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- Evidence from Japan -

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Globalization, Productivity and Plant Exit
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Abstract

During the 1980s and 1990s, Japanese manufacturers began to relocate production from sites in Japan to low-wage East Asian countries such as China, Malaysia and Thailand. Imports of manufacturing goods increased substantially over the same period. This rapid rise in imports, and proliferation of globalization, has led to concerns among policymakers that firms and plants may close. The media portray foreign multinationals as closing down productive Japanese plants and relocating them elsewhere in Asia. We find that this is not the case. Equally, the plants that are closed are below average productivity and the exit component contributes a very small fraction to productivity growth (using both the GR and FHK methods). In short, plant exit has not been the reason for Japan's low productivity growth in the 1990s. Instead a lack of productivity growth within plants is identified as being the main cause.

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JEL classification: D21, D24, F15, F23, L20, L6

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1. Introduction

The recent empirical studies[1], using establishment or firm level data, confirm that aggregate productivity growth at national level or industry level depends not only on the productivity gains within the establishments, but also on the shift in the output shares between the establishments or firms in the different level of productivities (see Bartelsman and Doms, 2000, Forster et al. 2001 and Hayakawa, Kimura, and Machikita 2009). If the output of the establishments with higher productivities can expand their production and that of the lower productivity establishments contracts, this change in the market share also brings improvements in aggregate productivity in the economy. The productivity improvement through market selection is examined by Disney, Haskel and Heden (2003) by using UK manufacturing data set. They find the market selection (entry, exit and the reallocation of market share) accounts for 80-90% of establishment TFP growth for 1982-92 period in UK. Criscuolo, Haskel and Martin (2004) use more recent data on UK manufacturing plants and find that the share of productivity growth accounted for by entry and exit increased from 25 per cent in the 1980s to 50 per cent in the 1990s.

Increased import penetration may lead to higher domestic market competition and higher aggregate productivity by forcing the least productive establishments to exit from the market, as described in the Melitz and Ottaviano (2005) model. Lileeva (2007) examines the effect of US-Canada Free Trade agreement on the productivity of the Canadian manufacturing sector. This study finds that the lower tariff rate in Canada increased exit rates among moderately productive non-exporting plants and lead to the

[1] The recent studies on Japanese productivity dynamics using micro data, such as Nishimura, Nakajima and Kiyota (2005) and Fukao and Kwon (2006) confirm the role of “between” effects on the industrial productivity growth.

reallocation of the market share to the higher productivity plants in Canadian manufacturing plants.

Bernard, Jensen and Schott (2006a) find that the probabilities of shut downs are higher in industries facing increased import competition from low-wage countries, especially for low-wage and labor-intensive plants within the industries. Bernard, Jensen and Schott (2006b) examine the effect of the trade cost reduction, such as tariff and transportation rates, on the reallocation in the US manufacturing sector and find that low productivity plants in the industry that have relative larger decline in the trade costs are more likely to die. Bernard and Jensen (2007) show empirical results about the US manufacturing death that the probability of death is substantially lower for those plants that are part of multi plant firm and also domestic plants that are owned by US multinationals. Greenaway, Gullstrand and Kneller (2008) find that the effect of trade on exit of Swedish firms being strongest when trading partners are other than OECD countries.

This paper adds to the growing evidence on plant exit and the survival chances of multinational owned enterprises. Görg and Strobl (2003) address the probability of exit of majority owned plants in Ireland, and Gibson and Harris (1996), Bernard and Jensen (2002), Bernard and Sjöholm (2003) look at evidence from New Zealand, the United States and Indonesia, respectively. The results differ depending upon the country under inspection. For example, Alvarez and Görg (2009) find that multinationals are more likely to shut plants in Chile, but only during downturns, while Mata and Portugal (2004) find that survival probabilities are higher among Portuguese plants when they are foreign owned.

The reminder of the paper is organized as follows. In the next section, we give a overview of the data and describes the construction of the plant-level, firm-level and industry-level characteristics. Section 3 investigates differences between plants depending on their ownership structure by controlling other firm, plat and industry characteristics. Section 4 investigates whether plant exit has an effect upon Japanese productivity growth in the recent years. Section 5 concludes.

2. Data

Our primary data sources are the linked longitudinal data sets of the Census of Manufactures (hereafter called COM) and the Basic Survey of Japanese Business Structure and Activities (BSJBSA) for the period 1994-2005. The COM data is an establishment-level data conducted by the Ministry of Economy, Trade and Industry (METI). The COM data covers all plants located in Japan and it include the information on plant characteristics, such as, their location, number of employees, tangible assets, and value of shipments. On the other hand, the BSJBSA is a firm-level survey conducted by METI. The survey includes all firms with more than 50 employees or over and with capital of 30 million yen or over. It provides data on corporate characteristics such as R&D activity, export, import, foreign ownership ratio, foreign direct investment, and fanatical details. For our analysis, we linked a plant-level data, the COM to a firm-level survey, the BSJBSA. At first, we constructed a plan-level panel data set, which covers all the manufacturing plants with more than 3 employees. Since BSJBSA dose not include firms with less than 50 employees or less than 30 million capital amounts, we have to exclude small single plants with less than 50 employees in our sample. In addition, even if plants belong to firms in the BSJBSA, due to the viability of data on tangible asset, which is indispensable to estimate TFP, those plants with less than 10 employees are excluded. Information on capital data is also not available for

2001, 2002 and 2004 for establishments with less than 29 employees. Therefore, our linked panel data set covers the years from 1994 to 2000, 2003, and 2005.

For an identification of plant entry and exit, we used using a unique identification number. An entering plant is deemed to have entered where it is observed at time *t* but was not observed in the dataset in previous period, *t*-1. Equivalently, an exiting plant is one that was observed at *t-1* but not at time *t*. In this framework, since our plant-level panel data set is restricted to plants with more than 3 employees, it is not possible to say whether this is caused by plant death or exit from the sample[2]. Exit is deemed to refer specifically to plant closure; industry switching and mergers are not considered within this framework[3].

The percentage of plants which either enter or exit is low, a feature which holds across industries. Throughout the sample, there are 2,330 instances of entry and 3,392 observations of exit. The exit rate may be affected by the size cut-offs. Throughout the dataset there are approximately 86,000 observations of single-plant firms. These plants have at least 50 employees meaning that they are fairly large, and less likely to exit. If the data permitted inspection of small plants, the exit rate may be higher since such establishments traditionally face higher probabilities of death.

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[2] Industry switching is not regarded as plant exit. However, those plants whose industry switches from manufacturing sector to other sector at between t-1 and t, are not observed in our plant-level panel data set at t. Thus these plants are regarded as exiting plants.

[3] Switching and M&A activity are found to play an important role in other studies. In Swedish manufacturing industries over the period 1982-1995, Greenaway et al. (2008) find 2.9 percent of exit occurs through switching and 3.9 percent through mergers and acquisitions. Bernard et al. (2006a) find for the United States that in the face of competition from low-wage imports, firms switch towards more capital intensive sectors.

Table 1: Annual Rate of Entry and Exit

Year	Percentage of Firms	
	Entering	Exiting
Sample Average	.01	.02
1994	.01	.01
1995	.01	.01
1996	.01	.01
1997	.01	.02
1998	.03	.03
1999	.01	.03
2000	.01	.03
2001	.01	.03
2002	.01	.03
2003	.01	.02
2004	.01	.02
2005	.02	.00

Over the sample, the entry and exit rates are approximately 1 and 2 percent, respectively. There are some fluctuations around this, notably for the entry rate which 'spikes' to 3 percent in 1998. Overall, however, there is little variation with entry and exit remaining concentrated around the mean. While this may seem to be a fairly low rate of exit, it is comparable with that of Swedish manufacturers over the period 1982 to 1995 used by Greenaway et al. (2008).

Table 2 shows that the plant variables differ considerably across entering, exiting and continuing firms. For example, entering and exiting plants tend to be smaller and have lower sales, productivity and intermediate inputs than continuing plants. On average, continuing firms have a lower capital-labor ratio relative to entrants and exiting plants, and, despite paying higher wages than entrants, their wage rate is lower than what is paid by exiting plants.

Table 2: Plant-level Variables among Exiting and Continuing Plants

Variable	Obs	Mean	Sample Std. Dev	Min	Max
Exiting Plants					
Plant Size	3392	132	280	10	5584
Number of Employees					
Capital per Worker	3392	19.24	52.03	.00	2216
Millions of Japanese yen					
Plant Sales	3392	6333	22826	6.50	606569
Millions of Japanese yen					
Plant TFP	3392	.94	.51	-2.85	4.36
Total Factor Productivity					
Plant Wage Rate	3392	5.17	3.41	.07	88.83
Millions of Japanese yen					
Intermediate Inputs	3392	3683	15110	.10	476007
Intermediate Inputs divided by Plant Sales					
Entering Plants					
Plant Size	2230	151	314	10	5997
Number of Employees					
Capital per Worker	2230	21.68	39.95	.00	523
Millions of Japanese yen					
Plant Sales	2230	7112	28111	3.23	570846
Millions of Japanese yen					
Plant TFP	2230	.90	.52	-4.26	3.76
Total Factor Productivity					
Plant Wage Rate	2230	4.35	1.96	.12	16.04
Millions of Japanese yen					
Intermediate Inputs	2230	4142	17419	.26	387803
Intermediate Inputs divided by Plant Sales					
Continuing Plants					
Plant Size	164218	227	494	10	21309
Number of Employees					
Capital per Worker	164218	16.94	29.19	.00	1056
Millions of Japanese yen					
Plant Sales	164218	11424	55138	2.88	5855928
Millions of Japanese yen					
Plant TFP	164218	.96	.34	-4.81	4.28
Total Factor Productivity					
Plant Wage Rate	164218	4.83	1.74	.03	90.55
Millions of Japanese yen					
Intermediate Inputs	164218	6730	40414	.10	4276681
Intermediate Inputs divided by Plant Sales					

2.1. Plant-Level Variables

Information is provided on the three-digit industry in which a plant operates[4]. The plant-level variables include plant size (measured by the number of employees), capital per worker, plant sales, plant TFP (measured relative to the industry and in logs), plant wage rate and the volume of intermediate inputs used by the plant.

Table 3: Plant-level Variables

Variable	Obs	Mean	Sample Std. Dev	Min	Max
Plant Size					
Number of Employees	169590	225	489	10	21309
Capital per Worker					
Millions of Japanese yen	169590	5119	23240	.07	1052705
Plant Sales					
Millions of Japanese yen	169590	11321.71	54454	2.88	5855928
Plant TFP					
Total Factor Productivity	169590	.96	.35	-4.81	4.36
Plant Wage Rate					
Millions of Japanese yen	169590	4.84	1.79	.03	40.5
Intermediate Inputs					
Intermediate Inputs divided by Plant Sales	169590	6669	39879	.10	4276681

The manufacturing establishments are split into 48 industries and TFP is calculated for each plant relative to the industry average. Following Caves, Christensen and Diewert (1982), Caves, Christensen and Tretheway (1983), and Good, Nadiri, Roeller and Sickles (1983), we define the TFP level of establishment *p* in year *t* in a certain industry in comparison with the TFP level of a hypothetical representative establishment in year 0 in that industry as follows

[4] A list of industries is included in Appendix Table 1

$$
\ln TFP_{pt} = \left(\ln Q_{ft} - \overline{\ln Q_t}\right) - \sum_{i=1}^{n} \frac{1}{2}\left(S_{ift} + \overline{S_{it}}\right)\left(\ln X_{ift} - \overline{\ln X_{it}}\right)
$$

$$
+ \sum_{s=1}^{t}\left(\overline{\ln Q_s} - \overline{\ln Q_{s-1}}\right) - \sum_{s=1}^{t}\sum_{i=1}^{n}\left(\overline{S_{is}} + \overline{S_{is-1}}\right)\left(\overline{\ln X_{is}} - \overline{\ln X_{is-1}}\right)
$$

where Q_{ft}, S_{ift} and X_{ift} denote the gross output of plant *f* in year *t*, the cost share of factor *i* for establishment *p*'s input of factor *i* in year *t*. Variables with an upper bar denote the industry average of that variable. We use 1994 as the base year. Capital, labor and real intermediate inputs are used as factor inputs.

The representative establishment for each industry is defined as a hypothetical establishment whose gross output as well as input and cost share of all production factors are identical with the industry average. The first two terms on the right hand side of the equation denote the gap between plant *f*'s TFP level in year *t* and the representative establishment's TFP level in year *t* and the representative establishment's TFP level in the base year. $\ln TFP_{ft}$ in the equation constitutes the gap between establishment *f*'s TFP level in year *t* and the representative establishment's TFP level in the base year.

2.2. Firm-Level Variables

In addition to information on each plant, our dataset also includes specific information on firms. This includes firm age, size, capital-labor ratios, a multi-plant dummy and information on whether the firm conducts FDI. In the empirical section we use this to study firm-level variables, such as ownership and exporting status, affect plant exit. Summary statistics of the firm-level variables are shown in Table 4.

Table 4: Firm-level Variables

Variable	Obs	Mean	Std. Dev	Min	Max
Age In months	14033	37.64	15.53	0	150
Size Number of Workers	14033	459	1918	50	77185
Capital per Worker Millions of Japanese yen	14033	12.79	20.74	.00	1275
Firm TFP Total Factor Productivity	14033	.93	.15	-3.53	2.39
Foreign Ownership Dummy 1 if Foreign Firm holds more than 50% of capital	14033	.01	.12	0	1
R&D Complexity log R&D divided by Firm Sales	6815	-4.94	1.54	-10.71	1.92
Export Dummy 1 if the firm exports	14033	.26	.44	0	1
Import Dummy 1 if the firm imports	14033	.20	.40	0	1
FDI 1 if outward loans and investment > 0	14033	.15	.36	0	1
Intermediate Inputs Millions of Japanese yen	14033	16208	110875	1	7177500
Multi-plant Dummy 1 if the firm has more than one plant	14033	.23	.42	0	1

It is apparent from Table 4 that the incidence of foreign ownership in Japanese firms is low. A firm is adjudged to be foreign owned if a foreign firm holds more than 50 percent of the capital[5]. Many firms appear to be globally engaged with 26 percent exporting, 20 percent importing and 15 percent of firms investing abroad. Almost half of firms own more than one plant.

[5] Görg and Strobl (2005) use the same criteria. The International Monetary Fund classifies a firm as being foreign owned if a foreigner holds in excess of 25 percent of the firm's equity.

2.3. Industry-Level Variables

The importance of industry-level variables in determining exit has been firmly established with Roberts and Tybout (1997) finding sunk costs to be important and Bernard et al. (2006a) highlighting how import penetration from different regions can affect exit. With these ideas in mind, we include industry-level variables that capture the effect globalization may impact on plant exit.

Intra-industry trade is often found to have a positive effect upon firm exit. As international trade grows firms diversify their product range which may lead them to enter new industries and exit ones they were once involved in. It has also been established by Greenaway et al. (2008) that firms do not just closedown their operations, they switch to new industries too. This is also found by Bernard et al. (2006a) who find that in the United States, firms which are confronted by low-wage import competition sometimes switch to more capital intensive sectors.

Our measure of intra-industry trade is constructed using the Grubel-Lloyd (1975) index.

$$GL_{it} = \left[\left(X_{it} + M_{it} \right) - \left| X_{it} - M_{it} \right| \right] \frac{100}{\left(X_{it} + M_{it} \right)}$$

where GL_{it} is the Grubel-Lloyd index of intra-industry trade in industry *i* in year *t*, X_i are exports in industry *i* during year *t* and M_{it} are imports in industry *i* during year *t*.

The importance of import competition in affecting plant survival has been addressed by several authors. As in Bernard et al. (2006a), our dataset allows us to disaggregate import penetration into low-wage country import penetration and other country imports[6].

The effect of low-wage country imports upon exit is not entirely clear. Differences in countries' endowments will have profoundly different effects upon the labor, or capital, intensity of the goods they produce. According to the factor proportions framework imports from low-wage countries could be thought to positively affect plant exit since such imports are likely labor abundant and consequently displace similar, high wage, Japanese goods. Bernard et al. (2006a) find that for the United States, a one standard deviation increase in low-wage import penetration increases the probability of plant exit by 2.2 percentage points. However, it is also possible that the source of import competition could have little effect on exit. Where industries are already saturated with imports from low-wage countries, additional imports may do little to affect exit. Exit may be non-linear in imports with low-wage imports only having an effect upon plant exit where there is relatively little existing import competition.

The measure of low-wage import competition (LWPEN) is constructed as follows

$$LWPEN_{it} = \frac{M_{it}^{LW}}{M_{it} + Y_{it} - X_{it}}$$

[6] Countries are deemed to be low-wage where they have GDP per capita of less than 5 percent that of Japan.

where $LWPEN_{it}$ represents low-wage country import competition in industry i at time t, M_{it}^{LW} is the value of imports from low-wage countries in industry i at time t, M_{it} and X_{it} represents the value of total imports and exports in industry i at time t and Y_{it} denotes output in industry i during year t.

Our second measure of import competition is similar to that used to construct LWPEN. It embodies imports from all countries that are not deemed to be "low-wage".

$$OTHPEN_{it} = \frac{M_{it} - M_{it}^{LW}}{M_{it} + Y_{it} - X_{it}}$$

where $OTHPEN_{it}$ denotes imports from all countries except low-wage economies.

The industry variables mentioned so far capture the influence of globalization upon plant exit. We also include a measure of sunk entry costs. The empirical literature has identified sunk entry costs as being an important factor in shaping exit. For example, Aw et al. (2002) finds that the nature of sunk costs result in very different productivity distributions in South Korea and Taiwan. Sunk costs also play a key role in determining death rates of plants (Dunne, Roberts, and Samuelson, 1988, 1989)

Since exit rates tend to be highly correlated with the sunk costs of entry and exit we use the same measure as Bernard and Jensen (2002) and Greenaway et al. (2008). For each industry and year, sunk costs are deemed to be the minimum of either the entry or exit rate. In steady-state equilibrium, entry and exit rates should be equal. Entry and exit rates should vary with sunk costs. An increase in sunk costs would mean that the entry rate should fall, in equilibrium. However, to focus solely on entry rates could be misleading as an industry characterized by high sunk costs could experience a high entry rate due to high expected profits. By using the minimum of entry or exit, we circumvent this problem.

Summary statistics for the industry-level variables are provided in Table 5. Intra-industry trade accounts for approximately half of all trade over the sample. Sunk costs have an average value of 1 percent, that is, the average of the minimum of the entry and exit rates in an industry is 1 percent of the total number of operating plants. The share of low-wage imports accounts for a third of Japanese imports.

Table 5: Industry Variables

Variable	Obs	Mean	Std. Dev	Min	Max
Grubel-Lloyd Index	157273	.50	.26	.01	1.00
Trade that is Intra-Industry					
Sunk Costs	169590	.01	.01	0	.05
Minimum of entry and exit rate					
Import Penetration	131669	.09	.09	.00	.67
Imports divided by apparent consumption					
LWPEN	131669	.03	.05	.00	.28
Low wage imports					
OTHPEN	131669	.06	.06	.00	.55
Imports from all other countries					

2.4. Plant Features

2.4.1. Multinational Enterprises

Using the information on foreign direct investment we construct a multinational enterprise (MNE) dummy. A firm is assumed to be a multinational where the outward loans and investment variable has a positive value. Recently the international trade literature has found multinational owned plants differ from purely domestic ones. Japanese plants appear to conform to many of the findings reported elsewhere in the literature. For example, in Table 6 we observe MNE owned plants (where MNEs are deemed to include domestic- and foreign-owned multinational plants) to be larger, more capital intensive, more productive, have higher sales, pay higher wages and use more intermediate inputs when compared with plants which are non-MNE owned.

Table 6: Differences between MNE and non-MNE Owned Plants

	Ownership	
Variable	MNE	non-MNE
Observations	53328	116262
Plant Size Number of Employees	415	138
Capital per Worker Millions of Japanese yen	25.73	13.07
Plant Sales Millions of Japanese yen	25782	4689
Plant TFP Total Factor Productivity	1.03	.93
Plant Wage Rate Millions of Japanese yen	5.57	4.51
Intermediate Inputs Intermediate Inputs divided by Plant Sales	15259	2728

Simple T-tests reveal that non-MNE owned plants are significantly smaller, less capital intensive and have lower TFP and wages than MNE owned plants[7]. Exit rates are significantly higher among non-MNE owned plants although the difference between the

[7] T-tests are computed by subtracting the mean of group *j* from the mean value of group *i* to find the difference. A t-test is then run where the null hypothesis is that the differences between the means are zero.

mean exit rate of MNE and non-MNE plants is small[8]. These results are shown in Table 7.

Table 7: T-tests on the differences between MNE and non-MNE Owned Plants	
Variable	Difference
Exit Rate	.00**
Size	-.72***
Capital Intensity	-.68***
TFP	-.10***
Wages	-1.07***

The richness of the dataset also permits investigation of how, within firms, exiting MNE plants differ from those which continue. In Table 8 it is shown that, within firms, MNE exiting plants are significantly smaller, less capital intensive and pay higher wages when compared with plants which continue in the same firm. When compared to continuing plants in the same firm, exiting plants do not appear to have significantly different productivity.

[8] When we compare the differences between the plant-level variables across MNE and non-MNE exiting plants, these features remain.

Table 8: Within MNE T-tests

Variable	Difference
Size	.79***
Capital Intensity	.20***
TFP	.02
Wages	-.61***

2.4.2. Foreign Ownership

As with MNEs, the role of foreign ownership in determining plant exit has been much discussed with Mata and Portugal (2004), Bernard and Sjöholm (2003) and Girma and Görg (2004) all touching on the subject. Foreign firms may be more footloose relative to domestic firms since they can relocate production across countries. However, it is possible that they may be less likely to close plants because they have incurred sunk costs to operating abroad which leads to entrenchment and a reduction in the probability of plant exit. As in the previous section, we use T-tests to examine whether there are significant differences in exit rates and the plant-level variables between domestic and foreign owned plants.

In Table 9 we report results of t-tests that deal with differences between domestic and foreign owned plants. “Domestic plants” refer to all Japanese plants, that is, irrespective of whether they belong to a multinational or not. The same is true of foreign owned plants. We find that foreign plants are significantly larger, more capital intensive, productive and pay significantly higher wages than domestic plants. These results accord with what many other authors, such as Bernard and Sjöholm (2003), have found. The wage premium paid by foreign plants may be a means of incentivizing workers if foreign plants are more likely to exit

Table 9: T-tests on the differences between Domestic and Foreign Owned Plants

Variable	Difference
Exit Rate	.00***
Size	-.58***
Capital Intensity	-.73***
TFP	-.16***
Wages	-1.44***

3 Empirical Model and Results of plant shutdowns

In the previous section we observed that plants which exit have, on average, different attributes compared with continuing firms. Multinational and foreign owned plants also appeared to differ from domestically owned plants. In this section we investigate how the plant-, firm- and industry-level variables affect the probability of plant exit. We address several hypotheses which include whether ownership, export orientation, and MNE concentration affect plant exit. Regressions are also conducted to see how plant characteristics within firms affect exit.

The focus of the research is purely upon the determinants of plant exit, that is, shutdown. We do not have information on switching or M&A activity. Hence, we use a probit estimator of the form

$$\Pr\left(y = 1 \mid x\right) = \frac{\Psi\left(x\beta\right)}{1 + \Psi\left(x\beta\right)}$$

where $\Psi(.)$ denotes the cumulative normal distribution.

3.1. Plant, Firm and Industry Characteristics

We begin by looking at how the plant, firm and industry variables affect plant exit. The first model includes import penetration rather than disaggregating it into the LWPEN and OTHPEN components. The results are reported in Table 10[9].

From the regression in this specification, we find that plants which exit are more likely to be small, have low productivity relative to the industry mean, and have lower capital intensity. A one standard deviation increase in plant size reduces exit by 0.06 percentage points while the effect is a 0.008 and 0.04 percentage point fall in exit likelihood when plant capital intensity and TFP increase by the same amount. High wage plants are more likely to exit: a one standard deviation increase raises exit by 0.14 percentage points.

Dunne et al. (1989), Görg and Strobl (2003), Mata and Portugal (2004) and Bernard

[9] The reported results are from a probit estimator. We also estimated for the same regressions by a logit model and the results are quite similar to those obtained from probit estimations.

and Sjoholm (2003) also find the probability of exit to be decreasing in plant size. Bernard and Jensen (2007) observe that surviving plants are larger, more productive than the average plant and are more capital intensive. Bernard and Jensen (2007) also find that exiting plants pay significantly lower wages than survivors. This is in contrast to our findings for Japan.

We split the sample into single- and multi-plant firms and run the regressions again to see whether the probability of exit differs according to whether the plant is part of a multi-plant firm or not[10]. The results show that high wage plants are more likely to exit, regardless of whether the firm is a single-plant or multi-plant business. In addition, it does not matter whether we split the sample according to whether firms are multinationals or not, higher wage plants have a greater probability of exit. However, high wage plants are more likely to exit if they are part of a multi-plant (0.018 versus 0.005) or multinational firm (0.019 versus 0.006). It could be that we are observing the influence of off shoring, but the positive sign on wages among single-plant and non-MNE plants may be due to the effect of import competition or the declining competitiveness of such establishments in the export market. While plants are more likely to exit if they are high wage and belong to a multinational, the t-tests in Table 8 showed that within multinational firms, exiting plants had significantly lower wages than continuing plants.

The firm-level exporter and importer dummies are found to significantly increase the probability of plant exit. A one standard deviation increase causes a 0.02 percentage

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[10] Results are not reported here.

point increase in exit for both variables. This goes against what other scholars have found. For example, Bernard and Jensen (2007) find that even after controlling for plant size, productivity, factor intensity and ownership structure, export status reduces the probability of exit by 15%. Compared with non-exporters, and conditional on plant variables, they find exporting firms are 6.8 percentage points less likely to close. However, as we shall see in later regressions, the exporter and importer dummies are capturing the influence of MNE status.

Theoretically, it could be the case that multi-plant firms could increase the probability of exit of their plants by relocating production to another subsidiary plant. Equally, headquarter services, finance and the industry experience of other establishments within the group may ameliorate the chance of exit for a plant belonging to a multi-plant firm. While we find a one standard deviation increase in the multi-plant variable leads to a 0.10 percentage point increase in exit, the results from other studies often depend on the country under inspection. After controlling for plant features, Bernard and Jensen (2007) find that there is no difference in the likelihood of exit for plants owned by a multi-plant firm in the United States. On the other hand, Mata and Portugal (2004), and Bandick (2007) find the contrary.

Table 10: Plant, Firm and Industry Determinants of Exit

	Specification 1	2	3
Plant-level Variables			
Size	-.058***	-.058***	-.057***
	(-23.22)	(-23.03)	(-23.21)
Capital Intensity	-.008***	-.008***	-.008***
	(-5.90)	(-5.81)	(-5.75)
TFP	-.041***	-.041***	-.040***
	(-4.65)	(-4.63)	(-4.57)
Wages	.144***	.145***	.146***
	(8.82)	(8.83)	(8.91)
Firm-level Variables			
Export Dummy	.021**	.026***	
	(2.47)	(4.08)	
Import Dummy	.017**		.022***
	(2.15)		(3.78)
Multi Plant Dummy	.100***	.101***	.101***
	(16.19)	(16.34)	(16.62)
R&D Intensity	.002***	.002***	.003***
	(2.70)	(2.82)	(3.18)
Industry-level Variables			
Grubel-Lloyd Index	.012	.013	.012
	(.27)	(.28)	(.26)
Import Penetration	-.137	-.136	-.132
	(-1.51)	(-1.51)	(-1.46)
Sunk Costs	-.001*	-.001*	-.001*
	(-1.80)	(-1.80)	(-1.80)
Industry Dummies	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes
Number of Observations	78315	78315	78315
Pseudo R^2	.14	.13	.13

Standardised coefficients.
z-statistics reported in parentheses
***, ** and * indicate significance at at least the 1 percent, 5 percent and 10 percent levels

Firm R&D intensity is found to positively affect plant exit, a finding which runs contrary to other results reported in the literature (Perez at al., 2004). However, the effect is conditional on plant-level variables. When these are excluded, plants belonging to firms with high R&D intensities are less likely to exit, although the standardized coefficient is small.

The Grubel-Lloyd index of intra-industry trade and import penetration are both found to be insignificant. However, industry sunk costs have a negative effect on plant exit. This arises because in industries with high sunk costs potential entrants must draw a high productivity so that they may profitably produce (Melitz, 2003). Consequently there are fewer successful entrants and competition for market share is diminished. The reduction in competition means that incumbent firms face a lower chance of exit. Greenaway et al. (2008) find industry sunk costs to be negatively related with plant exit among Swedish manufacturers (using the same measure of sunk costs). Using an industry entry cost measure, Bernard and Jensen (2007) find higher industry sunk costs reduce exit.

The magnitude of the marginal effects is small. This is in part due to the low exit rate in the sample (2% of firms). Despite this, the marginal effects for closedown reported by Greenaway et al. (2008) are similar in magnitude. In this context, the relative size of each variable becomes important. For example, being a large plant is a more effective means of survival than being capital intensive. Multi-plant ownership and high plant wages have the same effect upon exit. Plant- and firm-level variables are considerably more important in the determination of exit than are industry variables.

3.2. Disaggregating Import Penetration

Previously we saw that industry import penetration did not have a significant effect on plant exit. A potential explanation could be that by aggregating together low-wage and all other country imports, we were obscuring the effect that each component has on exit. Low-wage country imports may increase the likelihood of exit since these are goods which tend to be labor intensive and have a competitive advantage when competing with the same type of (higher wage) products produced in Japan. In contrast, OTHPEN may represent goods which are complementary to the production process and hence reduce the chance of exit.

Disaggregating import penetration into LWPEN and OTHPEN does little to affect the other variables. All variables remain signed as in Table 10 and they are still significant. Imports from low-wage countries are not found to significantly affect exit, nor does import competition from all other countries. It could be that exit is non-linear in import competition. Imports would then only have an impact on plant survival once they have captured a significant market share. Across all industries and years, imports from low-wage countries have a market share of just 3 percent while the figure for OTHPEN is 8 percent. Although there are some instances where the import penetration measures account for half of production, the statistics suggest that the fairly low level of competition from abroad is the reason why Japanese manufacturers are less susceptible to import competition compared with the United States (Bernard et al., 2007).

Table 11: Disaggregating Import Penetration

	Specification 1	2	3
Plant-level Variables			
Size	-.057***	-.057***	-.057***
	(-23.30)	(-23.31)	(-23.27)
Capital Intensity	-.008***	-.008***	-.008***
	(-5.90)	(-5.90)	(-5.91)
TFP	-.041***	-.041***	-.041***
	(-4.67)	(-4.67)	(-4.67)
Wages	.144***	.143***	.144***
	(8.81)	(8.79)	(8.83)
Firm-level Variables			
Export Dummy	.020**	.020**	.021**
	(2.45)	(2.43)	(2.46)
Import Dummy	.017**	.017**	.016**
	(2.21)	(2.14)	(2.13)
Multi Plant Dummy	.100***	.100***	.100***
	(16.21)	(16.21)	(16.22)
R&D Intensity	.002***	.002***	.002***
	(2.71)	(2.71)	(2.70)
Industry-level Variables			
Grubel-Lloyd Index	.005	.002	.009
	(.12)	(.04)	(.20)
LWPEN	.022	.009	
	(.87)	(.37)	
OTHPEN	-.123		-.095
	(-1.61)		(-1.32)
Sunk Costs	-.001*	-.001*	-.001*
	(-1.84)	(-1.85)	(-1.83)
Industry Dummies	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes
Number of Observations	78315	78315	78315
Pseudo R^2	.14	.13	.13

Standardised coefficients.
z-statistics reported in parentheses
***, ** and * indicate significance at at least the 1 percent, 5 percent and 10 percent levels

3.3. Foreign Ownership

The issue of ownership often been raised as a potential cause of plant and firm exit. The issue is important since exit and the loss of jobs impacts upon welfare. Foreign, or multinational, owned plants may be less integrated in the local domestic economy (because of their vertical or horizontal linkages) so may be more likely to exit when business conditions deteriorate (Flamm, 1984). They are not as familiar with the domestic market and its modus operandi as domestic firms are which results in foreign firms incurring greater sunk costs when entering a new market. Negative shocks may then have less of an impact on the exit decision since the large costs of entry provide an incentive to remain active and recoup as much of the fixed costs as possible. Girma and Görg (2004), Taymaz and Ozler (2007) and Bernard and Sjöholm (2003) all address whether foreign ownership affects establishment survival and growth, while Mata and Portugal (2004) look at whether new domestic and foreign owned firms differ in their chances of survival. We investigate whether foreign ownership, as well as multinational ownership, affects exit in Japan.

Multinational ownership has also been the centre of empirical and theoretical work. On the empirical side, Alvarez and Görg (2005) look at whether Chilean multinational owned plants are more likely to exit relative to domestic plants while Görg and Strobl (2002) examine whether multinationals are more "footloose" than domestic firms in Irish manufacturing industries. Theoretically, it is difficult to conclusively state whether multinationals are more or less likely to shut down plants. While it is conceivable that multinationals could rapidly relocate production across borders, they may not do so given the large sunk costs they bear from setting up a new plant. The direction of causality could go either way depending on the nature of foreign direct investment (FDI). If FDI is horizontal (as in Helpman, Melitz and Yeaple, 2004), then multinationals may be less likely to close plants since they serve a target market and have been revealed as preferred to exporting. Instead, it may be vertically integrated firms that are more likely to close plants since they have explicitly set up operations abroad which are essential to the final production of a good. They may then be more sensitive to changes in a plant’s costs of production.

Our dataset permits investigation of the role of foreign ownership and its effects on plant exit. We also explore whether multinational enterprises are more, or less, likely to close down plants. To investigate these issues, we re-run the regressions used previously, but now include dummy variables for foreign and multinational ownership. Foreign ownership is defined as where a foreign firm holds in excess of 50 percent of the Japanese firm’s share capital. If this is the case the foreign ownership dummy takes a value of 1 and zero otherwise. The effect of foreign ownership could be either positive or negative. Foreign firms are able to relocate production across plants in different countries and are more footloose. Conversely, foreign firms which come to Japan must wish to produce for the Japanese market. It is unlikely they would use Japan for export platform FDI. The foreign firms which do locate in Japan would then be more likely to remain and keep their plants open.

We define a multinational firm as being one which engages in foreign direct investment (FDI), through investment and outward loans. If the value of FDI is greater than zero, the MNE dummy takes a value of 1 and zero otherwise. Using this, and the foreign ownership variable, we construct dummies for domestic and foreign owned multinationals. If the firm invests in FDI and is foreign owned, then it is deemed to be a foreign multinational. Throughout the sample we have 623 observations of plants owned by a foreign firm and 53,328 instances of plants being owned by a multinational. Of the latter, there are only 74 observations where a plant is part of a foreign MNE. These figures reconcile with anecdotal evidence of low levels of FDI into Japan.

The first column of Table 12 shows the results of the regression when we include the foreign ownership dummy in the original model. The plant, firm and industry variables remain identically signed and significant at the same levels as in Table 10. Foreign ownership is found to be insignificant. This implies that plants with foreign owners are not footloose and adds weight to the hypothesis that the sunk costs of entering a foreign market provide an incentive to remain in the face of negative shocks.

Table 12: Ownership and Plant Exit

	Specification 1	2	3	4
Plant-level Variables				
Size	-.057***	-.060***	-.057***	-.060***
	(-23.32)	(-24.21)	(-23.32)	(-24.22)
Capital Intensity	-.008***	-.009***	-.008***	-.009***
	(-5.93)	(-6.73)	(-5.91)	(-6.73)
TFP	-.041***	-.043***	-.041***	-.043***
	(-4.70)	(-4.86)	(-4.67)	(-4.87)
Wages	.143***	.139***	.144***	.139***
	(8.76)	(8.58)	(8.80)	(8.58)
Firm-level Variables				
Export Dummy	.020**	-.000	.020**	-.000
	(2.44)	(-.04)	(2.44)	(-.04)
Import Dummy	.016**	.005	.016**	.005
	(2.04)	(.57)	(2.10)	(.57)
Multi Plant Dummy	.101***	.090***	.101***	.090***
	(16.25)	(14.09)	(16.21)	(14.07)
R&D Intensity	.002***	.002**	.002***	.002**
	(2.72)	(2.07)	(2.69)	(2.06)
Ownership Variables				
Foreign Owner Dummy	.125*			
	(1.88)			
MNE Dummy		.063***		
		(8.06)		
Foreign MNE Dummy			.127	
			(.86)	
Domestic MNE Dummy				.064***
				(8.10)
Industry-level Variables				
Grubel-Lloyd Index	.003	.002	.004	.002
	(.07)	(.04)	(.08)	(.05)
LWPEN	.022	.022	.022	.022
	(.87)	(.84)	(.87)	(.84)
OTHPEN	-.124	-.126	-.124	-.126
	(-1.61)	(-1.62)	(-1.61)	(-1.61)
Sunk Costs	-.001*	-.001*	-.001*	-.001*
	(-1.84)	(-1.81)	(-1.83)	(-1.80)
Industry Dummies	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
Number of Observations	78315	78315	78315	78315
Pseudo R^2	.14	.14	.14	.14

Standardised coefficients.
z-statistics reported in parentheses
***, ** and * indicate significance at at least the 1 percent, 5 percent and 10 percent levels

We find that a one standard deviation increase in the foreign ownership dummy raises the plant exit rate by 0.125 percentage points, although the effect is only significant at the 10 percent threshold. We shall see in later regressions that the role of foreign ownership is conditional upon the plant-level variables.

Our findings for foreign ownership differ from what has been found in some other studies. Mata and Portugal (2004) find that once firm characteristics are controlled for, being foreign does not reduce the chances of exit in Portugal. Taymaz and Ozler (2007) find that domestic firms have the same survival probability as foreign firms in Turkish manufacturing industries once establishment characteristics are controlled for (as we have done through the inclusion of the plant-level variables). Using data on Chilean manufacturing plants, Alvarez and Görg (2009) find that foreign ownership only has a positive effect upon plant exit during a significant downturn (the recession in the late 1990s in Chile). On average, they find that foreign ownership does not have a significant impact upon plant exit.

However, Bernard and Sjohölm (2003) find, for Indonesia, that once the greater size and labor productivity of foreign plants are controlled for, foreign plants are more likely to exit. Even when a battery of other variables (such as inputs per employee) is added to the specification, foreign firms remain 22 to 31 percent more likely to fail than comparable domestic establishments.

In the specifications of Table 12 we investigate whether multinationals are more likely to shut down plants. The MNE dummy enters significantly with a one standard deviation increase raising exit by 0.063 percentage points. That is, if the exit rate was initially 2 percent, such a change would raise it to 2.063 percent. Our finding indicates that, in Japan, multinationals are more likely to close plants, even when we condition on a raft of plant, firm and industry characteristics. Indeed, when we split the MNE dummy into foreign and domestically owned multinationals, we do not find a significant effect of foreign multinational ownership on plant exit. Rather, it is domestic MNEs which are more likely to shut down plants with a one standard deviation increase in the domestic MNE dummy causing 0.064 percentage points more exit.

The results are indicative of foreign MNEs setting up in Japan so they can access the domestic market. A confounding reason could be that the rules and regulations laid down by the Japanese government on the production of pharmaceutical products could be driving the results[11]. However, the results remain robust to the exclusion of the pharmaceutical industry from the regression.

Domestic multinationals are significantly more likely to close their Japanese plants. A potential explanation could be that we are observing off shoring. We shall return to this hypothesis in a later section when we look at the characteristics of the plants which multinational-, and domestic-multi-plant, firms shut down.

It has been common throughout the literature to look at the unconditional probability of exit. That is, are plants more likely to survive, or die, if they belong to a certain type of firm, regardless of their plant characteristics? We employ two methods to address this question. We first calculate the probability of exit, depending on ownership type while holding the plant variables at their means. The figures in Table 13 show that, for the average plant, which is foreign owned, the probability of exit is 0.0186. Plants

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[11] In order that a company can sell pharmaceutical goods in Japan, it must produce the drugs within Japan. Foreign firms must then set up production sites in Japan and cannot relocate their operations unless they wish to exit the Japanese market entirely.

with multinational owners are relatively more likely to exit than foreign owned plants with a probability of 0.024. However, since the majority of multinationals in the sample are Japanese, it is these that drive the result. Domestic multinationals' plants face an exit likelihood of 0.024 while for foreign-owned multinational plants the value is lower at 0.014.

The results in Table 13 highlight that once we control for plant characteristics, domestic multinationals are more likely to close down their plants than foreign multinationals or foreign owners. However, we are unable to say whether a specific form of ownership significantly affects exit. To address this we drop the plant-level variables and run the probit regressions including the ownership dummies. We can then assess the determinants of exit without conditioning on plant characteristics. Results are reported in Table 14.

Table 13: Plant Exit Probability and Ownership

Ownership Type		
Foreign Owner	**Probability**	**95% Conf. Interval**
Pr(Exit=1|x)	.0186	[0.0100 , 0.0272]
Pr(Exit=0|x)	.9814	[0.9728 , 0.9900]
Multinational Owner		
Pr(Exit=1|x)	.0240	[0.0100 , 0.0272]
Pr(Exit=0|x)	.9760	[0.9728 , 0.9900]
Foreign Multinational Owner		
Pr(Exit=1|x)	.0140	[0.0038 , 0.0242]
Pr(Exit=0|x)	.9860	[0.9758 , 0.9962]
Domestic Multinational Owner		
Pr(Exit=1|x)	.0240	[0.0213 , 0.0267]
Pr(Exit=0|x)	.9760	[0.9733 , 0.9787]

When we omit the plant-level variables, we observe that multi-plant and domestic MNE firms are more likely to close down their plants, regardless of the characteristics of their plants. The multi-plant dummy remains positive and significant with a beta coefficient of 0.091. Unlike in previous regressions, R&D intensity is now negatively signed which aligns with Perez et al.'s (2004) findings for Spain which shows firms engaged in R&D to be 57% less likely to fail. Our results point towards R&D playing a role in attaining, or maintaining, a plant's competitive edge. Of the ownership variables, only the domestic multinational dummy has a significant influence on plant survival. Foreign ownership and the foreign MNE dummy are both found to be insignificant.

Table 14: Unconditional Regressions of Ownership on Plant Exit

	Specification			
	1	2	3	4
Firm-level Variables				
Export Dummy	.005	.000	.005	.001
	(.70)	(.03)	(.72)	(.06)
Import Dummy	.002	-.000	.003	.000
	(.38)	(-.01)	(.43)	(.02)
Multi Plant Dummy	.091***	.090***	.090***	.090***
	(16.77)	(15.71)	(16.74)	(15.76)
R&D Intensity	-.001**	-.002***	-.002**	-.002***
	(-2.46)	(-2.77)	(-2.46)	(-2.74)
Ownership Variables				
Foreign Owner Dummy	.082			
	(1.51)			
MNE Dummy		.014**		
		(2.19)		
Foreign MNE Dummy			.046	
			(.41)	
Domestic MNE Dummy				.014**
				(2.10)
Industry-level Variables				
Grubel-Lloyd Index	-.006	-.007	-.005	-.006
	(-.15)	(-.16)	(-.13)	(-.15)
LWPEN	.023	.023	.023	.023
	(1.10)	(1.10)	(1.11)	(1.10)
OTHPEN	-.108	-.108	-.108	-.108
	(-1.56)	(-1.56)	(-1.56)	(-1.55)
Sunk Costs	-.001	-.001	-.001	-.001
	(-1.56)	(-1.55)	(-1.55)	(-1.55)
Industry Dummies	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
Number of Observations	78315	78315	78315	78315
Pseudo R^2	.06	.06	.06	.06

Standardised coefficients.
z-statistics reported in parentheses
***, ** and * indicate significance at at least the 1 percent, 5 percent and 10 percent levels

3.4. Firm's Export Orientation

Firms which engage in international trade are perceived to have traits that enable them to overcome the fixed costs associated with entering a foreign market. Bernard and Jensen (1995) established that exporting firms in the United States tended to be larger, more productive and more capital intensive than non-exporters (further evidence is surveyed in Greenaway and Kneller 2007). In light of these insights we incorporate export status into our regressions since firms which export have ‘better’ characteristics and may be less likely to close down their plants. We also consider whether plants belonging to firms that import are less likely to exit. One could imagine that, like exporting, importing carries sunk costs since a company must make contact with a supplier abroad, then arrange for the possible customization and transportation of goods. Importing firms would then be required to have higher productivity, or superior characteristics, than a domestic firm that does not import.

Given the data available, we are restricted to looking at importing and exporting at the firm level. We then construct four dummy variables: two-way trader, which takes a value of 1 if the firm imports and exports, and zero otherwise, export only, which takes a value of 1 if the firm only exports, import only, which is equal to 1 if the firm only imports and domestic only which has a value of 1 if the firm neither imports nor exports. Depending on the type of international trade a firm engages in, its plants are also assumed to be of that type. We have 44,070 observations of two-way traders, 21580 of plants which only export, 10,317 for plants that only import and 96,956 observations of plants which do not trade internationally.

The results in Table 15 show that two-way traders, exporting only and importing only plants are no less likely to exit than plants which exclusively serve the domestic market. The plant and firm variables remain the most powerful determinants of exit. Plants which belong to a multinational, or foreign, owned firm are more likely to exit but importers or exporters see no difference in exit rates among their plants. The effect of the firm being an importer, exporter or two-way trader, does not impact on exit above the effect of ownership.

Table 15: Firm Export Status and Plant Exit

	Specification				
	1	2	3	4	5
Plant-level Variables					
Size	-.060***	-.060***	-.060***	-.060***	-.060***
	(-24.26)	(-24.26)	(-24.27)	(-24.20)	(-24.21)
Capital Intensity	-.009***	-.009***	-.009***	-.009***	-.009***
	(-6.79)	(-6.81)	(-6.75)	(-6.77)	(-6.74)
TFP	-.043***	-.043***	-.043***	-.043***	-.043***
	(-4.88)	(-4.91)	(-4.87)	(-4.89)	(-4.87)
Wages	.138***	.138***	.139***	.138***	.139***
	(8.54)	(8.52)	(8.55)	(8.53)	(8.53)
Export Status					
Two-way Trader	.003	.008			
	(.34)	(.99)			
Exporter Only	-.010		-.010		
	(-.77)		(-.98)		
Importer Only	-.020			-.019	
	(-.81)			(-.85)	
Domestic					.003
					(.40)
Firm-level Variables					
Foreign Owner Dummy	.160**	.158**	.160**	.163**	.165**
	(2.23)	(2.20)	(2.26)	(2.31)	(2.33)
MNE Dummy	.064***	.060***	.057***	.057***	.063***
	(8.15)	(8.08)	(9.44)	(9.37)	(8.82)
Multi Plant Dummy	.090***	.090***	.090***	.090***	.091***
	(14.09)	(14.10)	(14.18)	(14.14)	(14.15)
R&D Intensity	.002**	.002**	.002**	.002**	.002**
	(2.09)	(2.00)	(2.19)	(2.12)	(2.18)
Industry-level Variables					
Grubel-Lloyd Index	-.001	-.001	-.001	-.001	-.001
	(-.02)	(-.02)	(-.03)	(-.02)	(-.03)
LWPEN	.022	.021	.022	.022	.022
	(.83)	(.82)	(.84)	(.84)	(.85)
OTHPEN	-.128	-.127	-.127	-.129	-.128
	(-1.63)	(-1.63)	(-1.62)	(-1.64)	(-1.63)
Sunk Costs	-.001*	-.001*	-.001*	-.001*	-.001*
	(-1.82)	(-1.81)	(-1.81)	(-1.81)	(-1.81)
Industry Dummies	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes
Number of Observations	78315	78315	78315	78315	78315
Pseudo R^2	.14	.14	.14	.14	.14

Standardised coefficients
z-statistics reported in parentheses
***, ** and * indicate significance at at least the 1 percent, 5 percent and 10 percent levels

3.5. MNE concentration within the industry

The concentration of MNEs within the sector a plant operates in may be a potential cause of exit. We have observed that multinational plants are, on average, large, more capital intensive and more productive than domestic plants. They are also backed by a firm infrastructure which may open new markets and opportunities. Single plant firms and other non-MNE plants may struggle to survive when confronted by such competition. To investigate this we include MNE concentration in our regressions using the following measure

$$MNE\_Concentration_{it} = \log\left(\frac{Total\_MNE\_Employees_{it}}{Total\_Employees_{it}}\right)$$

where $MNE\_Concentration_{it}$ is the concentration of MNEs in industry i at time t, $Total\_MNE\_Employees_{it}$ denotes the total number of workers employed by multinationals in industry i at time t and $Total\_Employees_{it}$ denotes the total number of people employed in industry i at time t.

Table 16: Multinational Concentration within the Industry

	Specification 1	2	3	4
Plant-level Variables				
Size	-.060***	-.060***	-.060***	-.060***
	(-24.22)	(-24.22)	(-24.21)	(-24.22)
Capital Intensity	-.009***	-.009***	-.009***	-.009***
	(-6.75)	(-6.73)	(-6.73)	(-6.73)
TFP	-.043***	-.043***	-.043***	-.043***
	(-4.86)	(-4.87)	(-4.86)	(-4.87)
Wages	.139***	.139***	.139***	.139***
	(8.58)	(8.58)	(8.57)	(8.59)
Firm-level Variables				
Export	-.000	-.000	-.000	-.000
	(-.05)	(-.04)	(-.04)	(-.04)
Import	.005	.005	.005	.005
	(.57)	(.57)	(.57)	(.57)
MNE Dummy	.063***	.063***	.063***	.063***
	(8.09)	(8.06)	(8.06)	(8.07)
Multi Plant Dummy	.090***	.090***	.090***	.090***
	(14.09)	(14.09)	(14.09)	(14.08)
R&D Intensity	.002**	.002**	.002**	.002**
	(2.07)	(2.07)	(2.07)	(2.07)
Multinational Concentration				
MNE Concentration	-.117			
	(-.64)			
Domestic MNE Concentration		.005	.003	
		(.03)	(.02)	
Foreign MNE Concentration		.000		.000
		(.92)		(.92)
Industry-level Variables				
Grubel-Lloyd Index	.006	.003	.002	.004
	(.15)	(.08)	(.04)	(.08)
LWPEN	.023	.023	.022	.024
	(.89)	(.92)	(.84)	(.91)
OTHPEN	-.133*	-.124	-.127	-.123
	(-1.67)	(-1.55)	(-1.59)	(-1.58)
Sunk Costs	-.001*	-.001*	-.001*	-.001*
	(-1.84)	(-1.82)	(-1.81)	(-1.82)
Industry Dummies	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
Number of Observations	78315	78315	78315	78315
Pseudo R^2	.14	.14	.14	.14

Standardised coefficients computed at mean values.
z-statistics reported in parentheses
***, ** and * indicate significance at at least the 1 percent, 5 percent and 10 percent levels

The inclusion of the MNE concentration measures in Table 14 does little to change the plant, firm and industry variables. We use various measures of MNE concentration to see whether domestic or foreign multinational concentration affects plant exit. All measures of multinational concentration are found to be insignificant. The results point towards MNE ownership, and specifically domestic MNE ownership, rather than the influence of MNEs within the industry being responsible for plant exit. Non-multinational plants are no more likely to exit when there is an increase in the concentration of multinationals within the sector they operate.

3.6. Plant Characteristics Relative to the Firm Average

Our dataset matches plant-level information to firm-level data. This allows us to look within the firm and compare the features of the plants which exit with those that the firm maintains operational. Specifically, we restrict the sample to multi-plant firms. We then look at how the plant variables relative to the firm variables differ between multi-plant MNE and non-MNE firms. Since the plant TFP variable is measured relative to the sector in which it operates, and firms may have plants in different sectors, we drop plant TFP from the regressions. The results are reported in Table 17.

Plants that are large relative to the rest of the firm are less likely to exit. The effect is more pronounced for non-multinational plants. A one standard deviation increase in the size ratio reduces the likelihood of exit by 0.44 and 0.61 percentage points for MNE and non-MNE owned plants. In the earlier regressions, plant capital intensity was found to be a negative determinant of exit. Within multi-plant firms this ceases to be the case. Relatively more capital intensive plants are less likely to exit, regardless of multinational status. However, MNE plants that are more capital intensive relative to the firm are 0.033 percentage points less likely to exit following a standard deviation increase in the plant-firm capital intensity variable. For non-MNEs the effect is more muted, with a beta coefficient of -0.023.

Previously we had seen that high wage plants were more likely to exit. This remains true, but only among MNE plants. For a one standard deviation increase in wages at MNE owned plants relative to the firm, exit rises by 0.12 percentage points. The same effect is not found among non-MNE multi-plant firms. Plants which pay relatively higher wages in these businesses are no more likely to exit. The reason for the differences may be that MNEs can relocate production to low-wage sites abroad and close their high-wage Japanese plants. Domestic multi-plant firms may relocate workers, or output, between their plants rather than close them.

Table 17: Within Multiplant Firm Exit Regressions

	Firm Type	
	Multinational	Non-Multinational
Plant-level Variables		
$Size^{plant}/Size^{firm}$	-.044***	-.061***
	(-16.53)	(-12.32)
$Cap\ Intensity^{plant}/Cap\ Intensity^{firm}$	-.033***	-.023***
	(8.09)	(6.35)
$Wages^{plant}/Wages^{firm}$	.120***	-.026
	(4.26)	(-1.21)
Firm-level Variables		
Export Dummy	.041	-.051**
	(1.12)	(-2.03)
Import Dummy	-.016	-.003
	(-.80)	(-.13)
R&D Intensity	-.011***	-.000
	(-4.05)	(-.12)
Industry-level Variables		
Grubel-Lloyd Index	.021	.112
	(.18)	(.75)
LWPEN	.044	.074
	(.85)	(1.07)
OTHPEN	-.068	-.781**
	(-.46)	(-2.48)
Sunk Costs	-.002*	.001
	(-1.80)	(.42)
Industry Dummies	Yes	Yes
Time Dummies	Yes	Yes
Number of Observations	28463	19840
Pseudo R^2	.12	.11

Standardised coefficients.
z-statistics reported in parentheses
***, ** and * indicate significance at at least the 1 percent, 5 percent and 10 percent levels

The firm-level variables also reveal that within multi-plant firms, MNE status can have differing impacts on plant exit. Plants belonging to multi-plant MNE firms which engage in R&D are less likely to exit. A standard deviation increase in R&D intensity at the average multi-plant multinational reduces the exit risk by 0.011 percentage points. R&D intensity does not have a significant effect on plants belonging to non-multinational multi-plant firms.

In earlier regressions we found that the exporter dummy was only ever significant when the MNE dummy was excluded. Here we find that among non-MNE multi-plant firms, plant exit is less likely when the firm is an exporter. The result is consistent with other findings in the literature. Since exporting constitutes domestic firm's route to the foreign market, those that export benefit from operating in more markets. They are also likely more productive relative to firms that only serve the domestic market.

High sunk costs help ameliorate the chance of exit only among MNE plants. This suggests that MNE plants are established primarily in sectors with higher barriers to entry, although the effect is only significant at 10 percent. Among domestic multi-plant firms OTHPEN reduces exit. The same is not true for MNE plants which are unaffected by this kind of import penetration. Perhaps this is because domestic plants are more reliant upon imported components while MNE plants can buy components from other MNE plants within the firm which are located abroad.

3.7. Modeling the Industry Dummies with Industry Variables

So far the industry variables have been picking up within industry variation in intra-industry trade, import penetration and sunk costs. We now remove the industry dummies and attempt to model them using industry-level variables. This allows us to look at how cross-industry variation in the industry variables affects them. In addition to the four industry variables used previously, we introduce two more: industry capital intensity and industry material intensity.

Industry capital intensity is defined as

$$Capital\_Intensity_{it} = \log\left(\frac{\sum_{j=1}^{N}\left(Plant\_Capital_{ijt}\right)}{\sum_{j=1}^{N}\left(Plant\_Labour_{ijt}\right)}\right)$$

where $Capital\_Intensity_{it}$ is the capital intensity of industry *i* at time *t* which is calculated by summing the capital of all plants in industry *i* during time *t* divided by the sum of labor in all plants of industry *i* during period *t*.

A measure of industry material (or input) intensity is also included. Material intensity is defined as

$$Material\_Intensity_{it} = \log\left(\frac{\sum_{j=1}^{N}\left(Plant\_Inputs_{ijt}\right)}{\sum_{j=1}^{N}\left(Plant\_Sales_{ijt}\right)}\right)$$

where $Material\_Intensity_{it}$ denotes the input intensity of industry *i* during time *t*, $Plant\_Inputs_{ijt}$ represents plant *j*'s inputs at time *t* in industry *i* and $Plant\_Sales_{ijt}$ denotes plant *j*'s sales at time *t* in industry *i*.

Again we use a probit model and include the plant, firm and all the industry variables. Seven specifications are run. The first includes all the industry variables while the remaining six include the industry variables one at a time. The plant variables remain essentially the same as before:

Unlike previously, we now observe that low-wage import penetration has a positive effect upon exit. This arises from the cross industry variation in LWPEN. The impact is small with a standard deviation increase raising exit by 0.002 percentage points, equivalent to about 0.1 percent of the average exit rate. The variable is also only significant at the 10 percent level when we condition upon the other industry variables. When LWPEN is included as the sole industry variable in column 3 it becomes highly significant, but the estimated coefficient remains small at 0.003. In column 4 we see that across sectors, OTHPEN positively affects exit. Again the effect is due to cross-industry variation. The result without industry dummies may suggest that exit rises due to the switching of plants between industries as international trade increases.

Table 18: Removing the Industry-level Variables

	Specification 1	2	3	4	5	6	7
Plant-level Variables							
Size	-.057***	-.045***	-.057***	-.057***	-.044***	-.045***	-.044***
	(-20.40)	(-19.73)	(-19.74)	(-19.78)	(-19.87)	(-19.85)	(-20.75)
Capital Intensity	-.011***	-.008***	-.011***	-.010***	-.008***	-.008***	-.008***
	(-7.53)	(-7.23)	(-8.29)	(-8.30)	(-7.22)	(-6.37)	(-6.55)
TFP	-.024***	-.017***	-.026***	-.025***	-.017***	-.017***	-.015***
	(-2.35)	(-2.23)	(-2.71)	(-2.68)	(-2.24)	(-2.20)	(-1.80)
Wages	.115***	.083***	.119***	.110***	.082***	.084***	.079***
	(7.16)	(5.51)	(7.59)	(7.24)	(5.49)	(5.56)	(5.38)
Firm-level Variables							
Export Dummy	-.004	.005	-.003	-.005	.004	.004	.004
	(-.48)	(.71)	(-.38)	(-.62)	(.60)	(.64)	(.52)
Import Dummy	.010	.006	.009	.009	.006	.005	.007
	(1.19)	(.83)	(1.02)	(1.10)	(.88)	(.82)	(1.08)
Multi Plant Dummy	.090***	.072***	.089***	.090***	.073***	.072***	.072***
	(13.93)	(14.12)	(14.09)	(14.10)	(14.22)	(14.22)	(14.24)
R&D Intensity	.002***	.001**	.002**	.002*	.001*	.001**	.002**
	(2.69)	(2.08)	(2.35)	(1.90)	(1.94)	(1.99)	(2.58)
Ownership Variables							
Foreign Owner	.145**	.182***	.140**	.136**	.181***	.182***	.191***
	(2.00)	(3.18)	(2.02)	(1.97)	(3.19)	(3.20)	(3.21)
MNE Dummy	.060***	.047***	.062***	.063***	.047***	.047***	.045***
	(7.57)	(7.34)	(7.79)	(8.05)	(7.40)	(7.31)	(6.91)
Industry-level Variables							
Grubel-Lloyd Index	-.001	.002					
	(-.22)	(-.85)					
LWPEN	.002*		.003***				
	(1.82)		(3.80)				
OTHPEN	.002			.005***			
	(1.09)			(3.02)			
Sunk Costs	.000				.001		
	(.21)				(.43)		
Industry Capital Intensity	.002					-.006	
	(.41)					(-1.56)	
Industry Material Intensity	.225***						.211***
	(3.63)						(4.68)
Industry Dummies	No	No	No	No	No	No	No
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	78315	78315	78315	78315	78315	78315	78315
Pseudo R^2	.12	.10	.12	.12	.10	.10	.10

Standardised coefficients.
z-statistics reported in parentheses
***, ** and * indicate significance at at least the 1 percent, 5 percent and 10 percent levels

Sunk costs and industry capital intensity are found to be insignificant in Table 16. Each constitutes a measure of the barriers to entry firms face. When industry dummies were included sunk costs exerted a negative and significant influence upon plant exit. It appears that sunk costs matter but that they are industry specific. For a one percent increase in industry material intensity exit increases 0.011 percent. Material intensity is taken to be a proxy for industry profitability. Where more inputs are required in the production process, the profits firms can make are reduced. The positive coefficient implies that industries with low profitability see more plants exiting. If we include the industry dummies, industry material intensity ceases to be significant meaning that the effect is a cross-, rather than, within-industry result.

4. Productivity Decompositions

So far the analysis has centered upon the determinants of plant exit. We have established how plant-, firm- and industry-variables affect plant exit. The next step is to investigate whether plant exit has an effect upon Japanese productivity growth in the recent years. We specifically ask whether multinational plant exit affects productivity differently to non-MNE plant exit.

Japanese productivity growth has been notoriously slow in the 1990s. In our sample we estimate productivity growth across the 51 industries to be 6 percent over the years 1994-2005. A potential explanation of the sluggish productivity growth could be that firms are off shoring the most productive plants to China and other low-wage East Asian countries.

To tackle the issue we decompose productivity into four components: within firm productivity growth, between firm reallocations of market share, entry of new plants and the exit of existing ones using a modification of the Griliches and Regev (1995) approach. We amend the Griliches and Regev methodology to split the exit component into MNE and non-MNE parts. The MNE component includes domestic, and foreign, multinationals. We subsequently decompose the MNE exit component into domestic and foreign shares. This permits inspection of whether multinationals have been off shoring their most productive Japanese plants.

Productivity is decomposed using the following method

$$\Delta P_t = \sum_{within} \bar{\theta}_i \Delta p_{it} + \sum_{between} \Delta\theta_{it}\left(\bar{p}_i - \bar{P}\right) + \sum_{enrty} \theta_{it}\left(p_{it} - \bar{P}\right) - \sum_{MNE\_exit} \theta_{it-k}\left(p_{it-k} - \bar{P}\right)$$
$$- \sum_{non\_MNE\_exit} \theta_{it-k}\left(p_{it-k} - \bar{P}\right)$$

where Δ denotes changes over k years interval between the first year (t-k) and the last year t, θ_{it} is plant i's market share in the given industry at time t, p_i is the productivity of plant i, P is aggregated productivity of the industry and a bar denotes averaging between (t-k) and t.

The within component represents productivity growth within plants, the between component constitutes the reallocation of market share across plants in the industry and the entry component denotes the productivity effect of new plants in the industry. The exit component is split in two so that we may disentangle the impact of MNE and non-MNE plant exit on aggregate productivity. Results of the decomposition are reported in Table 19.

Table 19: Griliches and Regev (1995) Productivity Decomposition		
Productivity Component	Obs	Mean
Within Plant	143725	.14
Between Plant	143725	.82
Entry	143725	.01
MNE Plant Exit	143725	.01
Non-MNE Plant Exit	143725	.01

The bulk of productivity growth arose from reallocations of market share from less productive, to more productive firms. Between firm reallocations of market share accounted for 82 percent of productivity growth. Productivity growth within plants accounted for 14 percent of aggregate productivity growth. The entry and exit components are more modest with values of 1 percent for entry and both forms of plant exit. The result shows that entering plants enter with above average industry productivity while exiting plants tend to have below average industry productivity which points to multinationals closing down less productive plants. This may provide some evidence that MNEs choose to keep their most efficient Japanese plants open, rather than move them abroad. Less productive plants are more likely to exit, although due to the nature of the available data, we cannot say whether they are off shored. Given that exiting MNE plants account for approximately one third of all exit, we can say that multinational plant exit has a greater influence on aggregate productivity than non-MNE exit.

When we classify multinationals as being “domestic” or “foreign” owned, where a plant is deemed to be foreign owned if more than 50 percent of the firm that owns it is held by foreigners. The results in Table 20 show that it is the exit of Japanese (domestic) plants which contributes positively to productivity. The exit of foreign plants has essentially no impact on productivity.

Table 20: Domestic and Foreign MNE Exit

Productivity Component	Obs	Mean
Within Plant	143725	.14
Between Plant	143725	.82
Entry	143725	.01
Domestic MNE Plant Exit	143725	.01
Foreign MNE Plant Exit	143725	.00
Non-MNE Plant Exit	143725	.01

We elaborate the productivity decompositions in Table 21 and split the within, between and entry components into MNE and non-MNE parts (the MNE component again includes all multinationals, domestic and foreign). In general, it is the non-MNE component of each element of productivity that has a greater bearing on aggregate productivity. Plant productivity within multinationals is estimated to contribute 4 percent of the growth in productivity while in non-MNEs the contribution is 10 percent. Likewise, the non-MNE part of the between plant variable accounts for 56 percent of aggregate productivity growth which is almost double the contribution of the multinational part.

Table 21: Multinational / Non-Multinational Productivity Decomposition		
Productivity Component	Obs	Mean
MNE Within Plant	143725	.04
Non-MNE Within Plant	143725	.10
MNE Between Plant	143725	.27
Non-MNE Between Plant	143725	.56
MNE Plant Entry	143725	.00
Non-MNE Plant Entry	143725	.01
MNE Plant Exit	143725	.01
Non-MNE Plant Exit	143725	.01

These findings suggest that multinationals may already be more productive than non-multinational plants (a fact confirmed by t-tests later in the chapter) and that subsequently, the rate of productivity growth in such plants is slower. It is also evident from the magnitude of the between plant productivity component that reallocations of market share across establishments are the prime mechanism which drive productivity in Japan over the period. However, while reallocations of output towards MNEs are found to be important, the key effect stems from reallocations of output from less- to more-productive non-multinational plants. Since multinational plants are, on average, more productive than non-MNEs, reallocations of market share have a less pronounced impact than reallocations away from the least productive non-MNE plants. Plants whose operations are solely domestic tend to be the least productive establishments meaning that displacement of their market share has the largest bearing on productivity[12].

[12] The results of the Griliches and Regev decomposition are broadly the same when only multi-plant firms are considered. The within- and between-plant components, together, account for 95 percent of productivity growth. Exit is found to account for approximately 3 percent of productivity growth among multi-plant firms.

Another technique which may be used to decompose productivity is the Foster, Haltiwanger and Krizan (1998) (FHK) methodology. There are slight, yet significant, differences between this and the Griliches and Regev (1995) formulation. The formula is as follows

$$\Delta P_t = \sum_{Continue}\theta_{it-k}\Delta p_{it} + \sum_{Continue}\Delta\theta_{it}\left(p_{it-k} - P_{t-k}\right) + \sum_{Continue}\Delta\theta_{it}\Delta p_{it} + \sum_{Entry}\theta_{it}\left(p_{it} - P_{t-k}\right) - \sum_{Exit}\theta_{it-k}\left(p_{it-k} - P_{t-k}\right)$$

The Foster et al. methodology contains three "continue" terms which broadly correspond to the within and between components of the Griliches and Regev formulation. However, base-year market shares are used as weights for each term, and an additional term, that combines changes in market shares and changes in productivity, is also included. A downside to the FHK formulation is that in the presence of measurement error, in market shares and productivity, the cross-product term will tend to exacerbate the effect. Owing to the correlation between productivity and market share, this may affect the within- and between-plant effects. This problem is partially dealt with in the Griliches and Regev framework through the averaging of market shares across periods.

Table 22 chronicles the results of the FHK decomposition. As in the Griliches and Regev decomposition, the two continuing terms and the cross-product variable (which correspond to the within- and between-plant components) account for the bulk of the growth in productivity. Plant entry again contributes positively to aggregate productivity growth, as does non-MNE plant exit. However, MNE plant exit is found to lower aggregate productivity which could hint at off shoring.

Table 22: Foster, Haltiwanger and Krizan (1998) Productivity Decomposition

Productivity Component	Obs	Mean
Continue 1	144204	-.15
Continue 2	144204	.95
Cross-Product Term	144204	.19
Plant Entry	144204	.02
MNE Plant Exit	144204	-.01
Non-MNE Plant Exit	144204	.01

Despite the effect of multinational plant exit having a rather muted effect on aggregate productivity in both the Griliches and Regev and FHK frameworks, each methodology produces an answer with a different sign. The FHK result suggests that while multinationals may not offshore their most productive units, they might choose to relocate relatively less productive units abroad, or simply close them down. We build upon these insights by first establishing what the determinants of plant exit are and then direct our attention towards off shoring through the use of input-output tables. However, first we offer a description of the unique dataset we use and some of its features.

5. Conclusion

The paper debases some of the myths about Globalization. For example, the media portray foreign multinationals as closing down productive Japanese plants and relocating them elsewhere in Asia. We find that this is not the case. Our results confirm that plants which are large, capital intensive and productive relative to the industry are, on average, less likely to exit.

We find that high wage plants more likely to exit. The plants which are owned by firms engaged in international trade no less likely to exit than plants which exclusively serve the domestic market. Multi-plant firms and those with high R&D expenditure are also more likely to shut down plants. However, our results also indicate that R&D plays a role in maintaining plants in competitive edge.

We also find that Japanese multinationals more likely to close plants, even when we condition on a raft of plant, firm and industry characteristics.

The plants that are closed are below average productivity and the exit component contributes a very small fraction to productivity growth (using both the GR and FHK methods). In short, plant exit has not been the reason for Japan's poor productivity growth. Instead a lack of productivity growth within plants is identified as being the main cause.

Although we present new evidence on the impact of Globalization on the domestic economy, there is much that can be done to improve upon our finding. Two avenues of research come into mind. The first issue that needs to be taken up in future research is the differences in technological advancement by industries. Since our research perspective is the macro-level impact of Globalization based on micro data, our empirical investigation is conducted by pooling whole manufacturing plants. However, the impact might differ from industry to industry. Therefore, further investigation by industry might be helpful for the understanding of the nature of the impact of Globalization. The second avenue is to examine the impact of multinationals' activity on the changes in production and employment of non-multinationals. We demonstrate by productivity decomposition that entry and exit are not the primary contributors of macro-level productivity growth, but rather changes in the share of each plant play an important role in aggregate productivity enhancement. Thus, the impact of Globalization on the changes in production and employment at plant –level might be another avenue for future research.

Appendix

Appendix Table 1: Plant-Level Industries

Livestock Products
Seafood Products
Flour and grain mill products
Miscellaneous foods and organic fertilisers
Beverages
Tobacco
Textile Products
Lumber and wood products
Furniture and fixtures
Pulp, paper and coated and glazed paper
Paper products
Printing, plate making for printing and bookbinding
Leather and leather products
Rubber products
Chemical fertilisers
Basic inorganic chemicals
Basic organic chemicals
Organic chemicals
Chemical fibres
Miscellaneous chemical products
Pharmaceutical products
Petroleum products
Coal products
Glass and its products
Cement and its products
Pottery
Miscellaneous cermaic, stone and clay products
Pig iron and crude steel
Miscellaneous iron and steel
Smelting and refining of non-ferrous metals
Miscellaneous fabricated metal products
General industry machinery
Special industry machinery
Miscellaneous machinery
Office and service industry machines
Electrical generating, transmission, distribution and industrial apparatus
Household electric appliances
Electronic data processing machines, digital and analog computer equipment and accessories
Communication equipment
Electronic equipment and electric measuring instruments
Semiconductor devices and integrated circuits
Electronic parts
Miscellaneous electrical machinery equipment
Motor vehicles
Motor vehicle parts and accessories
Other transportation equipment
Precision machinery and equipment
Plastic products
Miscellaneous manufacturing industries

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