Foreign Direct Investment Relationship and Plant Exit: Evidence from the United States

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Abstract

Previous research has shown that U.S. manufacturing plants belonging to U.S. multinational companies (MNCs) are more likely to shut down than other manufacturing plants, once plant and industry attributes have been controlled for (Bernard A. and Jensen B., 2007). This research has concentrated on the importance of plant characteristics and the role of the firm structure, while largely ignoring the impact of the U.S. MNCs' foreign operations. This study extends that research in two ways. First, this study looks at inward direct investment-that is, the U.S. manufacturing plants of foreign MNCs and not just the U.S. manufacturing plants of U.S. MNCs. It uses enterprise data from BEA's survey of inward direct investment on the U.S. operations of foreign-owned MNCs combined with establishment data from the Census Bureau's 1997 and 2002 Census of Manufacturing (CMF). The data are used to demonstrate that U.S. manufacturing plants of foreign MNCs are more likely to shut down than non-MNC plants and less likely to shut down than U.S. MNC plants, thereby providing the first empirical evidence for the United States.

The second extension is the use of data from the Bureau of Economic Analysis on the operations of foreign affiliates of U.S. MNCs to further examine their shut down decisions. Enterprise data from BEA's outward direct investment survey on the foreign operations of U.S. MNCs were combined with establishment data from the 1997 and 2002 CMF. The data are used to demonstrate that U.S. MNCs' domestic plants in the same industry as its foreign affiliates are less likely to close if increased production abroad serves the local market and more likely to close if increased production abroad is exported back to the United States, controlling for plant and industry attributes. Furthermore, using the foreign affiliate sales data in conjunction with coefficients derived from BEA's Input-Output tables, we identify foreign affiliates that are potential suppliers to their U.S. parents' plants (i.e., we identify vertically integrated foreign affiliates) and find that U.S. parents' domestic plants in the same industry as a vertically integrated foreign affiliate are more likely to close than parents' U.S. plants that are not in the same industry as a vertically integrated foreign affiliate.

1   Introduction

During the 1990s, U.S. multinationals (MNCs) increased employment by 4.4 million in the U.S. and 2.7 million abroad (Wessel, 2011). That is, for every job created abroad, two jobs were created in their U.S.-based parent. A decade later, U.S. multinationals cut their workforce in the U.S. by 2.9 million and added 2.4 million jobs overseas (Wessel, 2011). During the same time period, the United States experienced employment decline in manufacturing that reflected layoff of workers, a lack of new hiring, and plant closures. Between 1997 and 2002, 30 percent of U.S. plants, accounting for 17 percent of manufacturing employment, closed.[1] These trends fueled the popular perception that U.S. MNCs were shifting jobs abroad by closing their U.S. manufacturing plants and opening plants abroad.

In this study, we focus on closures of U.S. manufacturing plants by MNCs, in an attempt to close a gap in the growing literature on the determinants of a plant's exit. Research on the operating decision to close a U.S. plant has tended to concentrate on the importance of plant characteristics and the role

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[1]Based on the author's calculations.

of the firm's domestic structure, while largely ignoring the role of the firm's foreign direct investment (FDI) abroad.

Previous research has shown that U.S. plants owned by U.S. multinationals are more likely to close, once plant and industry attributes have been controlled for (Bernard and Jensen 2007). These findings are consistent with Rodrick (1997) who argues that increased FDI may lead to elastic labor demand for MNCs due to their ability to shift production across locations within the firm. This ability to relocation production outside of the United States but still within the firm may lead to an increased probability of shut down for its U.S. manufacturing plants and highlights the need to examine the role of the firm's direct investment abroad by including the activities of the firm's foreign affiliates as a determinant of a U.S. plant's shut down.

We extend this line of research in two ways. First, this study looks at inward direct investment-that is, the U.S. manufacturing plants of foreign MNCs and not just the U.S. manufacturing plants of U.S. MNCs. For U.S. manufacturing establishments in 1997 and 2002, we examine whether foreign ownership is associated with increased U.S. plant shut downs, providing the first empirical evidence for the United States. Consistent with the theory, we find that the probability of shut down is substantially higher for U.S. manufacturing plants of foreign MNCs than for non-MNC plants. This result is also consistent with the findings for other countries. Looking at manufacturing plant shut downs in Indonesia, Bernard and Sjoholm (2003) find that foreign-owned plants are significantly more likely to close than domestic establishments. In another study, Gorg and Strobl (2003) find that Irish plants with majority foreign ownership are more likely to exit their sample of manufacturing plants, where exit can be either due to closure or a change in ownership.

The second extension to the probability of shut down research is the use of data from the Bureau of Economic Analysis on the operations of foreign affiliates of U.S. MNCs to further examine a firm's decision to shut down a U.S. plant. A central challenge for the literature has been the lack of disaggregated data on a firm's manufacturing operations in the United States and its operations abroad. Existing research instead has been limited to the use of aggregated firm level data of the firms' U.S. operations. Our data, obtained by combining the enterpise data from BEA's outward direct investment survey on the foreign operations of U.S. MNCs with establishment data from the 1997 and 2002 Census of Manufacturing (CMF), provides an important first step in reconciling the conflicting literature of the impact of

foreign activities on domestic activities.

The existing empirical literature is largely silent on the impact that a firm's FDI abroad has on the firm's U.S. manufacturing plant survival. While the theoretical possibilities are numerous, our empirical evidence is quite clear. For U.S. MNCs, we find that a U.S. MNCs' domestic plants in the same industry as its foreign affiliates are less likely to close if increased production abroad serves the local market and more likey to close if increased production abroad is exported back to the United States. Furthermore, we find that a U.S. parents' domestic plants in the same industry as a vertically integrated foreign affiliate are more likely to close.

Our study is motivated by the existing literature on estimating the domestic effects of foreign activities of U.S. multinationals. Existing evidence on the effect is inconclusive. Desai, Foley, and Hines (2008) analyze U.S manufacturing firms between 1982 and 2004, concluding that more foreign investment and more foreign employee compensation is strongly associated with more domestic investment and employee compensation. Riker and Brainard (1997) using a panel of U.S. multinationals and their foreign affiliates between 1983 and 1992 find that foreign affiliate employment substitutes for U.S. parent employment.

The remainder of the paper is organized as follows. In section II, we present our theoretical model, framed after Bernard and Jensens' (2007) probability of shut down univariate probit model. Additionally, we use a different data source for a key variable of interest in their model and we introduce new variables that relate the industry of a U.S. plant to the industry of its parent's foreign affiliates. In section III, we provide a brief description of our data and present a few stylized facts. Section IV presents our empirical results, while conclusions follow in Section V.

2   Theoretical Framework

Our theoretical model builds upon Bernard and Jensens' (2007) probability of plant shut down univariate probit model:

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\begin{aligned}
Shutdown_i \;=\; & \beta_1 1997_i + \beta_2 Age_i + \beta_3 CapitalIntensity_i + \beta_4 Dissimiliarity_i \\
& + \;\; \beta_5 EntryCost_i + \beta_6 Exporter_i + \beta_8 USMNC_i \\
& + \;\; \beta_9 Multiplant_i + \beta_{10} Multiproduct_i + \beta_{11} NonproductionWage_i \\
& + \;\; \beta_{12} ProductionWage_i + \beta_{13} Size_i + \beta_{14} Standalone_i + \beta_{15} Takeover_i \\
& + \;\; \beta_{16} TFP_i + e_{mji}, \quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad (1)
\end{aligned}
$$

which includes firm, plant and region/industry characteristics. Table 1 describes these variables along with their expected impact on the probability of shut down. Bernard and Jensen (2007) find strong evidence that size, age, productivity, and the capital and skill intensities of the plant reduce the probability that the plant would be shut down. Additionally, they find that exporters and multiproduct plants are more likely to survive than non-exporters or single-product establishments. They also find strong evidence that plants owned by a multiplant firm or by a U.S. MNC are more likely to shut down than single-unit and non-multinational firms. Finally, a change in plant ownership decreases the probability of shut down of a plant.

Building upon equation (1) we first redefine what constitutes a U.S. MNC. Bernard and Jensen (2007), using data from the CMF, defined a firm to be a U.S. MNC if at least 10 percent of its assets were held outside the United States in 1987. We define a firm in the CMF to be a U.S. MNC if the firm reported in BEA's outward direct investment survey. We include in equation (1) this new measure, which we call *USMNC*.

We then expand equation (1) to include a measure of foreign-owned MNC status, which we call *FOMNC*. Bernard and Jensen (2007), unable to identify which establishments in the CMF belong to foreign-owned MNCs, group U.S. plants of foreign-owned MNCs into the category that includes firms with no foreign presence, that is, U.S. plants of non-MNCs. Our access to both BEA's inward direct investment survey and the CMF data enables us to not only identify establishments belonging to non-MNCs and U.S. MNCs, but also those belonging to foreign-owned MNCs. Foreign-owned plants whose ultimate beneficial owner (UBO) is located in the U.S. were classified as U.S. parent-owned, or U.S. MNCs.[2]

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[2] The UBO of a U.S. affiliate is the first person that is not more than 50 percent owned by another person in the affiliate's ownership chain beginning with the foreign person. Unlike the foreign parent, the UBO of a U.S. affiliate may be located in the United States.

2.1 U.S. Multinationals Foreign Direct Investment Abroad

We then turn to our U.S. MNC sample to study whether the probability of a plant shut down increases or decreases with the type of direct investment abroad of the U.S. MNC. In this section, we present the approach that we took to classify activities of U.S. MNCs as either horizontal or vertical. To separate the data into horizontal and vertical activities, given that not all division of production can be easily broken down as such, we use data from BEA's surveys on the foreign operations of U.S. MNCs and information from BEA's Input-Output tables to identify possible vertical relationships between U.S. plants and foreign affiliates. These data sources and assumptions made are discussed in this section.

2.1.1 U.S. Plants in the Same Industry as a Foreign Affiliate

Horizontal investment occurs when a U.S. MNC duplicates the same production process in different locations. Firms frequently engage in horizontal investment in order to access domestic foreign markets, thereby avoiding trade costs, such as tariffs and transportation costs, associated with exporting to a foreign market.[3]

For U.S parents involved in horizontal activities it is not possible a priori to say what impact these types of activites will have on the probability of shut down of their U.S. establishments. When trade costs are low and investment abroad substitutes for exports, one implication is that foreign affiliate employment should substitute for home employment. If such is the case, we would expect the probability of shut down of a U.S. plant to be positively associated with increased production abroad. On the other hand, when trade costs are high and the foreign affiliate primarily serves the local market, we would expect a negative association.

In this paper, we develop two ways to identify a horizontal relationship between a U.S. plant and a foreign affiliate. First, consistent with the literature, we classify horizontal investment to be between a U.S MNCs' foreign affiliate and U.S. plant when both are in the same input-output industry. We modify equation (1) to include an indicator variable that captures such a relationship between the industry of the plant and the industry of the for-

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[3]Harrison and McMillan (2007) argue that firms in highly protective sectors (textile or apparel) or in a sector with high costs of transportation (cement) are more likely to engage in horizontal investment.

eign affiliate. $SameIndustry_i$ is equal to one for a U.S. plant when there is a foreign affiliate of the firm in the same input-output industry as the U.S. plant.

Next, we account for the fact that our $SameIndustry_i$ variable is an imperfect indicator of horizontal investment because vertical investment can also occur between a U.S. plant and a foreign affiliate that operate in the same input-output industry. This occurs when each specializes in different stages of production. For parents involved in vertical activities, we would expect the probability of shut down of a U.S. plant to increase if the firm sources from a foreign affiliate that produces the same inputs of production as the U.S. plant. We differentiate pure horizontal activity from vertical activity by using BEA's dataset on the operations of foreign affiliates. The richness of these data allows us to observe each foreign affiliate's sales by destination: sales to the local market, sales back to the U.S. parent company, and sales to other countries. For each same industry pair, we assign to the U.S. plant the foreign affiliates' aggregated industry level sales by destination to account for whether the foreign affiliates' production is serving the local market or the parent company in the United States. For U.S. parents involved in horizontal activities, there would be no adverse affect on the probability of shut down of a U.S. establishment if production abroad is not a substitute for exports of the U.S. establishment and if production abroad primarily serves the local market. For firms engaged in vertical investment, the production of the foreign affiliate may adversely affect a U.S. plant if the firm shifts production from a U.S. manufacturing plant to the foreign affiliate. The plant's survival becomes threatened when the firm chooses to source not from this plant but from the foreign affiliate that produces the same inputs of production as the U.S. plant.

The foreign affiliate's sales by destination enter into equation (1) via two new variables. The first, which we call $LocalSales_i$, is the firms' local sales of foreign affiliates that produce in the same industry as the U.S. plant. The second, which we call $USSales_i$, is the firms' U.S. sales of foreign affiliates that produce in the same industry as the U.S. plant. Both variables are in logs. We would expect that an increase in local sales of a foreign affiliate who operates in the same industry as the U.S. plant results in a lower probability of shut down for the U.S. plant because that is likely horizontal investment. We would expect that an increase in sales to the United States by the foreign affiliate that is in the same industry as the U.S. plant would result in a higher probability of shut down for the U.S. plant because it indicates vertical

investment in which foreign production substitutes for domestic.

2.1.2 Industries Connected Via An Input-Output Relationship

To more carefully identify the role the firms' FDI plays on the firms' decision to shut down a U.S. plant we control for a set of variables that attempts to directly measure the relationship between the industries of the U.S. MNCs' foreign affiliates and the industries of the firms' U.S. plants. To determine the strength of the relationship, we use the foreign affiliate data in conjunction with the coefficients derived from BEA's Input Output Tables for 1997. For each pair of industry codes, we identify the direct requirements coefficient, which shows the amount of the commodity required to produce one dollar of the industry's output, to help us identify which foreign affiliates are potential suppliers to their U.S. parents' plants (i.e., we identify vertically integrated foreign affiliates). Alfaro and Charlton (2009) use a similar approach in their study of the determinants of FDI, where they use the 1987 Benchmark Input-Output Tables to measure vertical FDI as the activity of foreign-owned subsidiaries in industries upstream from the parent industry. To determine which industries are connected via an input-output relationship they use a positive direct requirements coefficient to indicate a vertical relationship.

Our approach differs in three ways from theirs. First, Alfaro and Charlton (2009) examine the strength of the relationship between the industry of the foreign affiliate and the industry of the parent company, whereas we are interested in the relationship between the industry of a firms' foreign affiliates and the industry of the firms' U.S. plants. Second, we use a 1997 input-output mix (i.e., technology) for the 1997 and 2002 CMF data and foreign affiliate data, while Alfaro and Charlton (2009) assume technology from 1987 would apply to production two decades later. Lastly, their approach for identifying vertical FDI suffers from their inability to observe intra-firm trade. Applying their approach in our study would lead to an overestimation of vertical activity in our data. To correctly distinguish vertical activities from horizontal activities, we use BEA's intra-firm trade data to observe when a foreign affiliate imports good for further processing from the U.S. parent, and we use BEA's destination of sales to identify when the foreign affiliate supplies its parent.[4]

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[4]BEA collects data on foreign affiliates' total imports from their U.S. parents broken out by the intended use of those imports: for further processing, for resale, or for other, which includes capital equipment.

Similar to Harrison and McMillan (2007) we construct a measure of intra-firm trade. This measure is constructed as the sum of foreign affiliates' imports for further processing and sales to the U.S. divided by total foreign affiliate sales.[5] Then, we weight the direct requirements coefficient by the share of intra-firm trade and set a threshold of zero to indicate no vertical integration between a U.S. plant and a foreign affiliate. This allows us to identify those foreign affiliates that potentially supply their U.S. parents with intermediate inputs.

Our approach allows us to introduce two additional new variables that attempt to measure the type of relationship (i.e., horizontal or vertical investment) that exists between the industry of the U.S. plant and the industry of the foreign affiliate. The first, which we call $Competes_i$, is an indicator variable equal to one if the U.S. plant is in the same industry as a foreign affiliate that supplies to another U.S. plant of the firm. For example, as shown in Figure 1, we assume a U.S. MNC has two U.S. plants in distinct industries, plant 1 in IO 42: Other Fabricated Metals, and plant 2 in IO 43: Engines and Turbines. For simplicity we further assume that the firm only has one foreign affiliate and that it is in the same industry as plant 1 and vertically integrated with plant 2. In other words, the foreign affiliate, a fabricated metals manufacturer, supplies the domestic engines and turbines manufacturer. We would expect a positive coeficient on our variable, $Competes_i$, which in this case measures the relationship between the foreign affiliate and the probability of shut down for the domestic fabricated metals plant. In other words, the probability of shut down of the domestic fabricated metals plant would be positively affected by the production of the fabricated metals manufacturer located abroad since the parent company potentially sources from the foreign affiliate abroad and not from the domestic plant for its engines and turbines plant.

Our second variable, which we call $VerticalIntegration_i$, is an indicator variable equal to one if the U.S. plant is in the same industry as a foreign affiliate of the firm and also vertically integrated with that foreign affiliate. For example, as shown in Figure 2, an MNCs' U.S. plant (plant 1) is in the same industry (IO 43: Engines and Turbines) as the foreign affiliate and also vertical integration exists between the two entities. Our variable, $VerticalIntegration_i$, attempts to measure the probability of shut down for

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[5]This measure of intra-firm trade is also used by Grossman and Rossi-Hansberg (2006) to quantify the increase in vertical activities of multinationals.

the U.S. domestic engines and turbines manufacturer, where the impact on the expected probability of shut down for such a plant is unclear. Given the interdependence between the U.S. manufacturer and the foreign affiliate, it is possible that such division of labor across the firm, if essential to the firm, could lead to a decrease in the probability of shut down for the domestic plant. However, the probability of shut down could increase if the firm decides to move its entire production from the domestic plant to its foreign affiliate abroad.

3   Data

Before we formally test the impact the U.S. MNC's foreign operations has on the firm's decision to shut down a U.S. plant, we provide a brief description of our data and present a few stylized facts.

3.1   Description of the Data

Our data are important for a number of reasons. First, to date, the central challenge for the literature has been the lack of disaggregated data on a firm's manufacturing operations in the United States and its operations abroad. Exisiting research instead has been limited to the use of aggregated firm level data of the firms' U.S. operations. Our data, obtained by combining the enterpise data from BEA's outward direct investment survey on the foreign operations of U.S. MNCs with establishment data from the 1997 and 2002 CMF, provides an important first step in reconciling the conflicting literature of the impact of foreign activities on domestic activities.

The unit of observation in the CMF is the establishment rather than the firm. Establishments, which we also refer to as plants, are defined to have shut down if the plant is in the CMF in year t but absent from the CMF in year $t+5$. Along with the CMF, we use the Longitudinal Business Database (LBD) from 1997 to 2005 to verify a plants' shut down, as opposed to a plants' change in ownership or temporary shut down, by using the plants' last year of operation.

From the Census, we also obtain plant characteristics including the years in operation of the plant, location, capital stock, the wages paid to nonproduction and production workers, the value of shipments, the value of exports, the number of products produced, and productivity. Our measure of pro-

ductivity, total factor productivity, is estimated from a five input production funtion that includes production and non-production workers, the book value of machinery and equipment, the book value of buildings and structure, and the value of purchased inputs and energy. At the plant level the CMF also gives us the 1997 primary four-digit Standard Industrial Classification (SIC) code and the 2002 primary four-digit North American Industry Classification System (NAICS) codes.

Data on the U.S. parent's foreign operations are obtained from BEA's outward direct investment survey. The survey provides information on employment, wages, output, location and major industry of the foreign affiliates. The BEA data also contain information on two key variables of interest in our study: 1) the foreign affiliates' sales by destination and 2) the value of intermediate goods shipped intra-firm (i.e., foreign affiliate imported goods for further processing). However, the latter key variable is not reported in BEA's annual outward direct investment surveys for the census years 1997 and 2002, but is reported in the benchmark years, 1994, 1999 and 2004. To construct a measure of this variable for census years, we average 1994 and 1999 benchmark data, and average 1999 and 2004 benchmark data. For 1994, the major industry of the foreign affiliate is based on a four-digit SIC code, while the major industry of the foreign affiliate in 1999 and 2004 is based on a four-digit NAICS code. Measures of aggregate foreign activity of individual firms are obtained by summing measures of firm activity by industry and year.

3.2   Stylized Facts

To get a sense of the importance of multinational firms in our sample in terms of their employment and output we present a few stylized facts and compare our results to Bernard and Jensen's (2007) findings. In their study, they found that U.S. MNCs between 1992 and 1997 only accounted for a small percentage of establishments in the United States, 6 percent, but they accounted for a significant percentage of output and employment, 34 and 26 percent, respectively. Table 2 shows that between 1997 and 2002, this pattern continues to exist. In 2002, while U.S. MNCs only account for a small percentage of establishments in the United States, 9 percent, they continue to account for a significant percentage of output and employment, 48 and 32 percent, respectively. Foreign MNCs account for 4 percent of U.S. establishments, 15 percent of output and 9 percent of employment.

Turning to our sample of U.S. MNCs' domestic establishments, Table 3 illustrates some differences between the characteristics of surviving and closing establishments. These differences reinforce the existing literature findings that survivors are bigger, older, more capital intensive, pay higher wages, more likely to export, more productive, and face higher entry cost, while closing plants are more likely to be plants taken over by a firm in the last 5 years and the only plant in its given industry within the firm.

Turning to our sample of U.S. MNCs' foreign affiliates, the data in Table 4 shows the mean of foreign affiliate sales for foreign affiliates that produce in the same industry as a U.S. MNCs' domestic plants. Not surprisingly, we find that a significant amount of the production of these foreign affiliates serves the local market, followed by production destined for other countries and the United States. Also, the production destined to the local market increased from 58 to 72 percent between 1997 and 2002, while the shares of production for export to other countries and the United States declined. Our findings support publicly available data from BEA. Its 2002 U.S. Direct Investment Abroad Statistics, "Table III.F 1. Sales by Affiliates, Selected Area and Industry of Affiliate and Type of Sale by Destination and Transactor," show that in 2002 nearly 65 percent of the foreign affiliates' sales were destined to the local market, followed by the production destined for other countries and the United States.

Table 5 shows the percentage of U.S. plants that compete with a vertically integrated foreign affiliate–that is, a plant in the same industry as a foreign affiliate that supplies its U.S. parent–and the percentage of U.S. plants that are in the same industry and vertically integrated with a foreign affiliate. While both shares increased overtime, the share of U.S. plants that compete with vertically integrated foreign affiliates of the firm had a larger increase–18 to 25 percent.

4   Empirical Results

Table 6 presents our empirical findings. The reported coefficients are the change in the probability of shut down for a marginal increase in the independent variable. Overall our empirical results are in line with the theory. Controlling for plant and firm attributes, we find that U.S. manufacturing establishments of U.S. MNCs and foreign MNCs have a higher probability of shut down than establishments belonging to non-MNCs (column I). This

result supports the theory that MNCs have elastic labor demand, because they are able to relocate production within the firm. Also, the magnitude of the coefficient for U.S. MNCs, at 0.0351, is in the range found by Bernard and Jensen (2007), which was 0.036 to 0.056.

To determine how the activities of the foreign affiliate affect the probability of shut down of the U.S. plant we restrict our sample to include only U.S. MNCs (column II-IV). In column II, the insignificant coefficient on our variable of interest, $SameIndustry_i$, suggests that if a firms' foreign affiliate and U.S. plant are in the same industry, that relationship alone, does not impact the probabilty of the U.S. plant closing. The insignificant coefficient could be due to measurement issues associated with our imperfect indicator of horizontal investment. Vertical investment can also occur between a U.S. plant and a foreign affiliate that operate in the same input-output industry, when each specializes in different stages of production.

Our measures for the destination of the foreign affiliates' production help us better distinguish horizontal activities from vertical activities (column III). The coefficients on $LocalSales_i$ is negative and significant and the coefficient on $USSales_i$ is positive and significant. These results indicate that when the foreign affiliate is in the same industry as the U.S. plant, the firms' decision to shut down the U.S. plant is dependent on the destination of the foreign affiliates' production. In other words, U.S. MNC's domestic plants in the same industry as its foreign affiliate are less likely to close if increased production abroad serves the local market and more likely to close if increased production abroad is exported back to the United States, controlling for plant and industry attributes. This result suggests that a firm engaged in horizontal investment may be less likely to shut down a U.S. plant than a firm engaged in vertical investment. For a firm engaged in vertical investment, their U.S. plants that compete with the firms' foreign affiliates may be adversely affected if these foreign affiliates export back to the United States.

Using our model that measures vertical integration via the input-output tables, we check to see if our results still hold. Our results in column IV, for our variable $Competes_i$ suggest that a U.S. parent's domestic plants that compete with its vertically integrated foreign affiliates face a higher probability of shut down than plants that do not compete with the foreign affiliates. While maintaining its supply source, a firm could potentially shift production away from the competing U.S. plant towards the vertically integrated foreign affiliate. The ability to relocate production within the firm could lead to an increased probability of shut down for the competing U.S. plant. The

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coefficient for our variable $VerticalIntegration_i$ is insignificant, therefore, we can not say much about the relationship between a U.S. plant and a foreign affiliate when both are in the same industry and vertically integrated with each other.

We next consider how sensitive our results are to our model specification. So far in this paper we have presented the results from a probit model of the firms' shut down decision. Additionally, to check for the robustness of our results and to allow for right censoring in the 2002 CMF data, since we do not observe a plants shut down after 2005, we also estimate a survival analysis model (failure time model). We set failure to be shut down and set the survival time based on the last year the plant was observed. Our survival analysis model results, in terms of the magnitude and signs of the coefficients, are consistent with our probit analysis results. Therefore, the former results are not shown in this version of our paper.

5   Conclusion

Manufacturing firms in the United States experienced substantial job losses beginning in 2000. The steep decline in manufacturing employment has often been attributed to increased competition from overseas. This paper considers how direct investment abroad by US MNCs affected U.S. manufacturing plant closures between 1997 to 2002. For U.S. manufacturing plants, we find that plant survival is dependent not only upon plant and firm characteristics but the type of direct investment abroad (i.e, horizontal and vertical activities) of the firm as well. We extend the previous research on the operating decision to close a U.S.plant in two ways.

First, in our probability of shut down model, framed after Bernard and Jensen (2007), we include inward direct investment. We extend the previous research with conclusive evidence that U.S. manufacturing plants of foreign MNCs are more likely to shut down than non-MNC plants. This result is consistent with the idea that MNCs are able and willing to shift production from their domestic establishments to their affiliates abroad and vice versa. This result is also consistent with the findings for other foreign-owned plants in other countries, such as Indonesia and Ireland. In our study, we provide the first empirical evidence for the United States.

In our second extension, we find conclusive evidence that a firms' type of foreign direct investment plays an important role in the firm's decision to shut

down a U.S. manufacturing plant. For U.S. parents involved in horizontal activities, foreign affiliate employment should substitute for home employment if investment abroad substitutes for exports. If such is the case, this would adversely affect the probability of shut down of the U.S. plant. However, there would be no adverse affect if production abroad is not a substitute for exports and if production abroad primarily serves the local market. Using data from BEA on the operations of foreign affiliates of U.S. MNCs our results suggest that U.S. MNCs' domestic plants in the same industry as its foreign affiliates are less likely to close if increased production abroad serves the local market and more likely to close if increased production abroad is exported back to the United States, controlling for plant and industry attributes.

Using the foreign affiliate sales data in conjunction with coefficients derived from BEA's Input-Output tables we identify foreign affiliates that are suppliers to their U.S. parents' plants (i.e., we identify vertically integrated foreign affiliates) and find that U.S. parents' domestic plants in the same industry as a vertically integrated foreign affiliate are indeed more likely to close than parents' U.S. plants that are not in the same industry as a vertically integrated foreign affiliate. For firms engaged in vertical investment, the production of the foreign affiliate appears to adversely affect a U.S. plant if the firm shifts production from a U.S. manufacturing plant to the foreign affiliate. The plant's survival becomes threatened when the firm chooses to source not from this plant, but from the foreign affiliate that produces the same inputs of production as the U.S. plant.

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Table 1: Description of Variables from Bernard and Jensen (2007)[a]

Variable	Description	Impact
Age	Difference between the current year and the first recorded Census year for the plant.	-
Capital Intensity	The log of the capital-labor ratio, where capital is the book value of machinery, equipment, buildings and structures.	-
Dissimilarity	A measure of whether the plant is similar to or different from other plants in the firm, measure based on input cost share of the plant and firm.	+
Entry Cost	Measure is based on the minimum of the industry entry and exit rates in a five-year interval.	-
Exporter	An indicator variable that is one when the plant exports and zero otherwise.	-
Multi-plant	An indicator variable that is one when there is at least one other plant belonging to the same firm and zero otherwise.	+
Multi-product	An indicator variable that is one when the plant produces multiple products and zero otherwise.	-
Multinational	Defined to be a firm with at least 10 percent of its assets held outside the U.S. in 1987.	+
Non-production wage	Log of the average wage paid to non-production workers at the plant.	-
Production wage	Log of the average wage paid to production workers at the plant.	-
Size	Log of plant total employment	-
Stand-alone	An indicator variable that is one if the plant is part of a multi-plant firm and is the only establishment in the firm producing in the industry.	+
Takeover	An indicator variable that is one if the plant changed owners in the previous five years.	+
TFP	Estimated from a five input production function (production and non-production workers at the plant, book value of machinery and equipment, book value of buildings and structures, and the value of purchased inputs and energy.	-

[a]Also, included are industry and regional control variables

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Figure 1: U.S. plant competing with a foreign affiliate

US Plant 1
IO 42: Other Fabricated Metals

US Plant 2
IO 43: Engines & Turbines

Plant 1 competes with
foreign affiliate

Vertically integrated
with plant 2

Foreign Affiliate
IO 42: Other Fabricated Metals

Figure 2: U.S. plant in the same industry and vertically integrated with a foreign affiliate

US Plant 1
IO 43: Engines & Turbines

US Plant 1
IO 42: Other Fabricated Metals

Vertically Integrated

Foreign Affiliate
IO 43: Engines & Turbines

Table 2: Output and Employment by Type

	1997 Establishments	1997 Output	1997 Employment	2002 Establishments	2002 Output	2002 Employment
Non-multinationals	90%	44%	60%	87%	38%	59%
U.S. Multinationals	7%	47%	32%	9%	48%	32%
Foreign Multinationals	3%	9%	8%	4%	15%	9%

Note: Based on the authors calculations. Numbers indicate the fraction of the category accounted for by that type of firm.

Table 3: Mean Characteristics for Surviving and Closing U.S. MNC Plants

	Survivors	Closures
Age	17.139	15.566
Capital Intensity	4.687	4.381
Dissimiliarity	.083	.089
Entry Cost	.742	.721
Exporter	.562	.423
Multiplant	.997	.995
Multiproduct	.777	.713
Nonproduction Wage	3.813	3.701
Production Wage	3.386	3.248
Size	5.099	4.628
Standalone	.123	.135
Takeover	.181	.259
TFP	.166	.087

Note: All means for survivors are statistically different from those for deaths at the 1 percent level.

Table 4: Mean of Foreign Affiliate Sales for Foreign Affiliates that Produce in the Same Industry as a Parents' U.S. Plant

	1997	2002
Local Market	58%	72%
Other Countries	27%	17%
United States	14%	11%

Note: Based on the authors calculations.

Table 5: The Percentage of U.S. MNCs' Plants that Compete with or are in the Same Industry as a Vertically Integrated Foreign Affiliate

	1997	2002
Competes	18%	25%
Same Industry	57%	61%

Note: Based on the authors calculations.

Table 6: <u>Multivariate Probit of Plant Shut downs on Characteristics</u>

	I	II	III	IV
Age	-.0033*	-.0011*	-.0011*	-.0011*
Capital Intensity	-.0112*	-.0131*	-.0134*	-.0635*
Dissimiliarity	.0907*	.0270	.0258	.0298
Entry Cost	-.1644*	-.2860*	-.2931*	-.2278*
Exporter	-.0297*	-.0358*	-.0362*	-.0356*
Multiplant	.0142*	.0150	.0116	.0202
Multiproduct	-.0166*	-.0082*	-.0080*	-.0092*
Nonproduction Wage	-.0158*	-.0154*	-.0157*	-.0141*
Production Wage	-.0088*	-.0170*	-.0176*	-.0078*
Size	-.0173*	.-.0304*	-.0308*	-.0304*
Standalone	.0021	-.0073	-.0055	-.0088
Takeover	.0393*	.0292*	.0296*	.0286*
TFP	-.0074*	-.0214*	-.0214*	.0386*
USMNE	.0351*	–	–	–
FOMNE	.0057**	–	–	–
Same Industry	–	.0002	–	–
Local Sales	–	–	-.0009**	–
U.S. Sales	–	–	.0019*	–
Competes	–	–	–	.0159*
Vertical Integration	–	–	–	-.0046
Number of observations	300,000	20,000	20,000	20,000

Note: The coefficients give the marginal effect of changing the independent variable. Industry, region and year fixed effects are included in the regression. Industry dummies are calculated at the three-digit IO SIC level. The number of observations are approximations. *indicates the coefficient is significant at the 5 percent level. **indicates the coefficient is significant at the 10 percent level.