Plant Exit and Productivity Performance: Evidence from Japan

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Abstract

We find that plant and firm characteristics are the main determinants of plant exit; industry variables tend to have a peripheral impact. Large, capital intensive and productive plants are less susceptible to exit while high wage plants are more vulnerable. Multinational ownership increases the likelihood of exit, though only among domestic multinationals. Within multi-plant firms, plant features relative to the firm average are important determinants of exit. The evidence suggests that globalisation, through the offshoring of productive plants to low-wage countries, has not been responsible for the lack of productivity growth in Japan. Rather this has been a consequence of poor within plant productivity growth.

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Introduction

"Productivity isn't everything, but in the long-run it is almost everything", so said Paul Krugman in *The Age of Diminished Expectations*. The post-war Japanese economy exemplifies the contrasting fortunes that productivity growth can cause. While capital flows doubtless played a part in resurrecting a country destroyed by war, the productivity miracle was ultimately responsible for the sustained successes enjoyed by Japan until the end of the 1980s. The subsequent 'lost decade' has seen growth stagnate and has been mirrored by equally sluggish productivity growth.

Several accounts have been advanced to explain Japan's recent woes. The media has attacked Globalisation and vilified foreign multinational enterprises (MNEs) for "hollowing out" the economy by closing plants and relocating production to lower-cost sites elsewhere in Asia. In this chapter we investigate whether plant exit has contributed to the poor productivity performance in Japan, through firm's closure of their most productive plants.

Our results indicate that plant exit has had almost no effect upon aggregate productivity and that the plants which are closed have below average productivity: offshoring has not been responsible for Japan's slow growth. Instead, the lacklustre growth of productivity within plants has been responsible. Productivity decompositions indicate that productivity growth within MNE plants has been 60 percent lower than in domestic plants. Reallocations of output towards multinational plants raise aggregate productivity by half as much as relocations to non-MNE plants.

Theoretical considerations of whether multinational ownership promotes or lessens the probability of plant exit are ambiguous. On the one hand, multinationals have plants in multiple countries so they could rapidly relocate production between sites, increasing the likelihood of plant closure. On the other hand, multinationals incur large sunk costs when entering a foreign country which reduces the chances of exit since firms have an incentive to recover as much of these costs as possible. Foreign multinationals are not more likely to closedown their plants. Rather, a plant belonging to a Japanese multinational is 0.063 percentage points more likely to exit, even when we control for a host of plant-, firm- and industry-level variables.

Industry variables are found to either have little effect on the rate of plant exit, or be insignificant. Imports from low-wage countries do not affect plant exit in Japan. Industry sunk costs are found to have a more profound effect upon survival among multinational owned plants than other plants. However, the impact upon exit is small, despite sunk costs being frequently cited as a crucial determinant of exit.

The work in this chapter 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, Bernard and Jensen (2002) look at evidence from the United States and Bernard and Sjöholm (2003) consider evidence from Indonesia. The results differ depending upon the country under inspection. For example, Alvarez and Görg (2005) find that multinationals are more likely to shut plants in Chile, but only during downturns, while Mata and Portugal (2002) find that survival probabilities are higher among Portuguese plants when they are foreign owned.

The paper proceeds as follows. Section 1 describes the data set we use, Section 2 investigates differences between plants depending on their ownership structure and in Section 3 we report regression results. In Section 4 we decompose productivity using the Griliches and Regev (1995) technique. In Section 5 we use a battery of checks to test the robustness of our results for ownership. Finally, conclusions are offered.

Section 1: Description of the Data

Our dataset comes from the Japanese "Census of Manufacturers". It comprises 169590 plant-level observations across the years 1994 to 2005 for 51 three digit, manufacturing industries. Firms with less than 50 employees are not required to submit information which restricts us to looking at firms with more than fifty workers. Owing to difficulties in calculating total factor productivity among very small plants, the minimum size of plants included in the dataset is 10.

Information is also included on plant entry and exit. Each plant has a unique identification number which allows us to identify entry and exit. These are measured using dummy variables. A plant is deemed to have entered where it is observed at time *t* but was not observed in the dataset in the previous period, *t-1*. Equivalently, a firm which exits is one that was observed at *t-1* but not at time *t*. It is not possible to say whether this is caused by plant death or exit from the sample. Exit is deemed to refer specifically to plant closure; industry switching and mergers are not considered within this framework[1].

The percentage of firms which either enter or exit is low, a feature which holds across industries. Throughout the sample, there are 2330 instances of entry and 3392 observations of exit. The exit rate may be affected by the size cut-offs. Throughout the dataset there are approximately 86000 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.

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

[1] 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. (2006) find for the United States that in the face of competition from low-wage imports, firms switch towards more capital intensive sectors.

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

Plant-Level Variables

The plant-level variables include plant size (measured by the number of employees), capital per worker, plant sales, plant total factor productivity (TFP) (measured relative to the industry and in logs), plant wage rate and the volume of intermediate inputs used by the plant. Information is also provided on the three-digit industry in which a plant operates[2].

Table 3: Plant-level Variables

Variable	Sample				
	Obs	Mean	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

TFP is calculated for each plant relative to the industry average. Following Good et al. (1997) and Aw et al. (1997), 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

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

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

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

denote the industry average of that variable. We use 1994 as the base year. Capital, labour 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 equation (1) 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 equation (1) constitutes the gap between establishment *f*'s TFP level in year *t* and the representative establishment's TFP level in the base year.

Firm-Level Variables

In addition to information on each plant, the dataset also includes specific information on the firm a plant is owned by. This includes firm age, size, capital-labour ratios, a multiplant 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 at approximately 1 percent of establishments (a firm is adjudged to be foreign owned if a foreign firm holds more than 50 percent of the capital[3]). Many firms appear to be globally engaged with 26 percent exporting, 20 percent importing and 15 percent of firms investing abroad. Almost a quarter of firms own more than one plant.

Industry-Level Variables

The importance of industry-level variables in determining exit has been firmly established with Roberts and Tybout (1995) finding sunk costs to be important and Bernard et al. (2006) highlighting how import penetration from different regions can affect exit. To capture these effects we include industry and globalisation variables: sunk costs, intra-industry trade and two measures of import competition.

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. (2006) 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

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

where GL_{ijt} 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.

[3] 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. Robustness checks do not show our findings to be sensitive to the choice of threshold.

The role of import competition in affecting plant survival has been addressed repeatedly. As in Bernard et al. (2006), our dataset allows us to disaggregate import penetration into low-wage country import penetration and other country imports[4]. The effect of low-wage country imports upon exit is not entirely clear. Differences in countries' endowments will have profoundly different effects upon the labour, 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 labour abundant and consequently displace similar, high wage, Japanese goods.

Bernard et al. (2006) 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

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

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 embodies imports from all countries not deemed to be "low-wage". It is calculated as

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

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

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

The industry variables mentioned so far capture the influence of globalisation upon plant exit. We also include a measure of sunk costs. The empirical literature has identified sunk costs as being an important factor in shaping exit. Where the sunk costs of entry are high firms must be of a high productivity to make production profitable given the high barriers to entry. The nature of the sunk costs of entry have been found by Aw et al. (2002) to result in very different productivity distributions in South Korea and Taiwan.

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 characterised 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. Low-wage imports account for approximately one third of Japanese imports.

Table 5: Industry Variables

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

Section 2: Plant Features

Multinational Enterprises

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

Variable	Ownership	
	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

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. The raw data in Table 6 shows multinational plants to, on average, employ more workers, have more capital per worker, higher sales, TFP and wages

than non-multinational plants. These observations are borne out by simple T-tests which reveal that non-MNE owned plants are significantly smaller, less capital intensive and have lower TFP and wages than MNE owned plants[5]. Exit rates are significantly higher among non-MNE owned plants although the difference between the mean exit rate of MNE and non-MNE plants is small[6]. 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 multinational firms, exiting plants differ from those which continue. In Table 8 it is shown that, within MNE firms, 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.

[5] 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.

[6] 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***

Foreign Ownership

As with MNEs, the role of foreign ownership in determining plant exit has been much discussed with Mata and Portugal (2002), 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 incentivising 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***

Section 3: Empirical Results

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 import competition, ownership, and how plant characteristics relative to the rest of the firm affect plant 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.

Question 1: How do plant-, firm- and industry-level variables affect plant exit?

We begin by looking at how the plant, firm and industry variables affect plant exit. The first model also includes industry-level sunk costs, the Grubel-Lloyd index

of intra-industry trade and import penetration disaggregated into its LWPEN and OTHPEN components. The results are reported in Table 10.

Table 10: 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

The results in Specification 1 of Table 10 confirm many of the features we observed in the raw data, even when we control for firm- and industry-variables. 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 (1995) and Bernard and Sjöholm (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[7]. 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 offshoring 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 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,

[7] Results are not reported here.

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 multiplant 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 multiplant firm. While we find a one standard deviation increase in the multiplant 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 multiplant firm in the United States. Mata and Portugal (1994) and Bandick (2008) find the contrary.

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 standardised coefficient is small.

The Grubel-Lloyd index of intra-industry trade and both import penetration measures are found to be insignificant. 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., 2005).

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. Multiplant 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.

Question 2: How does Ownership affect exit?

The issue of ownership often been raised as a potential cause of plant and firm exit. 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). Foreign firms are assumed not to be as familiar with the domestic market and its modus operandi as domestic producers. Consequently, they must incur larger sunk costs when entering. 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), Ozler and Taymaz (2004) and Bernard and Sjöholm (2003) all address whether foreign ownership affects establishment survival and growth while Mata and Portugal (1994) look at whether new domestic and foreign owned firms differ in their chances of survival. Mata and Portugal (1994) find foreign firms have hazard rates 51% lower than domestic firms, although the

differences decline over time. However, the effect of foreign ownership on survival tends to vary depending on the country under inspection. 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 may 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 53328 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 11 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: plants that are large, capital intensive and productive relative to the industry are, on average, less likely to exit. High wage plants remain more likely to exit. The firm-level variables also remain the same as in Table 10 with plants which are owned by firms engaged in international trade (through the import and export dummies) more susceptible to closure. Multiplant firms and those with high R&D expenditure are also more likely to shut down plants. The industry variables remain peripheral as before. Foreign ownership is found to be insignificant at 5%. 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 11: 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 (2002) find that once firm characteristics are

controlled for, being foreign does not reduce the chances of exit in Portugal. Ozler and Taymaz (2004) 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 (2005) 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 Sjöholm (2003) find, for Indonesia, that once the greater size and labour 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 Specifications 2, 3 and 4 of Table 11 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[8]. 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 offshoring. We shall return to this hypothesis in a later section when we look at the characteristics of the plants which multinational-, and domestic-multiplant, 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 11 show that, for the average plant, which is foreign owned, the probability of exit is 0.0186. Plants 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 plants that drive the result. Domestic multinationals' plants face an exit likelihood of 0.024 while for foreign-owned multinational plants the value is approximately half as strong at 0.014.

The results in Table 12 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 13.

[8] 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.

Table 12: 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 multiplant and domestic MNE firms are more likely to closedown their plants, regardless of their plant's characteristics. 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 Lopez 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. It is only when we condition on plant characteristics that foreign owners are more likely to shutdown their plants.

Table 13: 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

Question 3: How do plant characteristics relative to the firm average affect exit?

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 multiplant 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 14.

Table 14: 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

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 multiplant 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.

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 multiplant 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 multiplant 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. For example, Bernard and Jensen (2007) find exporters to be 15 percent less likely to shut down after controlling for plant variables and ownership structure. Since exporting constitutes domestic firm's route to the foreign market, those that export benefit from operating in more markets and increases their profits. 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 purchase components from other MNE plants within the firm which are located abroad.

Section 4: Productivity Decompositions

So far the analysis has centred 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 productivity growth over the period. We specifically ask whether multinational plant exit affects productivity differently to non-MNE plant exit.

Japanese productivity growth has been notoriously slow in recent years. 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 offshoring the most productive plants to China and other low-wage East Asian countries. This has aroused much debate in the media though only anecdotal evidence exists.

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. This permits inspection of whether multinationals have been offshoring 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 the *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 15.

Table 15: 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 marginally above average industry average 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 offshored. Given that exiting MNE plants account for approximately one third of exit, we can say that multinational plant exit has a greater influence on aggregate productivity than non-MNE exit. However, the effect is small, exiting plants are not highly unproductive.

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 16 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 16: 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 16 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 17: 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[9].

[9] The results of the Griliches and Regev decomposition are broadly the same when only multiplant 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 multiplant firms.

Section 5: Sensitivity Analysis

Definitions of Foreign Ownership and Multinational Enterprises

As a robustness check we examine whether our definitions of foreign ownership and a multinational enterprise are affected by the chosen thresholds. A plant was deemed to be foreign owned where a foreign firm owned in excess of 50 percent of the parent's equity. We subsequently found that foreign owners were more likely to shutdown plants, but only when we conditioned upon plant characteristics.

We broaden the definition of foreign ownership by looking at where a foreign firm has a 10 percent share of the equity and owns the firm outright. The 10 percent threshold is chosen since it constitutes the typical level at which a shareholder can ask for a seat on the company's board. There are 10996 observations in the dataset where foreign firms have at least 10 percent of the Japanese firm's equity. In 623 instances a plant is completely owned by a foreign firm. Using this data we create two dummy variables. The first takes a value of one where the stake owned by a foreign firm is greater than or equal to 10 percent of the equity, and zero otherwise. The second dummy has a value of 1 if a foreign firm completely owns the plant and zero otherwise.

From Table 18 it is apparent that the extent of a foreign firm's control over the Japanese firm plays a role in plant exit. When we define foreign ownership as being anything above 10 percent of a firm's equity, a one standard deviation increase raises exit by 0.103 percentage points. The effect is larger when we use our baseline measure, 50 percent or more of equity, where the estimated coefficient is 0.160. However, plants belonging to firms which are fully owned by foreign firms are not significantly more likely to exit (shown in the right hand column).

Previously we had found foreign owners to be more likely to closedown plants, but where a foreign firm owns the whole firm the probability that they close a plant is not significantly different from zero. A possible explanation of this may be that almost 60 percent of plants which are fully foreign owned belong to single-plant

firms (in Japan at least). They then represent the foreign parent's entire Japanese operations and may be less prone to exit given the sunk costs of entry.

Table 18: Foreign Ownership Specifications

	Foreign Equity Share		
	10+	>50	100
Plant-level Variables			
Size	-.059***	-.060***	-.060***
	(-26.00)	(-24.25)	(-24.21)
Capital Intensity	-.010***	-.009***	-.009***
	(-7.26)	(-6.78)	(-6.74)
TFP	-.044***	-.043***	-.043***
	(-5.14)	(-4.89)	(-4.88)
Wages	.133***	.138***	.139***
	(8.22)	(8.54)	(8.55)
Firm-level Variables			
Export Dummy	-.000	-.001	-.001
	(-.05)	(-.07)	(-.07)
Import Dummy	.003	.004	.004
	(.32)	(.48)	(.53)
Multi Plant Dummy	.088***	.091***	.091***
	(13.85)	(14.11)	(14.09)
R&D Intensity	.001	.002**	.002**
	(1.63)	(2.06)	(2.09)
Ownership Variables			
Foreign Owner	.103***	.160**	.241
	(4.90)	(2.26)	(1.40)
MNE Dummy	.060***	.063***	.064***
	(7.58)	(8.17)	(8.11)
Industry-level Variables			
Grubel-Lloyd Index	-.004	-.001	.002
	(-.08)	(-.02)	(.04)
LWPEN	.019	.022	.022
	(.73)	(.83)	(.84)
OTHPEN	-.127	-.127	-.126
	(-1.61)	(-1.63)	(-1.62)
Sunk Costs	-.001*	-.001*	-.001*
	(-1.76)	(-1.80)	(-1.82)
Industry Dummies		Yes	Yes
Time Dummies	Yes	Yes	Yes
Number of Observations	78315	78315	78315
Pseudo R^2	.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

In addition to foreign ownership, we also investigate the robustness of our multinational enterprise results. MNEs were found to increase plant exit. We had

defined a multinational as a firm that had flows of FDI and/or investments through loans abroad which were greater than zero. To test for robustness we generate three new MNE dummies. The first dummy deems a firm to be engaged in FDI, and hence to be a multinational, where it has FDI flows above the average. Where this is true the dummy takes a value of 1 and zero otherwise. Further multinational dummies are constructed along similar lines except that the firm is a MNE if it has FDI above the 90^{th} and 95^{th} percentile values for FDI. Results are shown in Table 19.

Table 19: Multinational Enterprise Specifications

	FDI		
	Mean	90^{th} Percentile	95^{th} Percentile
Plant-level Variables			
Size	-.061***	-.061***	-.061***
	(-26.61)	(-26.58)	(-26.14)
Capital Intensity	-.010***	-.010***	-.010***
	(-7.33)	(-7.47)	(-7.12)
TFP	-.042***	-.042***	-.042***
	(-4.97)	(-4.98)	(-5.09)
Wages	.131***	.129***	.131***
	(8.15)	(8.06)	(8.21)
Firm-level Variables			
Export Dummy	.016*	.014*	.019**
	(1.82)	(1.67)	(2.13)
Import Dummy	.014*	.011	.015*
	(1.67)	(1.33)	(1.86)
Multi Plant Dummy	.091***	.090***	.094***
	(14.43)	(14.07)	(15.06)
R&D Intensity	.001	.001	.001
	(1.24)	(.99)	(1.40)
Ownership Variables			
Foreign Owner	.137**	.135**	.124*
	(1.98)	(1.99)	(1.75)
MNE Dummy	.168***	.148***	.225***
	(8.32)	(8.92)	(8.27)
Industry-level Variables			
Grubel-Lloyd Index	.004	.005	-.000
	(.09)	(.12)	(-.00)
LWPEN	.022	.022	.021
	(.86)	(.86)	(.81)
OTHPEN	-.130*	-.132*	-.124
	(-1.66)	(-1.69)	(-1.60)
Sunk Costs	-.001*	-.001*	-.001*
	(-1.87)	(-1.86)	(-1.77)
Industry Dummies	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes
Number of Observations	78315	78315	78315
Pseudo R^2	.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

The plant and industry variables remain essentially identical to before except that in the first two specifications OTHPEN enters negatively and significant at the 10 percent level. Little changes among the firm-level variables except that the export and import dummies enter significantly in some specifications. However, this tends to be at the 10 percent level again.

Regardless of the way in which we define a multinational, we find that they are significantly more likely to closedown plants. We can also say that the likelihood of exit is increasing in the volume of FDI undertaken by the multinational. At the 90th percentile (defined as FDI greater than 6035 million yen) the coefficient estimate is 0.148, at the mean (defined as FDI greater than 9063 million yen) it is 0.168 and at the 95th percentile the beta coefficient is 0.225. When we look at the 99th percentile, the coefficient is greater still at 0.467. These results may provide an indication of multinationals being more able to relocate production the larger they are. Bigger multinationals would be expected to be more productive, making them less likely to keep open plants that are less productive relative to the firm.

Conclusions

Our results show that large, capital intensive and high productivity plants are less susceptible to exit. Domestic multinational ownership increases the likelihood of plant exit but foreign firms keep their plants open. This is because foreign firms enter to serve the domestic market. Exporting does not have an effect upon multinational owned plants, but it does decrease exit among plants belonging to purely domestic multi-plant firms. Plants which are large relative to the average size of plants within the same firm are less susceptible to closure. The same is true for plants that are capital intensive relative to the firm average. Relatively high wages increase the exit likelihood, although only in multinationals.

We have found plant exit through globalisation has not been responsible for Japan's slow productivity growth over the period 1994 to 2005. The plants which multinationals closedown are not their most productive establishments. This indicates that multinationals do not offshore their most productive plants to lower cost

economies in East Asia. The poor productivity performance stems from a lack of within plant productivity growth.

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