that pay lower wages registered larger employment increases, and therefore the substitution effect tended to dominate. For foreign affiliates in high-income countries, there were fewer manufacturing industries that recorded employment gains, and the gains were smaller overall. In printing and metals manufacturing, employment rose in high-income country affiliates, but fell in low-income country affiliates. Finally, decreasing affiliate employment in high-income countries complemented falling parent employment for the majority of industries,

Related Literature

A significant body of literature exists on the relationship between trade and wages. The main focus of the literature has been on the distributional effects of trade.[34] Traditional models of the economy, which assume perfectly competitive labor markets and full employment suggest that trade and trade liberalization play no role or play a marginal role in determining aggregate employment in the long run. However, research investigating the relationship between trade and employment in the short-run has uncovered important links between international trade flows and employment, especially sectoral employment. The research examining trade and manufacturing employment has found that trade may lead to job loss in the short run and that the level of income of a country's trading partner may matter in terms of employment outcomes.[35] More recently, attention has turned to offshoring, where despite data limitations there is a growing body of empirical work; a number of literature surveys review these topics in detail.[36] This review focuses on empirical research relevant to understanding the interaction between trade flows, employment, and offshoring.

Trade Flows and Jobs

There are three widely used empirical approaches to investigating the employment effects of trade: factor content, growth accounting, and regression-based labor demand methods.[37] Despite methodological differences, the trade, wages, and employment literature largely agree that trade flows play a role in short-run job loss and wage inequality and that the effects of skill-biased technical changes dominate, especially when it comes to wage inequality.[38] However, the debates on several important issues remain unsettled. How large a role does trade play in influencing employment? What are the

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[34] Standard theories, such as Heckscher-Ohlin-Samuelson (HOS), raise distributional questions between the owners of capital and labor. Wood (1994) and Leamer (1993) build on the HOS model so that it considers unskilled and skilled labor (and capital in the case of Leamer). Their version of the model predicts growing wage inequality between skilled labor and unskilled labor with trade liberalization. In the case of the United States, where skilled labor is the abundant factor, wages for skilled labor increase while wages for unskilled labor (the scarce factor) fall.

[35] Görg, "Globalization, Offshoring and Jobs," 2011.

[36] See, for example, Hoekman and Winters, "Trade and Employment," 2005; Kletzer, *Imports, Exports, and Jobs,* 2002; OECD, "Seizing the Benefits of Trade," 2010; Bottini, Ernst, and Luebker, "Offshoring and the Labor Market," 2007; Görg, "Globalization, Offshoring and Jobs," 2011.

[37] The factor content approach uses either an input-output based methodology or a computable general equilibrium model to estimate the amount of labor (direct and indirect) required to produce a given amount of exports or the amount of labor displaced by imports. By contrast, in order to estimate the effect of trade on employment, the growth-accounting approach breaks down changes in employment into effects from changes in domestic demand, exports, imports, and productivity. Regression-based methods involve estimating labor demand or production functions.

[38] Bernard, Jensen and Lawrence, "Exporters, Jobs, and Wages in U.S. Manufacturing," 1995.

channels through which trade influences labor market outcomes? Does the type of partners a country trades with influence that country's employment outcomes—and if so, how?

Kletzer (2002) examines the relationship between trade, employment, and job displacement for a sample of U.S. manufacturing industries. [39] Her results suggest that increased imports are associated with employment declines, especially in smaller import-competing industries like watches and clocks, footwear, and leather. Here she finds that within an industry, a 1 percent increase in import penetration is associated with a 0.4 percent reduction in employment. Kletzer's findings also indicate that a 1 percent increase in sales due to exports is associated with a 0.7 percent increase in employment growth.[40] Similarly, a 2007 Organisation for Economic Co-operation and Development (OECD) report finds that foreign competition in the most trade-exposed sectors tended to reduce employment in those sectors, but that on balance the aggregate level of employment in the economy does not change.

Revenga (1992) uses panel regressions to estimate labor demand models and finds a positive correlation between import prices and U.S. manufacturing employment that is larger than the effect of import prices on wages. [41] In particular, she finds that a 1 percent decrease in import prices is associated with a decline in U.S. manufacturing employment of between 0.24 and 0.39 percent. By contrast, a 1 percent decrease in import prices is associated with a decline in U.S. manufacturing wages of between 0.06 and 0.09 percent. Her results suggest that import competition has an especially significant effect on employment and the majority of an industry's adjustment to an adverse trade shock occurs through cutting jobs, not wages. [42] Revenga also finds an important role for exchange rates in explaining labor market outcomes.

Using data from between 1982 and 2002, Ebenstein et al. (2009) examine the effects of trade and offshoring on workers' wages and employment within manufacturing and across sectors and occupations.[43] Importantly, the study moves away from a partial equilibrium approach and considers

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[39] Kletzer, *Imports, Exports, and Jobs*, 2002.
[40] Another important contribution of Kletzer's analysis is that she examines job loss (as measured by the level of job displacement) in addition to net changes in employment. The former enables her to capture the dynamic aspects of trade adjustment and related costs that are masked by aggregate data.
[41] Revenga, "Exporting Jobs?" 1992.
[42] Ibid., 257.
[43] Ebenstein et al., "Estimating the Impact of Trade and Offshoring on American Workers," 2009.

spillover effects between sectors. The authors find a weak inverse association between import penetration and employment. Specifically, their results (which were not significant at the 5 percent level) show that a 1 percent increase in import penetration is associated with a 0.6 percent decrease in sectoral manufacturing employment.

Interestingly, Ebenstein et al. (2009) also examine the effects of trade at the occupational level and here they find that the effects of trade are larger and easier to detect. Their research shows that workers are more likely to remain in the same occupation when they switch jobs. This suggests that labor market frictions exist at the occupational level rather than the industry level and offers important insights into alternative channels through which trade influences labor market outcomes.

Some research suggests that the origin of imports matters when it comes to labor market outcomes. In their 1994 study, Sachs and Shatz[44] begin by postulating a counterfactual case, which assumes no trade. Their results suggest that trade with developing countries accounts for nearly all net U.S. job losses, reducing U.S. employment by 5.7 percent overall (6.2 percent in production employment and 4.3 percent in nonproduction employment).[45] Using plant-level data, Bernard, Jensen, and Schott (2006) investigate the role of trade with low-wage countries on plant survival and employment in U.S. manufacturing firms from 1977 to 1997.[46] The authors find that only imports from low-wage countries are negatively associated with plant survival and employment growth.

Autor, Dorn, and Hanson (2011) evaluate the effects of exposure to Chinese import competition on regional U.S. labor market outcomes between 1990 and 2007.[47] They consider U.S. local market variation in terms of exposure to import competition based on local variation in industry specialization. Like Ebenstein et al. (2009), they do not restrict themselves to the manufacturing sector.[48] Specifically, they use a general equilibrium approach that includes the traded and nontraded goods sectors. Their findings suggest that rising trade competition from low-income China affects local U.S. labor markets via reduced manufacturing employment in the most exposed labor markets and a decline in wages primarily

[44] Sachs and Shatz, "Trade and Jobs in U.S. Manufacturing," 1994.
[45] Ibid., 28-29.
[46] Bernard, Jensen, and Schott, "Survival of the Best Fit," 2006.
[47] Autor, Dorn and Hanson, "The China Syndrome," 2011.
[48] Ebenstein et al., "Estimating the Impact of Trade and Offshoring," 2009.

in sectors outside of manufacturing. In addition, they find that government transfer benefit payments increase most in the most trade-exposed regions.

Finally, Castro, Olarreaga, and Saslavsky (2007) estimate the effects of trade with China and India on Argentina's industrial employment and find that such trade had a small negative effect on industrial employment.[49] Taken together these studies suggest that the level of income (or location) of a country's trading partner matters when it comes to employment and wage outcomes.

Offshoring and Jobs

There is a burgeoning literature examining the relationship between offshoring and employment. There are challenges surrounding the evaluation of this literature, which are related to the fact that while most studies use firm-level data, they employ various definitions and measures of offshoring (e.g., affiliate employment, affiliate sales, and imported intermediate inputs), as well as diverse estimation methods, datasets, and timelines. In addition, the lack of data measuring trade in value-added hinders empirical work in this area. Nevertheless, a main concern in the literature is whether offshoring shifts jobs abroad by substituting foreign for domestic jobs or whether domestic and foreign jobs are complementary. While there is some disagreement regarding whether substitution or complementarity between parent and foreign affiliates dominates, recent studies are beginning to reconcile these divergent conclusions.

In their study examining the influence of increased foreign activity by U.S. manufacturing firms on domestic activities, Desai, Foley, and Hines (2009) find that MNC domestic employment and foreign affiliate employment are complementary. [50] Specifically, they find that a 10 percent increase in a firm's foreign employees was associated with a 2.3 percent increase in domestic employees. By contrast, Marin (2004)[51] examined Austrian and German firms that offshored in Eastern Europe and finds evidence of modest domestic job losses associated with job creation at foreign affiliates. Brainard and Riker (1997) also find evidence of low levels of substitution between domestic and foreign affiliate employment. [52]

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[49] Castro, Olarreaga, and Saslavsky, "The Impact of Trade with China and India," 2007.
[50] Desai, Foley, and Hines, "Domestic Effects of the Foreign Activities," 2009.
[51] Marin, "A Nation of Poets and Thinkers?" 2004.
[52] Brainard and Riker, "Are U.S. Multinationals Exporting Jobs?" 1997.

However, among affiliates in low-wage countries, substitution levels were much higher. Hanson, Mataloni, and Slaughter (2001) find that a 1.0 percent increase in affiliate sales is associated with an increase in U.S. parent employment of about 0.2 percent. [53]

Recent research by Wright (2010)[54] extends the Grossman and Rossi-Hansberg (2008)[55] model of offshoring to a continuum of perfectly competitive industries, in which tasks performed by production workers can be moved offshore, but not those performed by nonproduction workers. Wright, who measured offshoring by estimating imported intermediate inputs, finds that a 1-percentage-point increase in the extent of offshoring is associated with a 1.37 percent direct decline in domestic production worker hours (employment effect) and that the direct employment effect due to offshoring was responsible for 11.5 percent of U.S. production job losses from 1997 to 2007. Overall, he finds that offshoring generated a loss of production jobs in the U.S. manufacturing sector equal to 5.0 percent of all jobs lost during this period. Offshoring generated a 6.7 percent increase in nonproduction employment, which, combined with the loss of production jobs, resulted in an overall decline in employment of all workers by 1.60 percent.

Similar to the results in the trade and employment literature, which demonstrate that the origin of imports matters, empirical evidence linking offshoring and sectoral employment suggests that the location of foreign affiliates influences employment outcomes. For example, research by Harrison and McMillan (2007) examines the employment changes between U.S. MNC parents and their foreign affiliates between 1977 and 1999.[56] They find that affiliate employment in low-income countries substitutes for domestic employment. However, affiliate employment in high-income countries is complementary with domestic employment.

[53] Hanson, Mataloni, Slaughter, "Expansion Strategies of U.S. Multinational Firms," 2001.
[54] Wright, "Revisiting the Employment Impact of Offshoring," 2010.
[55] Grossman and Rossi-Hansberg, "Trading Tasks: A Simple Theory of Offshoring," 2008. In this widely cited theoretical paper, Grossman and Rossi-Hansberg argue that unlike trade in goods, *trade in tasks* represents bits of value being added in many different locations so that firms can take advantage of factor cost disparities in different countries without sacrificing gains from specialization. Offshoring generates a productivity effect akin to a factor-augmenting technology, which lowers firms' costs of tasks already being performed abroad and increases opportunities and wages for domestic workers involved in performing those tasks (i.e., high- or low-skilled workers).
[56] Harrison and McMillan, "Offshoring Jobs?" 2007.

Using firm-level data spanning 1982 to 2002, Ebenstein et al. (2009) examine the labor market effects of trade and offshoring within manufacturing and across sectors and occupations.[57] They find a small substitution effect whose magnitude changed depending on the location of the offshoring. In particular, a 10 percent increase in offshoring to low-wage countries reduced domestic manufacturing employment by 0.2 percent, while a 10 percent increase in offshoring to high-wage countries was associated with an increase in domestic manufacturing employment of 0.8 percent.

Empirical Framework

Following Greenaway, Hine, and Wright (1998),[58] Castro, Olarreaga, and Saslavsky (2007),[59] and Harrison and McMillan (2007),[60] we develop a framework based on factor quantities, since the focus of our study is on MNC labor demand. We also include key aspects of Harrison and McMillan (2007) regarding multinationals and offshoring and the aggregation of countries into low- and high-income groups.[61] Specifically, we assume that a multinational firm uses both labor (L) and capital (K) at home (*h*) or

abroad *(f)* in producing output Q. Firm *i*'s total use of labor L_i and capital K_i in production of Q is shown as:

(1) $Q_i = a(L_i, K_i)$ where

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

(3) $K_i = g(K_h, K_f)$

The firm's profit function can be written as:

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

where π_i is the firm's total profits, P_i is the price of the firm's output, w_h and w_f are domestic and foreign wages, and r_h and r_f are the prices of capital at home and abroad.

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[57] Ebenstein et al., "Estimating the Impact of Trade and Offshoring on American Workers," 2009.
[58] Greenaway, Hine, and Wright, "An Empirical Assessment of the Impact of Trade," 1999.
[59] Castro, Olarreaga, and Saslavsky, "The Impact of Trade with China and India," 2007.
[60] Harrison and McMillan, "Offshoring Jobs?" 2007.
[61] On the other hand, as discussed earlier, we construct our high- and low-income groups based on regional-level data provided by BEA's USDIA combined with available country-level data.

To obtain the demand for domestic labor by the firm, we maximize (4) with respect to L_h by obtaining the marginal value product of labor and setting it equal to the domestic wage:

(5) $w_h = P_i \frac{\partial Q_i}{\partial L_h}$ and (6) $\frac{\partial Q_i}{\partial L_h} = \frac{\partial Q_i}{\partial L_i} \frac{\partial L_i}{\partial L_h}$.

The labor demand function for the MNC can be derived from (5) and (6) as:

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

where A_i represents technological change in the firm's production function. Depending on the specific production function, labor and capital at home or abroad could be perfect substitutes, perfect complements, or imperfect substitutes for each other.

Estimation of (7) suffers from the identification problem to the extent that wage changes have been driven by productivity changes and other demand shifters over time. To correct for this, we estimate a reduced form equation for the firm's domestic employment, L_h, assuming the following labor supply function to the firm:

(8) $L_h = s(t, w_h)$

where *t* represents a vector of exogenous time-varying variables that affect the workforce, such as immigration or educational opportunities. Setting labor supply (8) equal to demand (7) results in the following reduced form equation for domestic employment:

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

Equation (9) specifies a relationship between an MNC's use of domestic (home) labor as a function of such variables as technological change, output prices, capital stocks at home and abroad, and time-varying variables.

Following Castro, Olarreaga, and Saslavsky (2007), we assume that both technological change A_i, and output prices, P_i are functions of import penetration and export share, plus a time trend that captures multifactor productivity:[62]

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[62] Castro, Olarreaga, and Saslavsky, "The Impact of Trade with China and India," 2007.

(10) $A_i \, P_i = f(M, X, t)$

where t is a time trend, M represents import penetration, and X represents export share.

The Model

Substituting (10) into (9) and taking logs yields:

(11) $\text{Ln}L_{iht} = B_0 + \sum_j \alpha_j M_{ijt-1} + \sum_{j \neq f} \mu_j X_{ijt-1} + \sum_{j \neq h} \gamma_j L_{ijt-1} + \sum_j \omega_j K_{ijt-1} + d_t + I_i + \varepsilon_{ijt}$

where L_{iht} represents total U.S. parent employment in industry i in period t; M_{ijt-1} is import penetration in industry i by location in period t-1; X_{ijt-1} is a measure of U.S. export share in industry i in period t-1; L_{ijt-1} is foreign employment for the U.S. parent in industry i in period t-1; K_{ijt-1} is the capital stock in industry i by location in period t-1; d_t represents time fixed effects; and I_i represents industry fixed effects. The industry dummies control for unobserved explanatory factors specific to each industry, while the time dummies capture the impact of productivity growth, macroeconomic shocks, trade liberalization, labor market reforms, and changes in exchange rates. Finally, the model allows for industries to do business in both high- and low-income countries. The literature suggests that the location of foreign activity by U.S. parents matters when it comes to domestic labor market outcomes.[63] We therefore disaggregate offshoring activities (represented by L_{ijt}) into low-income and high-income countries.

We expect the coefficient for import penetration to be negative and the coefficient for export orientation to be positive. The coefficient for affiliate employment will be negative if foreign affiliate employment acts as a substitute to parent domestic employment and positive if it is complementary to parent domestic employment. Finally, the coefficient on capital expenditure is expected to be positive in the case of parent domestic employment and negative in the case of affiliate employment.

The Data

To estimate the relationship between trade and offshoring and MNC employment, we use industry-level data from the BEA's U.S. Direct Investment Abroad (USDIA) survey covering the 1999 to 2008 period (see the Data Appendix for more details on the data and sources). According to BEA, U.S. direct investment abroad refers to ownership, directly or indirectly, by a U.S. investor ("U.S. parent") of

[63] See Bernard, Jensen, and Schott, "Survival of the Best Fit," 2006 and Harrison and McMillan, "Offshoring Jobs?" 2007.

at least 10 percent of a foreign business ("foreign affiliate").[64] The BEA also collects data for a second category of U.S. direct investment abroad—majority-owned foreign affiliates (MOFAs), where the combined ownership of all U.S. parents exceeds 50 percent.

The BEA conducts benchmark surveys every five years; it also conducts quarterly and annual sample surveys. The benchmark surveys are mandatory, covering the entire universe of MNCs and collecting more data than the annual and quarterly surveys, which conduct sample surveys. BEA has developed systematic methods for deriving universe estimates from the nonbenchmark sample surveys.[65] The BEA also extrapolates data for small affiliates for nonbenchmark years. Unlike Harrison and McMillan (2007) and Desai, Foley, and Hines (2009),[66] whose studies rely on BEA USDIA firm-level data (which is not publicly available) from the benchmark years alone, we use the publicly available industry-level data and supplement the benchmark data with data from all USDIA annual surveys between 1999 and 2008 in order to have a large enough dataset. USDIA survey data consists of multiple tables, each presenting a measure or set of measures related to parents or affiliates involved in foreign direct investment relationships. We primarily rely on MOFA data for the regression analysis.

In addition to the USDIA data, we use shipments and productivity data from the Manufacturing Industry Database maintained by the National Bureau of Economic Research (NBER)–U.S. Census Bureau Center for Economic Studies (CES); trade and tariff data compiled from the official statistics of the U.S. Department of Commerce; and GDP data from the World Bank's World Development Indicators database.

Data cover 29 manufacturing industries observed over 10 years, from 1999 to 2008 (table 8). (The actual number of observations is 261, due to the use of lagged variables; when lagged variables are used, 2000 is the earliest year of observation for the non-lagged dependent variable.) The panel is strongly balanced, as all industries are represented in all years. U.S. parent employment is the dependent variable.

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[64] The 10 percent ownership level is an international standard for countries reporting direct investment data to the IMF.

[65] See U.S. Department of Commerce, BEA, USDIA, "International Methodologies," http://www.bea.gov/scb/account_articles/international/usdia94.htm.

[66] Harrison and McMillan, "Offshoring Jobs?" 2007 and Desai, Foley, and Hines, "Domestic Effects of the Foreign Activities," 2009.

TABLE 8 Correlation Matrix

	U.S. parent employment	Import penetration (high-income countries)	Import penetration (low-Income countries)	Export share	Total Factor Productivity (TFP)	Affiliate employment (high-Income countries)	Affiliate employment (low-Income countries)	Capital expenditures (parents)	Capital expenditures (affiliates) (high-income countries)	Capital expenditures (affiliates) (low-income countries)
U.S. parent employment	1.00									
Import penetration (high-income countries)	0.09	1.00								
Import penetration (low-income countries)	–0.21	0.54	1.00							
Export share	–0.08	0.60	0.53	1.00						
Total factor productivity	–0.02	0.08	0.18	0.20	1.00					
Affiliate employment (high-income countries)	0.73	0.28	–0.15	–0.12	–0.01	1.00				
Affiliate employment (low-income countries)	0.57	0.18	0.10	0.03	0.07	0.81	1.00			
Capital expenditures (parents)	0.73	0.35	–0.10	–0.03	–0.03	0.88	0.70	1.00		
Capital expenditures (affiliates) (high-income countries)	0.61	0.28	–0.16	–0.10	–0.00	0.92	0.80	0.86	1.00	
Capital expenditures (affiliates) (low-income countries)	0.36	0.14	0.01	0.11	0.06	0.60	0.78	0.59	0.74	1.00

Source: Compiled by USITC staff from BEA, USDIA, and NBER-CES data.

Following Kletzer (2002)[67] "import penetration" is imports divided by imports-plus-shipments, and "export share" is exports divided by exports-plus-shipments. Import penetration, affiliate employment, and capital expenditures at foreign affiliates were each calculated for all countries, and separately for high-income versus low-income countries.[68] This was done to see whether the correlations between these independent variables and U.S. parent employment are significantly different in specifications where all countries are aggregated, compared to specifications where high- and low-income countries are distinguished. The countries included in the "high-income" and "low-income" groups remained the same in all years (see table A1 in the Data Appendix for the summary statistics). Finally, productivity growth is a five-factor total productivity based on a production function that includes capital, production worker hours, non-production worker hours, non-energy materials, and energy.[69]

Estimation Issues and Identification Strategy

Due to the adjustment costs involved in the hiring and firing of workers, changes in labor demand may be sluggish. This suggests the presence of lagged employment terms (and other independent variables) in the equation. The former may lead to first-order serial correlation in the errors. One way to overcome the possible serial correlation of the error term is to include a lagged parent employment as an explanatory variable; however, in ordinary least squares (OLS) estimations the inclusion of a lagged dependent variable in a panel setting can result in biased and inconsistent estimates when fixed effects are correlated with the dependent variable.[70]

We have a second endogeneity problem because our independent variables (trade, affiliate employment, and capital) may be determined simultaneously with parent employment. In order to overcome these challenges we follow the identification strategy of Castro, Olarreaga, and Saslavksy

[67] Kletzer, *Imports, Exports, and Jobs*, 2002.

[68] We use capital expenditure (a flow variable) rather than capital stocks as called for by the model because the USDIA dataset is missing a large number of data points for capital stocks (i.e., assets), making it impossible to disaggregate by high- and low-income countries. While we recognize that the use of a capital flow does not match the model exactly, we believe capital expenditure is a sound proxy.

[69] See Bartelsman and Gray, "The NBER Manufacturing Productivity Database," 1996 for a discussion of how the Divisia index of Total Factor Productivity (TFP) growth was constructed and the source data. Due to issues related to the availability of data, we use TFP as a measure of productivity instead of labor productivity, which we used in our trend analysis.

[70] Castro, Olarreaga, and Saslavsky, "The Impact of Trade with China and India," 2007, 12.

(2007) and Greenaway, Hine, and Wright (1999),[71] who use the Generalized Method of Moments (GMM) (Arellano and Bond 1991, Blundell and Bond 1998)[72] The GMM addresses some potential sources of bias by differencing data to eliminate industry-specific effects or any time-invariant industry-specific variables. By using lags of the right-hand side variables as instruments for the possibly endogenous variables, it may help minimize the endogeneity of the independent variables. However, this approach may not completely control for endogeneity. Therefore, we also estimate equation (11) using instrumental variables (IVs).

Following Xu (2006), we use U.S. tariff rates (weighted by country and by industry groups) as an instrument for import penetration.[73] The level of industry tariffs affects the cost and competitiveness (vis-à-vis domestic production) of imported products and thus import penetration levels. We use GDP levels (for the countries in table A-5 of the Data Appendix) weighted by export market share.[74] GDP represents foreign demand for U.S. exports. As such, it is used as an instrument for export share. Since MNCs consider net income to determine their capital investments in future years, net parent income and net affiliate income are used as instrumental variables for parent capital expenditures and affiliate capital expenditures, respectively. Finally, we use affiliate sales as an instrument for affiliate employment. MNCs consider sales performance in their decisions of how many people they will hire.

There are two requirements for a valid IV; the first is that the IVs are exogenous so they are uncorrelated with the error term, and the second is that they are correlated with the endogenous explanatory variables for which they are instrumenting. We show that our IVs meet the requirements in the following section.

Results

We follow Arellano and Bond (1991) and Blundell and Bond (1998) in using the GMM system estimation, which addresses some potential sources of bias by incorporating previous values of the

[71] Ibid., and Greenaway, Hine, and Wright, "An Empirical Assessment of the Impact of Trade," 1999.
[72] Arellano and Bond, "Some tests of specification for panel data," 1991 and Blundell and Bond Blundell, R. and S. Bond, "Initial conditions and Moment Restrictions, 1998.
[73] Xu, "What Determines Capital Structure?" 2006.
[74] Specifically, we divided the countries into high- and low-income groups (as described in table A5 in the Data Appendix) and then weighted GDP according to the export market size of the countries.

dependent variable.[75] Only the year dummies are considered exogenous, and the estimation uses a "collapsed" instrument set to limit the number of instruments. In all regressions, we include year dummies, express all continuous variables except productivity as logs, and lag all independent variables by one year, as the model anticipates inertia in labor demand. The columns include the number of instruments used and the Hansen J-statistic score (a test for the joint validity of the instruments).[76] In the columns labeled GMM1 and GMM2, we estimate equation (11). GMM1 presents results for all countries aggregated and GMM2 presents the results for the specification where high- and low-income countries are distinguished. GMM3 and GMM4 repeat these specifications with productivity replacing both import penetration and export share, in order to test robustness by introducing a more direct control for productivity growth.[77]

Our results are reported in table 9. We find that the overall relationship between affiliate employment and U.S. parent employment is mixed. However, our results partially support findings in the literature that location matters when it comes to offshoring. In particular, when high-income countries are distinguished from low-income countries, there is a consistently positive and significant correlation between employment in high-income affiliates and employment at U.S. parents. This relationship is significant at the 95 percent level, and holds whether or not import penetration and export share are replaced with productivity. One explanation may be that foreign affiliates in high-income countries tend to be involved in complementary activities.

Contrary to the findings in the literature, we find that the coefficient on employment in low-income affiliates is not significant. For example, in GMM2, a 1 percent increase in affiliate employment in high-income countries is associated with a 1.6 percent increase in U.S. parent employment the

[75] Specifically, GMM accommodates the possibility that the current dependent variable is influenced by past values of the dependent variable by using two sets of "moment conditions": one set of equations with levels, and one with first differences. We use the "xtabond2" command in STATA.

[76] The J statistic scores for these results pass the test—i.e., the hypothesis that the model is valid cannot be rejected—at conventional levels of significance of 0.10 (GMM1 and GMM2) or 0.05 (GMM3 and GMM4). However, see Roodman, "A Note on the Theme of Too Many Instruments," 2008, for caveats in interpreting J-statistics.

[77] The original model incorporates productivity by assuming that technological change is a function of import and export share.

TABLE 9 Regression results (the dependent variable is U.S. parent employment)

	GMM1	GMM2	GMM 3	GMM 4
Lagged dependent variable (1 year)	–0.059 (–0.03)	0.461 (–0.56)	1.270 (1.55)	–0.671 (–0.76)
Import penetration (all countries)	–1.324* (–1.82)			
Import penetration (high-income countries)		–0.181 (–0.21)		
Import penetration (low-income countries)		–0.425 (–1.10)		
Export share	0.169 (0.17)	0.200 (0.39)		
Total factor productivity			–0.758 (–1.18)	–1.109 (–1.03)
Affiliate employment (all countries)	1.184 (0.73)		–0.550 (–0.80)	
Affiliate employment (high-income countries)		1.557‡ (2.73)		2.004‡ (3.75)
Affiliate employment (low-income countries)		0.043 (0.16)		–0.093 (–0.30)
Capital expenditures (parents)	0.048 (0.05)	–0.059 (–0.13)	–0.286 (–1.00)	0.046 (0.10)
Capital expenditures (affiliates) (all countries)	0.109 (0.24)		0.316 (0.77)	
Capital expenditures (affiliates) (high-income countries)		0.007 (0.03)		0.090 (0.34)
Capital expenditures (affiliates) (low-income countries)		0.019 (0.15)		0.035 (0.28)
Constant	–2.982 (–0.44)	0.342 (0.16)	1.167 (0.40)	–0.337 (–0.18)
Number of observations	261	261	261	261
Number of instruments	21	27	19	23
Hansen J-statistic (prob > chi2)	.124	.110	0.099	0.086

* 10 percent level significance (1.65); ‡ 1 percent level significance (2.58).

following year.[78] The average industry in high-income countries experienced a –0.08 percent annual change in affiliate employment between 2000 and 2008. The predicted decrease in U.S. parent employment associated with this change, holding every other variable constant, is –0.13 percent (1.6 * –0.08).

Additionally, the coefficient on import penetration is negative and significant at the 10 percent level in GMM1. A 1 percent increase in import penetration is associated with a 1.3 percent decrease in U.S. parent employment. The 3.95 percent increase in the average annual industry import penetration rate between 1999 and 2008 is associated with a predicted decrease in U.S. parent employment of 5.1 percent, holding all other variables constant. The data do not permit us to distinguish meaningfully between

[78] The elasticity of affiliate employment in high-income countries with respect to U.S. parent employment emerges as slightly higher (2.0) in GMM4.

imports from high-income and low-income countries. This result provides some support, albeit weak, for the finding from the earlier trend analysis that the level of trade exposure may be negatively associated with employment in the sector.

The productivity coefficient in GMM3 and GMM4 was not significant, suggesting we did not miss a productivity effect in the GMM1 and GMM2 specifications. This finding supports the results of our trend analysis. Finally, our econometric results are broadly consistent when we try variations on estimations presented here, suggesting that these correlations are robust.

Tables 10 and 11 presents the results of the first-stage regression results for the IVs. The first-stage regression results show that the IVs are significantly correlated and that the signs are in the right direction (negative for the correlation between tariffs and import penetration, and positive for the correlation between the remaining IVs and the corresponding endogenous variables). In addition, the F-statistics are sufficiently large to fulfill the condition for an IV strong enough to explain our endogenous variables. The only exceptions are export share in all countries (table 10) and import penetration in low-income countries (table 11), where the instruments emerge as weak.

TABLE 10 First stage IV regressions, all countries

	Import penetration (all countries)	Affiliate employment (all countries)	Capital expenditures (affiliates, all countries)	Export share (all countries)	Capital expenditure (parents, all countries)
U.S. industry tariffs (all countries)	–0.0767‡ (0.0202)	0.0752‡ (0.0119)	0.0709‡ (0.0164)	–0.0470* (0.0201)	0.0571‡ (0.0185)
Affiliate sales	0.146** (0.0818)	0.0825‡ (0.0481)	0.856‡ (0.0663)	0.0824 (0.0815)	0.792‡ (0.0749)
Net affiliate income (all countries)	–0.0418 (0.0706)	–0.138‡ (0.0415)	0.123* (0.0573)	0.0962 (0.0703)	–0.268‡ (0.0646)
GDP (all countries)	1.616‡ (0.476)	–1.657‡ (0.280)	–1.664‡ (0.386)	0.673 (0.474)	–3.538‡ (0.436)
Net parent income(all countries)	–1.125‡ (0.0344)	0.0797‡ (0.0202)	–0.0110 (0.0279)	–0.102‡ (0.0342)	0.393‡ (0.0315)
Constant	–52.32‡ (14.84)	48.26‡ (8.732)	49.18‡ (12.04)	–23.82‡ (14.79)	108.8‡ (13.59)
Observations	246	246	246	246	246
R-squared	0.170	0.820	0.800	0.103	0.767
F statistic	9.80‡	219.17‡	191.48‡	5.48‡	157.96‡

‡ 1 percent level significance; * 5 percent level of significance; ** 10 percent level significance.

Note: All variables are logged and lagged by one year.

TABLE 11 First stage IV regressions, high- and low-income countries

	Import penetration (high-income)	Import penetration (low-income)	Affiliate employment (high-income)	Affiliate employment (low-income)	Capital expenditure (affiliates, high-income)	Capital expenditure (affiliates, low- income)	Export share	Parent capital expenditure
GDP (all countries)	1.831‡ (0.656)	4.951‡ (1.153)	–2.162‡ (0.417)	–3.242‡ (0.745)	–2.900‡ (0.550)	–3.055‡ (0.794)	2.163‡ 0.537	–2.059‡ 0.645
Net parent income (all countries	–0.167‡ (0.051)	–0.125 (0.089)	0.103‡ (0.032)	0.110** (0.058)	0.030 (0.043)	0.130* (0.062)	–0.096* (0.042)	0.248‡ (0.049)
U.S. Industry tariffs (high-income countries)	0.373‡ (0.084)	0.491‡ (0.148)	–0.065 (0.0537)	–0.290‡ (0.096)	–0.038 (0.084)	–0.009 (0.102)	0.518‡ (0.069)	0.185* (0.083)
U.S. Industry tariffs (low-income countries)	–0.603‡ (0.099)	–0.609‡ (0.173)	0.086 (0.063)	0.311‡ (0.112)	–0.049 (0.083)	–0.036 (0.119)	0.549‡ (0.081)	–0.313‡ (0.097)
Affiliate sales (high-income countries)	0.746‡ (0.135)	0.429** (0.238)	0.794‡ (0.086)	–0.088 (0.153)	0.732‡ (0.113)	–0.121 (0.164)	–0.005 (0.111)	1.048‡ (0.133)
Affiliate sales (low-income countries)	–0.839‡ (0.112)	–0.123 (0.197)	0.094 (0.071)	1.187‡ (0.127)	0.472‡ (0.094)	1.339‡ (0.136)	–0.434‡ (0.092)	–0.039 (0.110)
Affiliate income (high-income countries)	–0.064 (0.087)	–0.425‡ (0.153)	–0.196‡ (0.056)	–0.332‡ (0.099)	–0.025 (0.073)	0.0309 (0.106)	0.223‡ (0.0715)	–0.232‡ (0.086)
Affiliate income (low-income countries)	0.276‡ (0.094)	0.007 (0.165)	–0.057 (0.059)	0.050 (0.107)	–0.149** (0.079)	–0.171 (0.114)	0.138** (0.0771)	–0.203* (0.093)
Constant	–59.22‡ (20.40)	–156.4‡ (35.84)	63.63‡ (12.98)	96.11‡ (23.15)	86.26‡ (17.11)	89.84‡ (24.68)	–67.02‡ (16.70)	62.80‡ (20.04)
Observations	119	119	119	119	119	119	119	119
R-squared	0.465	0.297	0.812	0.795	0.866	0.853	0.481	0.737
F statistic	11.97‡	5.82‡	59.46‡	53.46‡	88.58‡	80.01‡	12.73‡	38.56‡

‡ 1 percent level significance, * 5 percent level of significance, ** 10 percent level significance.

Note: All variables are logged and lagged by one year.

The IV regression results are reported in table 12. Based on the results of the over-identification test, we cannot reject that the instruments are valid. However, due to the sizable loss of degrees of freedom in the IV specification (especially in IV2), our preferred specification is table 9.[79] Nonetheless, we find that the IV results lend support to our original findings. In IV1, we find that the negative coefficient on import penetration in all countries is deflated from –1.324 in GMM1 to –0.731 in the IV1 results. This is consistent with the simultaneity bias leading to coefficients that are too negative. The IV estimates suggest that a 1 percent increase in import penetration from all countries leads to a decrease in

[79] Specifically, we are concerned about a large number of missing observations in IV2 (for high- and low-income countries). This may be reflected in the high p-value (0.930), which diminishes our confidence in the IV2 results. In a series of subsequent regressions, we used various permutations of our IVs for high- and low-income countries that do not suffer from a large number of missing observations (the majority of IVs) and through this exercise were able to confirm that these instruments are valid. In the end, IV2 provides support, albeit weak, to our GMM2 findings.

TABLE 12 Regression results for IVs (the dependent variable is U.S. parent employment)

	IV 1	IV 2
Lagged dependent variable (1 year)	0.558 (0.330)	0.827‡ (0.123)
Import penetration (all countries)	-0.731* (0.427)	
Import penetration (high-income countries)		-0.071 (0.098)
Import penetration (low- income countries)		-0.086** (0.037)
Export share	0.234 (0.292)	0.068 (0.084)
Total factor productivity		
Affiliate employment (all countries)	0.186 (0.231)	
Affiliate employment (high-income countries)		0.22 (0.173)
Affiliate employment (low- income countries)		-0.024 (0.059)
Capital expenditures (parents)	0.0942 (0.302)	-0.0114 (0.105)
Capital expenditures (affiliates) (all countries)	-0.0358 (0.163)	
Capital expenditures (affiliates) (high-income countries)		0.024 (0.057)
Capital expenditures (affiliates) (low- income countries)		-0.07* (0.042)
Constant	0.221 (0.816)	-0.156 (0.404)
Number of observations	219	106
Number of instruments	29	22
Hansen J-statistic (Over identification test)	0.538	0.930

‡ 1 percent level significance, * 5 percent level of significance, ** 10 percent level significance.

Note: The instrumental variables used are U.S. tariff rates (weighted by country, industry groups), GDP levels weighted by export market share, affiliate sales, and net parent income and net affiliate income.

parent employment of .73 percent. The coefficient on affiliate employment in high-income countries (IV2) remains positive, but the magnitude of the coefficient is much smaller than what emerged in GMM2. The estimates in IV2 indicate that a 1 percent increase in foreign affiliate employment in high-income countries is associated with a 0.22 percent employment increase in the U.S. The IV2 results also suggest that if the affiliate is in a low-income country, a 1 percent increase in foreign affiliate employment is associated with 0.02 percent decline in U.S. employment.

Conclusion

This study examined the relationship between trade, offshoring, and MNC employment in the U.S. manufacturing sector between 1999 and 2008, reviewing published results and updating them through the use of more recent publicly available data. We sought to answer a set of related questions that included whether trade flows and/or offshoring are associated with declining manufacturing employment and whether the origin of imports and the location of offshoring activities matter to employment outcomes in the manufacturing sector. We examined sectoral and industry-level trends and used econometric analysis to model the effects of trade and offshoring on employment in this sector on a dynamic panel of industries in the aggregate and in high- and low-income countries. We controlled for two types of endogeneity by introducing GMM and a set of instrumental variables.

Our results partially support findings in the literature with regard to the importance of location when it comes to offshoring employment effects. Specifically, in our preferred specification we find that foreign affiliate employment in high-income countries is complementary with U.S. parent employment (U.S. employment in manufacturing is higher when foreign affiliate employment in high-income countries is higher); foreign affiliate employment in low-income countries seems to have no effect on U.S. parent employment. This last point runs contrary to the claims of the opponents of offshoring that posit that jobs abroad replace jobs at home. Indeed, the substitution effect does not seem to be the driving force behind declining U.S. manufacturing employment. We also find that trade exposure may influence employment outcomes. Specifically, our results showed that higher import penetration is associated with lower U.S. manufacturing employment. However, this is a weak result because the effect of import penetration is inconsistent across specifications. Indeed, the data do not allow a meaningful distinction to be made between imports from low- and high-income countries.

One of the limitations of our study is the partial equilibrium nature of our approach. A more nuanced understanding would require an examination of the relationship of trade to employment outcomes in a general equilibrium framework that also considers imperfect labor mobility and adjustment costs. While the literature review identified a small number of empirical studies that have used a general equilibrium framework to evaluate the relationship between globalization and labor market outcomes across sectors, there is a need for additional research using data that are more recent. In addition, the trend analysis revealed that China has emerged as a significant destination country for offshoring, and its importance has grown significantly over the period under consideration. Research assessing the impact on

U.S. employment of offshoring to China would shed some light on an issue that is the subject of intense debate. Finally, expanding this work to capture outsourcing would provide a more complete picture of the factors influencing U.S. parent employment in the manufacturing sector.

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DATA APPENDIX

Summary Statistics and Data Sources

TABLE A.1 Summary statistics

	MEAN	STDEV	MIN	MAX
U.S. parent employment (thousands)	267.9662	228.7085	2.6	1152.7
Import penetration (all)	0.236252	0.163401	0.035945	0.890559
Import penetration (high-income countries)	0.132539	0.085064	0.022382	0.470987
Import penetration (low-income countries)	0.142908	0.171906	0.008692	0.878841
Export share	0.150593	0.083101	0.026765	0.414717
TFP	0.001958	0.057716	–0.22413	0.443221
Affiliate employment (all countries)	151.0683	163.2609	7.1	908.1
Affiliate employment (high-income countries)	84.08172	96.15284	3.2	561
Affiliate employment (low-income countries)	66.98655	75.35659	0.6	391.1
Capital expenditures (parents)	5017.259	9591.989	19	70686
Capital expenditures (affiliates - all)	1665.331	2139.766	64	13278
Capital expenditures (affiliates – high-income countries)	1144.369	1592.229	16	10032
Capital expenditures (affiliates – low-income countries)	520.9621	674.9289	–15	3802

Source:

TABLE A.2 Summary of data and sources (all for 1999–2008)

Variable	Source
U.S parent employment	BEA, USDIA
U.S. imports and exports	Compiled from official statistics of the U.S. Department of Commerce
Shipments	NBER-CES, Manufacturing Industry Database
Total factor productivity	NBER-CES, Manufacturing Industry Database
Affiliate employment	BEA, USDIA
Capital expenditures	BEA, USDIA
Affiliate and U.S. parent net income	BEA, USDIA
Affiliate sales	BEA, USDIA
U.S. tariff rates (weighted by country and by industry group)	Compiled from official statistics from the U.S. Department of Commerce
GDP levels	World Bank, World Development Indicators

The BEA Data

Much of the data for this project were collected from the U.S. Direct Investment Abroad (USDIA) survey conducted by the U.S. Department of Commerce's Bureau of Economic Analysis (BEA) for the years 1999–2008.The data consist of multiple tables, each presenting a measure or set of measures related to parents or affiliates involved in foreign direct investment relationships. The following tables have Group III (Majority-Owned Nonbank Affiliates of Nonbank U.S. Parents) affiliate data for 62 industrial categories within six aggregate groups of countries and eight specific countries. We selected industrial categories pertaining to manufacturing, and divided the countries into two broad categories, high-income and low-income. The Group III tables we used are:

- 3E4: Sales by Affiliates, Industry by Country
- 3E7: Net Income of Affiliates, Industry by Country
- 3D7: Capital Expenditures by Affiliates, Industry by Country.
- 3H4: Employment of Affiliates, Industry by Country

In general, Group III data were employed rather than Group II data because they were more complete, with fewer undisclosed observations. However, we also employed the following Group II (Nonbank Affiliates of Nonbank U.S. Parent) table for parent data because Group III data are not provided for parents, and Group II data serve as a close proxy:

- 2M1: Selected Financial and Operating Data of U.S. Parents, by Industry of U.S. Parent

Each of the data tables contained missing observations. These data are deliberately suppressed by the reporting agency to protect nondisclosure agreements. In some cases (e.g., table 3H4), the BEA provides ranges within which missing data points must lie. Equipped with these ranges, and row and column sums, estimates for missing data points were generated. Other tables (2M1 and 3D7) did not contain ranges within which estimates lay. These estimates are thus somewhat less informed. The row and column sums were preserved, however. The total number of missing data points estimated for this study is 751. We used data at the BEA disaggregated level only. Aggregate sums assisted in estimating suppressed data points.

TABLE A.3 Missing data

BEA Year	2M1 Parent employment per 29	2M1 Parent capital expenditure per 29	2M1 Parent income per 29	3D7 Capital expenditures by affiliates per 145	3E4 Sales by affiliates per 145	3E7 Net income of affiliates per 145	3H4 Employment of affiliates per 145
1999	0	0	0	15	20	20	6
2000	0	0	0	21	18	18	12
2001	0	0	0	21	18	18	8
2002	0	0	0	20	16	16	8
2003	0	2	2	18	14	14	10
2004	0	2	2	29	16	16	14
2005	0	0	0	29	22	22	11
2006	0	0	0	23	27	26	14
2007	0	0	0	17	27	27	15
2008	2	2	2	26	26	26	13

Note: Parent data are reported in one column, containing each of the 29 industry categories described. Affiliate data derive from calculations employing total global reports and each of four columns describing high-income data, as defined below. Hence, there are five times as many data points being collected for affiliate measures as for parent measures.

TABLE A.4 BEA table manufacturing industries list

BEA name	Aggregate category	Used	Matches NAICS code
Manufacturing	x		3
Food		x	311
Beverages and tobacco products		x	312
Textiles, apparel, and leather products		x	313, 314, 315, 316
Wood products		x	321
Paper		x	322
Printing and related support activities		x	3231
Petroleum and coal products			4227
Chemicals	x		325
Basic chemicals		x	3251
Resins and synthetic rubber, fibers, and filaments		x	3252
Pharmaceuticals and medicines		x	3254
Soap, cleaning compounds, and toilet preparations		x	3256
Other chemicals		x	3253, 3255, 3257, 3258, 3259
Plastics and rubber products		x	326
Nonmetallic mineral products		x	327
Primary and fabricated metals	x		
Primary metals		x	331
Fabricated metal products		x	332
Machinery	x		
Agriculture, construction, and mining machinery		x	3331
Industrial machinery		x	3332
Other Machinery		x	333, except 3331, 3332
Computers and electronic products	x		334
Computers and peripheral equipment		x	3341
Communications equipment		x	3342
Audio and video equipment		x	3343
Semiconductors and other electronic components		x	3344
Navigational, measuring, and other instruments		x	3345
Magnetic and optical media		x	3346
Electrical equipment, appliances, and components		x	335
Transportation equipment	x		336
Motor vehicles, bodies and trailers, and parts		x	3361
Other transportation equipment		x	336, except 3361
Furniture and related products		x	337
Miscellaneous manufacturing		x	339

The BEA classification codes for industries over this period directly correspond to the codes used by the U.S. Census Bureau’s North American Industry Classification System (NAICS). The NAICS classifications over this period for this set of industries were constant (NAICS 1997, 2002, 2007). We excluded data on BEA industries 3242 (integrated petroleum refining and extraction), 3243 (petroleum refining without extraction), and 3244 (other petroleum and coal products). These observations, which contained an additional 104 missing observations, would have required concording outside of the manufacturing sector under NAICS classifications.

The BEA provides data for all industries for the following country groups:

1. **Canada.**
2. **Europe.** More detailed data are provided for the following countries within Europe, the sum of which is not equal to the total for all of Europe: France, Germany, the Netherlands, and the United Kingdom.
3. **Latin America and other Western Hemisphere.** More detailed data are provided for the following countries within Latin America and other Western Hemisphere countries, the sum of which is not equal to the total for all Latin American and other Western Hemisphere countries: Mexico, Brazil.
4. **Africa.** No country-specific data.
5. **Middle East.** No country-specific data.
6. **Asia and Pacific.** More detailed data are provided for the following countries within Asia and Pacific, the sum of which is not equal to the total for all of Asia and Pacific: Australia, Japan.
7. **All countries.** The sum of the data for Canada and the countries of Europe, Latin America and other Western Hemisphere, Africa, Middle East, and Asia and Pacific.

The construction of the high- and low-income country groupings is based on the BEA's definition of regional country groupings. The only exception is that we took advantage of the fact that there were enough data to remove Australia and Japan from the low-income Asia and Pacific region and to place them in the high-income country grouping. Therefore, data for Canada, Europe, Australia, and Japan were summed to create a high-income country group. The low-income country group includes Latin America and Western Hemisphere, Africa, the Middle East, and Asia (except for Japan and Australia).

When compared to the World Bank's classification, 56 percent of those countries classified by us as "high-income" are classified as "high-income" by the World Bank; the remaining countries in our "high-income" group are predominantly upper-middle-income countries as defined by the World Bank. The high-income country group thus represents mainly high-income countries and a group of upper-middle-income countries that are moving toward or have more in common with high-income than low-income countries. Table A.5 provides the list of countries that we included in the high-income and low-income country groups.

TABLE A.5 High- and low-income country classification

High-income countries
Canada, Australia, Japan
Europe: Albania, Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Gibraltar, Greece, Greenland, Hungary, Iceland, Ireland, Italy, Kazakhstan, Kyrgyzstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Malta, Moldova, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tajikistan, Turkey, Turkmenistan, Ukraine, United Kingdom, Uzbekistan, Yugoslavia, Vatican City
Low-income countries
Latin American and Other Western Hemisphere: Anguilla, Antigua and Barbuda, Aruba, Argentina, Bahamas, Barbados, Bermuda, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, French Islands (Caribbean), French Guiana, Guyana, Haiti, Honduras, Jamaica, México, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, St. Lucia, St. Pierre and Miquelon, Suriname, Trinidad and Tobago, United Kingdom Islands (Atlantic), United Kingdom Islands (Caribbean), St. Vincent and the Grenadines, Uruguay, Venezuela
Africa: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad**,** Comoros, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Republic of the Congo, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Western Sahara, São Tome and Príncipe, Seychelles, Zambia, Zimbabwe
Middle East: Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Yemen
Asia and the Pacific: Afghanistan, Bangladesh, Bhutan, Brunei, Burma, Cambodia, China, Fiji, French Islands (Indian Ocean), French Islands (Pacific), Hong Kong, India, Indonesia, Kiribati, Laos, Macau, Malaysia, Maldives, Marshall Islands, Micronesia, Mongolia, Nauru, Nepal, New Zealand, North Korea, Pakistan, Palau, Papua New Guinea, Philippines, Republic of Korea, Singapore, Sri Lanka, Solomon Islands, Taiwan, Thailand, Tonga, Tuvalu, United Kingdom Islands (Indian Ocean),United Kingdom Islands (Pacific), Vanuatu, Vietnam, Western Samoa

Note: This list represents a mix of countries and a few overseas territories and overseas collectivities.