Globalisation, Multinationals and Productivity in Japan's Lost Decade

November 2009

Tomohiko Inui

(Economic and Social Research Institute, Cabinet Office and Nihon University)

Richard Kneller

(GEP, University of Nottingham)

Toshiyuki Matsuura

(Keio University)

Danny McGowan

(GEP, University of Nottingham)

1. Introduction

During Japan's 'Golden Age' (1956-1973) growth in output per worker averaged 8% per annum, four times the rate recorded in the United States over the same period. While capital flows doubtless played a part in resurrecting a country destroyed by war, the productivity miracle was ultimately responsible for the sustained successes of the economy, culminating in Japan becoming the world's second largest economy and raising per capita income levels from 27% of US levels in 1956 to 69% by 1973 and 84% by the start of the 1990s.[1] The subsequent 'lost decade' has seen GDP growth stagnate and has been mirrored by equally sluggish productivity growth. In our sample we estimate that across the manufacturing sector productivity growth averaged just 0.5% per annum from 1994-2005, while per capita income is estimated to have fallen to around 72% of US levels.

Numerous hypotheses have been advanced to explain Japan's soporific economic performance since the early 1990s. Often these emphasise macroeconomic factors, such as fiscal policy (both too little and of the wrong sort) or the liquidity trap (Hayashi and Prescott, 2002).[2] Others have instead used micro level data and sought to explain the low rate of productivity growth that accompanied the lost decade, with the industrial structure of Japan, the banking sector and multinational firms often identified as key factors.[3]

A number of competing arguments are included here. Cowling and Tomlinson (2000) for example, argue that it was caused by the 'elite globalisation' strategies of Japanese MNEs.[4] The domestic manufacturing sector has been 'hollowed out' as multinationals have offshored production to lower wage economies in the rest of Asia. This has resulted in the closure of what were relatively productive domestic plants adding further drag to productivity.[5] A different explanation for the closure of more productive firms is offered by Nishimura et al. (2005), who focus on the role of banks in allocating financial resources to productive firms. They argue that during the 1996/7 financial crisis this link broke down such that firms with relatively low productivity survived at the expense of those with higher productivity. Kimura

[1] Data from Maddison (2009).
[2] Makin (1996) for example cites the slow response of the Bank of Japan to reduce interest rates due to outdated inflation measures, and the impact this may have had on peoples' beliefs. Or alternatively, Krugman (1999) argues that the aging population's desire to save for their retirement, along with the country's risk adverse nature, demonstrated by its high savings rate and accentuated by the collapse of the bubble economy, reduced consumer spending.
[3] These are of course the same factors often used to explain its relative economic success up until that point.
[4] Over the period of study some 800,000 jobs have been shed by Japanese manufacturing firms.
[5] Nishimura et al. (2005) report that relatively productive firms were closed in Japan in 1996 and 1997, although they do not investigate whether these were multinational firms.

and Fujii (2003) argue instead that excess plant closure during the 1990s reflected the reversal of the rapid expansion into new products and markets by Japanese firms during the 1980s.

Some in the literature have taken the opposite view that the rate of firm and plant closure has been too low, rather than too high. Caballero et al. (2003), Peek and Rosengren (2003), Ahearne and Shinada (2005) and more recently the Economist (2009) have argued that stringent bankruptcy laws, a unique industrial structure and government intervention have resulted in a plethora of what they label ‘zombie’ companies. Equipment, buildings and labour have been fossilised in firms that achieve relatively low sales and profit margins.

Finally, others emphasise the weak contributions to aggregate productivity growth from the within firms and between firm components of aggregate productivity change. Makin (2008) for example, discusses the effect from the weak balance sheets of Japan’s banks, that resulted from the collapse of property and asset markets at the beginning of the 1990s, coupled with their close alliances with Japanese MNEs. According to this view, loans to firms outside of the keiretsu networks were limited, preventing investment in profitable projects such that the rate of productivity improvement within firms was too low. Finally, Kwon et al. (2009) return to the theme of zombie lending, but to show how this led to resource reallocation towards firms with low productivity adding negatively to aggregate productivity growth.

In this paper we attempt to discriminate between these different explanations for low productivity growth in Japan using micro level data drawn from the Japanese census of manufacturing production and focusing on the role played by multinational firms and increased globalisation. We begin by decomposing aggregate productivity growth to assess the relative contributions from productivity improvements within firms, those which occur from the entry and exit of firms and the reallocation of market shares across firms. We find that the weak contributions made from the entry/exit and within firm growth components appear to be the main contributors to the low aggregate growth.

Using the results from this exercise we then focus in detail on the determinants of these sources of productivity change. Within this we include questions prominent within the previous literature, but which have so far lacked formal quantitative evidence. This includes issues about the characteristics of plants that have been shut by Japanese MNEs. Throughout the exercise we compare out results with those found for similar questions for other countries and the previous evidence for Japan.

From this we identify a number of aspects of the Japanese economy where behaviour is very similar to that for other developed countries, as well as areas where the behaviour is different. With respect to the firms and plants that are closed down we find that, as in other country contexts, these firms are likely to be small and have low productivity. However, the estimated marginal effects are much smaller, a consequence of the very low rates of entry and exit from Japanese manufacturing. These low exit rates are at least in part explained by a striking difference between Japanese firms and those in other developed countries. Our results suggest that increased globalisation, including a measure of increased import competition from low wage economies, has had no effect on the entry and exit of firms and plants in Japan. An explanation for this result we find little support for is the strict rules on bankruptcy laws and 'zombie' loans, preferring instead an explanation that focuses on the regulations in place that prevents the entry of new firms.

The low rate of productivity growth in Japan is also often seen as a product of Japanese MNEs offshoring production and shutting plants that are relative to others in their industry, high productivity. We find that this is true, plants shut by MNEs are relatively more productive than the industry average, but they are generally weaker elements of the MNE more generally. This behaviour is also not distinct to MNEs. Both MNEs and other multi-plant firms shut weaker plants. Indeed the behaviour of these two types of firm is very similar, including again their lack of response to increased globalisation. Finally, our analysis suggests that the rate of productivity growth within firms is also partly a consequence of low entry and exit rates. Generally we find that the determinants of productivity change are similar to those found for other countries, but that productivity improvement is lower in industries in which globalisation is higher. The low rate of entry and exit in Japan therefore means that this affects more firms than would otherwise have been the case.

The rest of the paper proceeds as follows. Section 1 provides an overview of the literature on Japan and a history of the rise of manufacturing. Section 2 describes the data set we use and the decomposition of aggregate productivity. In Section 3 we investigate a host of hypotheses and report regression results. The questions investigated in this section include the closure of firms, of plants and within firm productivity change. Finally, Section 5 draws some conclusions.

2. A Brief History of Japanese Manufacturing

From the end of the Second World War the Japanese Ministry of International Trade and Industry (MITI) has pursued an active industrial policy, designating specific industries as being "strategic" (Johnson, 1982). Cowling and Tomlinson (2001) note that policy makers have granted direct subsidies, discriminatory tariffs, import restrictions and favourable industry regulation to manufacturing industries they note that the machinery sector benefited from these interventions due to its strategic designation. Until 1971 MITI also helped stifle foreign competition through tariffs and quotas. Restrictions were imposed on inflows of foreign direct investment to protect infant industries, yet Japanese firms were encouraged to collaborate with foreign firms abroad.

Alongside these favourable government policies, Japanese firms have relied heavily on close relationships and co-operation between suppliers (buyers) of their inputs (outputs) to reduce costs and satisfy demand. Consequently there are extensive linkages between upstream and downstream firms within an industry in Japan. This results in specialisation by the majority of small keiretsu firms which supply intermediate inputs. For example, 56% of small Japanese firms are involved in some form of subcontracting (Whittaker, 1997). Production, the supply of parts and delivery are coordinated in a horizontal manner (Aoki, 1990).[6] This reduces production costs and maintains product quality.[7] The construction of keiretsu networks did not just extend to production. Banking keiretsu were also established to provide finance to corporations. According to Aoki (1990) a main bank acts as the principle lender to the company and that it is responsible for closely monitoring the company's business affairs.[8] However, despite their financial ties main banks tend not to intervene while the corporation continues to make profits.[9] Ordinarily the role of the banking keiretsu was to provide low-cost, long term finance.

Keiretsu networks did not arise exogenously, rather they were encouraged by MITI, which sought to encourage a system of mass production with large corporations at the centre supported by keiretsu sub-contractors (Cowling and Tomlinson, 2001). As mass production flourished, domestic markets became saturated with consumer durables. Initially corporations

---

[6] A product of keiretsu networks is the Just-in-Time (JIT) model of production. JIT was designed to minimise inventories yet respond to daily orders as quickly as possible.

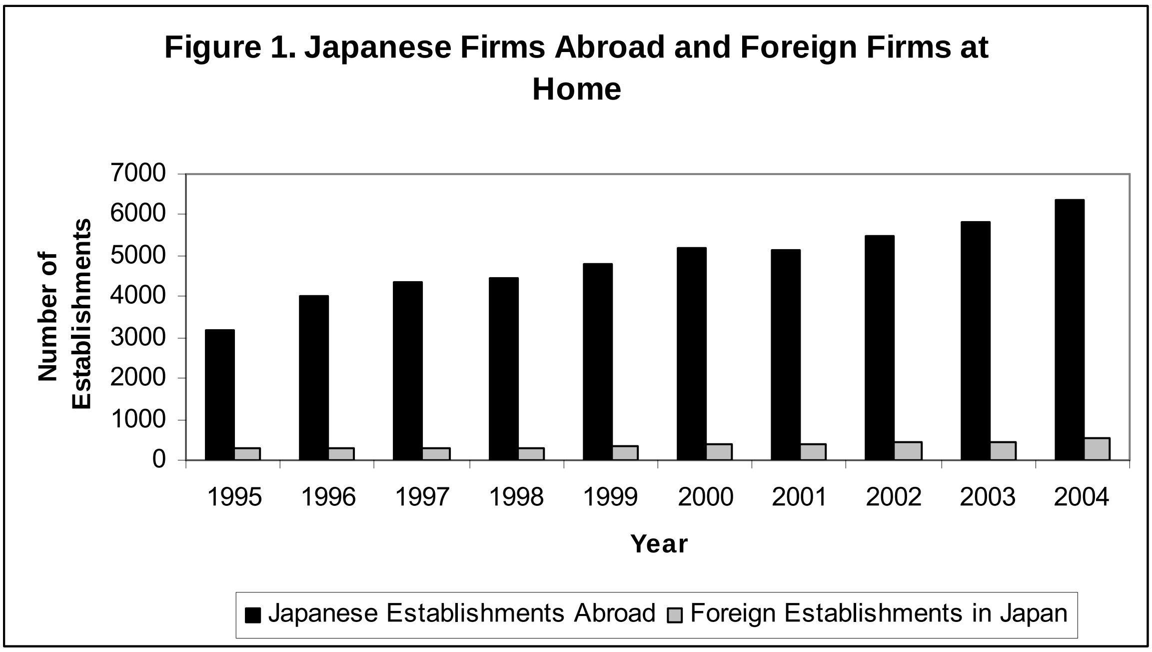
[7] A consequence of these relationships is the geographical concentration of feature of manufacturing industries. Of Japan's 47 prefectures, 73% of machinery output occurs in 15 prefectures (Cowling and Tomlinson, 2001).

[8] Financial institutions as a whole (including insurance companies) own about 40% of the total outstanding stock of listed companies. However, the main bank has the closest ties with the firm, both in terms of cash-management, as well as short term credits.

[9] During crises the main bank would assume responsibility for conducting rescue operations (Aoki, 1990).

overcame this by exporting. However, the resulting large trade surpluses led to retaliatory trade barriers. To overcome these barriers Japanese firms began to locate abroad.

Following the relaxation of restrictions on outward FDI flows in 1971, Japanese firms have steadily relocated production abroad. Between 1981 and 1995 $470 billion was invested by Japanese firms in foreign affiliates (Cowling and Tomlinson, 2001) an annual average growth rate of 22% (Cowling and Tomlinson, 2000). Figure 2 demonstrates that this trend has continued in the subsequent decade. By 2004 the number of Japanese establishments located abroad was approximately double that found in 1995. The firms that have most vigorously embraced the benefits of globalisation were the MNEs around which keiretsu sub-contractors orbit.



Notes: Data obtained from http://www.esds.ac.uk/international

The collapse of the Nikkei stock market in 1989 heralded the start of a new era for the Japanese economy. In 1991 property values fell rapidly, growth stagnated and the country experienced recessions (1991-1993 and 1998-1999). Deflation became normal. Arguments on why Japan met this fate have been varied. Some commentators have claimed that the Japanese economy has been "hollowed out" by multinational firms, taking advantage of the liberalisation of FDI to relocate production abroad.

3. Decomposition of Aggregate Productivity

The data we use in this paper combines information from the Japanese "Census of Manufacturers" and the "Basic survey on Japanese Business Structure and Activities" (BSJBSA) conducted annually by METI. Further details on these datasets can be found in the Appendix to this paper. The "Census of Manufacturers" (COM) comprises 169,590 plant-level observations from 1994 to 2005 for all establishments with more than 5 employees.[10] A lack of data on intangible assets, necessary in the construction of TFP, means we are also forced to exclude plants with less than 10 employees from the sample. We use this data to conduct a decomposition of aggregate productivity following the methodology outlined in Griliches and Regev (1995). This methodology provides the contribution to aggregate productivity growth from that within plants, the between component (the reallocation of market share across plants in the industry) and that which follows from the entry and exit of plants in the industry. We link the COM plant-level data to the BSJBSA firm-level data. The use of the BSJBSA restricts our regression analysis later in the paper to include only firms with more than 50 employees, although it is worth noting that the lower limit on plants remains 10 employees.

As already discussed we estimate that the aggregate rate of productivity growth across the manufacturing firms within our sample was just 0.5 per cent per annum. This figure lies between the estimates for the Japanese economy as a whole of 0.8 per cent per annum (1990-1995) by Jorgenson and Motohashi (2005), 0.2 per cent per annum (1991-2000) by Hayashi and Prescott (2002) and 0.1 per cent (1991-2002) by Ahearne and Shinada (2005). Decomposing this growth suggests that all of the channels have contributed positively to the overall rate of productivity growth in Japan. Therefore none has been very fast as a consequence, such that all of the channels would appear to be relevant when discussing explanations behind the low rate of Japanese productivity growth.

According to Table 1 the majority of this growth, 68 per cent, is contributed by non-MNE firms. This is disproportionate to the employment and output shares of such firms: non-MNEs account for 49 per cent of employment and 35 per cent of output. In this sense it would also seem that any explanation of the slow productivity growth in Japan is also likely to include both multinational and non-multinational firms. For both MNEs and non-MNEs aggregate growth primarily arose through the reallocations of market share from less productive to more productive firms. This form accounted for 82 per cent of productivity growth, or an average annual rate of 0.83 per cent per annum. Of interest this rate of growth is comparable to that

[10] Entry and exit will therefore be defined by movement above and below this level.

reported for the US in Foster, Haltiwanger and Krizan (2001), which might be used to suggest that within firm and entry and exit are the main sources for slow growth in Japan relative to that found in other developed countries.

In support of this view, and in contrast to the fears of hollowing out through the closure of firms and plant, the effect of closure accounted for just 1% of total productivity growth. This, as Ahearne and Shinada (2005) and The Economist (2004, 2009) suggested, and as we show in more detail below would appear to be explained largely by the very low rate of entry and exit that occurred within Japanese manufacturing. Finally, the contribution from within plant productivity growth was just 14 per cent, on average. To provide some context to this figure, Haltiwanger (1997) found within plant productivity changes in manufacturing industries generated 54% of aggregate U.S. productivity improvements between 1977 and 1987. For Israel, Griliches and Regev (1995) found the figure to be 83% for the years 1979-88.

The decompositions we present also broadly support those presented by Ahearne and Shinada (2005) using data on firms listed on the Japanese stock exchanges on an industry-by-industry basis. While there are differences across sectors, they calculate that for the construction, wholesale and retailing industries in Japan that the between component of aggregate productivity growth was negative, while it was close to zero in most manufacturing sectors.

In the next section of the paper we explore the determinants of the different elements of aggregate productivity, starting with the question of why the rate of exit is very low in Japan and whether this is explained by the actions of MNEs or of the forces of globalisation. We separate this question into two parts. The first compares the closure of single and multi-plant firms in a single framework. We then consider the question of which plants within a firm are singled out for closure. The final section considers the rate of productivity growth within firms. Given the comparability with the contributions to overall productivity growth found in the US we choose to exclude the between component from further analysis.

Table 1: Multinational and non-MNE Plant Productivity Decompositions

Productivity Component	Obs	Rate	% Contributed by MNEs
Average Annual Productivity Growth Rate	143725	0.5%	
Of which			
Within Plant	143725	.14	28.6
Between Plant	143725	.83	32.5
Plant Entry	143725	.01	0.0
Plant Exit	143725	.02	50.0

Notes: Multinational components include domestic and foreign multinationals

4. Empirical Results

Question 1: What causes the closure of Japanese firms and plants?

We identify exit from the sample using the unique identification number given to all firms and their plants. A firm/plant is deemed to have entered when it is observed at time *t* but was not observed in the dataset in the previous period, *t-1*. Equivalently, a firm/plant that exits is one that was observed at *t-1*, but not at time *t*. In Table 2 we report the rate of entry and exit within each year for the total sample and for MNEs, and for single and multi-plant non-MNEs. Throughout the sample there are 2,330 instances of entry and 3,392 observations of exit, with a median rate of exit of 1 per cent per annum.[11] The low rate of entry and exit is consistent with the high average age of firms in the sample, which is over 40 years. We use this to suggest that the low rate of exit is not a consequence of the size threshold imposed on the Japanese census data at 3 employees. It also suggests that low entry and exit rates have been a feature of the Japanese economy for a very long period of time, and are therefore unlikely to be the reason that productivity growth declined in Japan after the 'golden age'. Finally, in contrast to any argument they are a consequence of some form of active industrial policy in Japan, it is worth noting that they are a feature of the data that also holds across industries.

[11] These are line with the evidence for Japan reported in Caballero et al. (2003), Peek and Rosengren (2003) and Ahearne and Shinada (2005).

This rate of exit is much lower than that found for other developed countries. For the US Bernard and Jensen (2004) calculate 32 per cent of plants are shut over a 5 year period. Indeed the rate of churn (entry plus exit) in Japan is most similar to that found for small, open developed countries such as Austria, Switzerland, Sweden rather than the typical large developed country. According to the Eurostat FEED[12] dataset the lowest rate of churn amongst European countries is 5.7 per cent in Switzerland, 9.3 per cent in Sweden and 9.7 per cent in Austria. For France, Germany and the UK the comparable figures are 11, 17 and 18 per cent respectively. Low entry and exit rates in smaller countries is usually explained as a result of the open nature of their economies, resulting in severe left truncating of the productivity distribution in a Melitz (2003) type of framework. A consequence of this is the high share of exporters in the total population of firms. Greenaway et al. (2008a) report for Sweden that exporters account for over 80 per cent of the total number of firms. In our data the proportion of exporters is around 30 per cent, a figure it is worth noting is likely to be biased upwards because export information is available only for firms with more than 50 employees. Severe left truncating of the productivity distribution would not therefore appear to be a likely source of low entry and exit rates in Japan.

Table 2: Annual Entry and Exit Rates

	Complete Sample		MNE		Multi (ex. MNE)		Single Plant	
Year	Entry	Exit	Entry	Exit	Entry	Exit	Entry	Exit
1994	.01	.01	.01	.01	.01	.01	.01	.01
1995	.01	.01	.01	.01	.01	.01	.01	.01
1996	.01	.01	.01	.01	.01	.01	.01	.01
1997	.01	.02	.01	.02	.01	.02	.01	.02
1998	.03	.03	.02	.03	.03	.03	.03	.03
1999	.01	.03	.01	.03	.01	.03	.01	.03
2000	.01	.03	.01	.03	.01	.03	.01	.03
2001	.01	.03	.01	.03	.02	.03	.01	.03
2002	.01	.03	.01	.03	.01	.03	.01	.03
2003	.01	.02	.01	.02	.01	.02	.01	.02
2004	.01	.02	.01	.02	.01	.02	.01	.02
2005	.02	-	.02	-	.02	-	.02	-

Entry and exit rates vary across firm types, with the highest rates identified in multi-plant firms and multinationals. While these rates of exit are low when compared to other countries, that they are higher relative to those found for single plant firms might explain why the rate of closure of plants is seen by commentators within Japan as high, although some cultural

[12] Eurostat Firm Entry and Exit Data Dimensions.

aversion to exit would be needed to claim that these are excessive. That the rate of exit is higher for multi-plant firms would appear consistent with the explanation of corporate restricting by large Japanese firms as a result of their over-expansion in the 1980s by Kimura and Fuji (2003) or alternatively of offshoring of the production of intermediate inputs by Japanese multinationals.

As multi-plant and multinational firms are typically larger and more productive than single plant firms it would also appear consistent with the argument made in Nishimura et al. (2005) that this could have acted as drag on aggregate productivity growth. We explore this point in Table 3 below where we report the average productivity of plants according to their ownership and if they exit alongside the averages for firms of different types as a whole. As expected, the table shows that on average plants owned by MNEs are some 7 per cent more productive than the average plant within the same industry and some 10 per cent more productive than the average non-MNE plant. It would also seem that, conditional on their ownership, plants that exit have lower average productivity compared to those that remain. In the case of MNE plants this difference is small at 1 per cent, but it is larger for non-MNE plants at 4 per cent. The table also confirms the view that the plants shut by MNEs are relatively productive compared to other plants in the same industry and could therefore contribute negatively to aggregate productivity growth. Plants shut by MNEs are on average 6 per cent more productive than the average plant in the same industry.

Table 3: Average Plant Productivity

	Obs	Mean	Std. Dev	Min	Max
Average Plant Productivity	169590	.96	.35	-4.81	4.36
Average Plant Productivity if Owned by:					
Multiplant Multinational	41690	1.03	.40	-4.81	4.36
Single Plant Multinational	11638	.99	.35	-2.39	3.83
Domestic Multiplant Firm	41998	.93	.36	-3.66	4.30
Single Plant Domestic Firm	74264	.92	.30	-4.34	3.68
Average Exiting Plant Productivity if Owned by:					
Multiplant Multinational	1142	1.02	.51	-2.26	4.36
Single Plant Multinational	174	1.02	.57	-1.03	3.83
Domestic Multiplant Firm	1237	.88	.51	-2.85	4.30
Single Plant Domestic Firm	839	.90	.47	-2.12	3.44

What are the factors that explain which plants and firms are shut in Japan? In Table 4 we investigate the determinants of plant closure using a probit regression. In so doing we build on prior evidence for Japanese manufacturing found in Kimura and Fujii (2003) and Kimura and Kiyota (2006), which we extend to consider the role of firm and industry import penetration, the multinational status of the firm and industry sunk costs. We group the dependent variables into plant, firm and industry level determinants of exit. The plant level variables include measures of size (employment), capital intensity, TFP and average wage. Summary statistics of these variables can be found in Table A1 in the Appendix. The firm level variables capture the R&D intensity of the firm, its ownership (whether it is a foreign owned firm), and the extent of its engagement with global markets (whether it exports, imports or owns affiliates abroad). The industry level measures attempt to capture the effects of globalisation on the probability of survival more generally and are measured by import penetration and intra-industry trade.

The results from Table 4 suggest that the type of plants that are closed in Japan are similar to those found to exit in other countries. We find that the probability of exit is decreasing in the size, capital intensity and TFP of the plant and increasing in the average wage. This matches evidence reported in Dunne et al. (1989), Görg and Strobl (2003), Mata and Portugal (1994), Bernard and Sjoholm (2003), Bernard and Jensen (2007) for other OECD countries and Kimura and Fujii (2003) for Japan. The table suggests however, that the effect of these variables on the probability of exit is very small, an artefact of the low rate of exit in the sample. A one standard deviation in plant size, capital intensity or TFP decreases the probability of exit by just 0.50, 0.09 and 0.05 percentage points[13].

We find a more limited role for firm characteristics in determining exit. There are reasons to believe that that a firm's R&D expenditure may affect the markets in which a firm operates. Perez et al. (2004) for Spain find that R&D intensity lowers the hazard rate, while Kimura and Kiyota (2003) find similar evidence for Japanese firms. However, the direction of the relationship is not obvious. Since R&D is associated with uncertainty firms with high R&D intensities or which operate in R&D intensive sectors may face a higher risk of failure. This has been found by Audretsch and Mahmod (1995), Audretsch et al. (2000) and Segarra and Callejon (2002). Conditional on the plant variables we find no effect from R&D intensity of the firm in the probability of exit. This result occurs as a result of the above average characteristics of firms that conduct R&D however. When we exclude the plant variables

[13] If the probability of exit was initially 5 percent (0.05) then a one standard deviation increase in plant size would reduce it to 0.045

from the regression we find that firm R&D intensity reduces the probability of exit by 0.07 percentage points.

We also find in Table 4 initial evidence that offshoring may play a role in firm closure. Conditional on the plant, firm and industry variables, importing firms are 0.03 percentage points more likely to close their plants. Offshoring as an explanation for plant closure might also explain the significance of the indicators of the MNE status of the firm in the regression. In regression 1 we find that plants belonging to domestic MNEs and foreign MNEs are more likely to exit, with a stronger effect found for domestic MNE status. [14] This latter effect occurs despite the low levels of foreign presence of foreign firms within Japan. Of the 53,328 observations of plants owned by a multinational, only 761 observations relate to plants owned by a foreign multinational. Also of interest, we find that the behaviour of multinational firms is distinct from that of multi-plant firms more generally, which also have a higher probability of exit conditional on their firm and plant characteristics. If plant closure is due to the pace of entry into new products and markets during the 1980s, the pattern of its reversal is different between multinationals and non-multinationals.

The behaviour of MNEs is again not inconsistent with that found for multinationals in other countries, where the effect of foreign ownership on the probability of survival has been found to be somewhat mixed. Using panel data on Chilean manufacturing plants, Alvarez and Görg (2005) find that foreign ownership has a positive effect on exit, but only during the significant recession of the late 1990s, while Bernard and Sjoholm (2003) find that conditional on their greater size and labour productivity, foreign plants are more likely to exit in Indonesia. Mata and Portugal (2002) in contrast find that conditional on firm characteristics, being foreign has no effect on the probability of exit in Portugal, while Ozler and Taymaz (2004) fail to find any difference in survival prospects between foreign and native firms for Turkey.

[14] We measure foreign ownership as a binary variable equal to 1 if more than 50 percent of the firm's capital is foreign owned and zero otherwise The 50% threshold is also used by Görg and Strobl (2002). The results are robust to either the International Monetary Fund's definition of foreign ownership at the 25% level, or, to including the absolute percentage of capital which is foreign held (which may take a value between 0 and 100).

Table 4: Plant, Firm and Industry Determinants of Exit

Variable	Regression (1)	(2)	(3)
Plant Variables			
Size	-.47***	-1.28***	.27***
	(-31.34)	(-28.48)	(-34.13)
Capital Intensity	-.11***	-.24***	.80***
	(-9.74)	(-8.60)	(-9.92)
TFP	-.05***	-.31***	.73***
	(-5.32)	(-3.72)	(-4.94)
Wages	.12***	.65***	1.95***
	(8.78)	(5.95)	(8.45)
Firm Variables			
Export Dummy	.01	.01	1.01
	(.44)	(.08)	(.21)
Import Dummy	.03**	.18***	1.17**
	(2.37)	(2.60)	(2.38)
Firm Exports	.06***	.00***	1.00***
	(3.12)	(5.62)	(4.58)
Firm Imports	.02	.00**	1.00
	(1.16)	(2.09)	(1.44)
R&D Intensity	.02	.01**	1.00
	(1.36)	(2.23)	(1.28)
Domestic MNE Dummy	.10***	.53***	1.62***
	(7.95)	(7.29)	(7.85)
Foreign MNE Dummy	.02**	1.04**	2.54***
	(2.09)	(2.23)	(2.82)
Multiplant Dummy	.20***	.92***	2.35***
	(19.18)	(15.97)	(16.75)
Industry Variables			
Grubel-Lloyd Index	-.02	-.11	.90
	(-.39)	(-.62)	(-.74)
LWPEN	.01	-.08	1.01
	(.19)	(-.61)	(.07)
OTHPEN	-.06	.07	.91
	(-.77)	(.30)	(-.54)
Sunk Costs	-.03***	-.05**	.96***
	(-2.67)	(-2.38)	(-2.84)
Industry Dummies	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Number of Observations	131559	15672	131669
R^2	.15	-	-

Notes: Standardised coefficients in regressions 1-4. Logit coefficients in regression 5 and hazard ratios in regression 6. Z-scores clustered at the firm level are reported in parentheses. Industry dummies are defined at the three-digit level. ***, ** and * indicate significance at the 1, 5 and 10 percent levels.

The most striking difference in the behaviour of Japanese firms with that found for other countries comes with respect to the industry level measures of globalisation. In other contexts greater industry level exposure to global markets has been found to be a cause of firm and plant death, see for example Bernard et al. (2006) and Greenaway et al. (2008). Greater exposure to foreign competition in industries in which the country has a comparative disadvantage leads to the closure of production plants. For Japan we find no such effects, irrespective of the source of that import competition. This is somewhat unexpected given that the measures of firm level imports were found to significantly affect the likelihood of exit.

Firms that offshore, they import or own affiliates abroad, are significantly more likely to exit than other types of firms, but the greater levels of import penetration within the industry more generally has no effect on the likelihood of exit.

One explanation might be that import penetration levels in Japan are low and some threshold level is required to be reached before it affects plant closure. Such a view does not have strong support. While import penetration rates are lower in Japan compared to other OECD countries they are not drastically lower. Over the sample, on average, imports from low wage countries account for about 9 percent of production. In comparison, Bernard et al. (2006) report for the US that aggregate import penetration rises from 15 percent to 28 percent between 1977 to 1997. Moreover, the level of import penetration from low wage economies is more similar between these two countries. In the US import penetration from low wage economies increased from 2 percent to 6 percent whereas in our sample it doubled to 4 percent between 1994 and 2002.

Of the industry variables, only industry sunk costs are found to have a significant effect on exit. This supports evidence from Dunne, Roberts and Samuelson (1988, 1989), Bernard and Jensen (2007) for the US, Geroski (1991a,b) for the UK and Greenaway et al. (2008) for Sweden.[15] According to our estimates a one standard deviation increase in industry sunk costs reduces exit by 3 percentage points. In industries with high sunk costs potential entrants must draw a high productivity so that they may profitably produce (Hopenhayn, 1992; Melitz, 2003). Consequently there are fewer successful entrants and incumbents face a lower probability of exit.

This result points to the role of entry as an unexplored determinant of low exit rates in Japan. Strict bankruptcy laws, government regulation and 'zombie' lending by banks to relatively unproductive firms have been used to explain low rates of exit, however without similar restrictions on the ability of new firms to enter the market it is not clear why the rate of new entry would also be low. In support of this view, and of surprise given the discussion in the previous literature on the difficulties in closing firms, according to the World Bank's Ease of Doing Business Indicators Japan ranks as the country in which the costs of closing a business (measured as the recovery rate in bankruptcy) are *lowest* out of the 183 countries that make up the sample. For comparison the UK is ranked number 9, the US at 15, Germany at 35 and

[15] We do not consider the question of whether sunk-costs and exit are correlated with entry into the Japanese manufacturing sector (Dunne, Roberts and Samuelson, 1988, 1989), or indeed whether there is a net rate of entry or exit into the industry.

France at 42. In contrast Japan's ranking in the ease of opening a new business in that dataset is 91 (out of 183) in between Mexico and Uzbekistan. For this measure the US lies at number 8, the UK at 16, France at 22 and Germany at 84.

In the remaining regressions of the table we consider the robustness of those findings to different estimation techniques. The number of observations of exit in the sample is low. King and Zeng (2001a, 2001b) demonstrate that logit and probit models can lead to an under-estimation of the probability of rare events, and as the event becomes rarer in an increasingly dysfunctional manner. Regression 2 in Table 3 repeats the regression in column 1 but follows the methodology outlined by King and Zeng (2001a, 2001b) to correct the standard errors for rare events. The King and Zeng method works by choosing a random sample of the 0's (non-exit in the current context), estimating a logit regression and then correcting the coefficients and standard errors post-estimation (using information on the proportion of 1's in the population). Their general suggestion is to choose between 2-5 times the numbers of 0's and 1's. As a second robustness test we use a Cox proportional hazard model rather than a probit estimator. Non-parametric estimators have proved popular in the plant exit literature with Mata and Portugal (2002) and Bandick (2007) employing them to describe the survival rates of Swedish multinational owned, and Spanish, plants.

The results in regression 2 and 3 of Table 3 are robust to this change. We continue to find that large, capital intensive, productive plants with low wage costs are less likely to exit. The firm-level variables are also unchanged. Intensive importers and exporters are more likely to close plants, as are multinationals and multiplant firms. Exporting status and firm R&D intensity remain insignificant. Sunk costs continue to be the sole significant industry-level determinant of exit.

Question 2: What are the Causes of Exit within Multiplant Firms?

From Table 4 it is clear that firms that are small, have low productivity, low capital intensity etc. have a greater probability of closing down. However we also find that the effect of these variables is small and that both multi-plant and multinational firms have a greater probability of exit. Motivated by that later result in this section we focus on the type of plants that are shut by multinational firms and those multi-plant firms that have no overseas affiliates.

We now measure the plant variables relative to the firm average. For example, the size ratio is calculated as the natural logarithm of the number of plant employees divided by the number of people employed by the firm. Similar variables are constructed for capital intensity and wages. Since multiplant firms may have operations in several industries, such that plant and firm TFP are not comparable, we choose to drop this variable from the regression. The remaining control variables are similar to those included in Table 4. To these we add a measure of the capital intensity and material intensity of the plant relative to the firm, which we use to capture the vulnerability of plants to being shut and their production offshored. These variables are measured as:

$$Firm\_Plant\_CAP_t = \log\left(\frac{plant\_capital\_\mathrm{int}ensity_t}{average\_firm\_capital\_\mathrm{int}ensity_t}\right)$$

$$Firm\_Plant\_MAT_t = \log\left(\frac{plant\_material\_\mathrm{int}ensity_t}{average\_firm\_material\_\mathrm{int}ensity_t}\right)$$

Finally, we explore the Kimura and Fujii (2003) hypothesis that plant closure in the 1990s reflected the excessive growth of large Japanese firms in the 1980s. We capture this effect using a dummy variable that takes a value equal to one if the plant operates in the same 3-digit industry as the firm (and zero otherwise).

Table 5: Within Multiplant Firm Regressions

Variable	Regression (4)	(5)
Firm Type	**MNE**	**Multi**
Plant-level Variables		
$Size^{Plant}/Size^{Firm}$	-.47***	-.31***
	(-19.03)	(-15.79)
Capital $Intensity^{Plant}$/Capital $Intensity^{Firm}$	-.10***	-.15***
	(-4.05)	(-6.82)
$Wages^{Plant}/Wages^{Firm}$	.08***	.01
	(4.90)	(.44)
Same Industry Dummy	.00	-.01
	(.09)	(-.29)
Firm-level Variables		
Export Dummy	.02	-.04*
	(.71)	(-1.83)
Import Dummy	.01	.01
	(.50)	(.68)
Firm Exports	-.10**	-.06**
	(-2.51)	(-2.22)
Firm Imports	-.05	-.01
	(-1.27)	(-1.08)
R&D Intensity	-.07***	-.14***
	(-4.11)	(-6.74)
Industry-level Variables		
Grubel-Lloyd Index	-.01	-.02
	(-.05)	(-.24)
LWPEN	.04	.07
	(.34)	(.47)
OTHPEN	-.04	-.20
	(-.31)	(-1.15)
Sunk Costs	-.07***	-.02
	(-2.99)	(-.91)
Industry Capital $Intensity^{plant}$/Industry Capital $Intensity^{firm}$	-.15***	.01
	(-3.56)	(.28)
Industry Material $Intensity^{plant}$/Industry Material $Intensity^{firm}$	-.11***	-.00
	(-3.28)	(-.06)
Industry Dummies	Yes	Yes
Year Dummies	Yes	Yes
Number of Observations	30688	31645
Pseudo R^2	.15	.11

Notes: Standardised coefficients in all regressions. Z-scores clustered at the firm level are reported in parentheses. Industry dummies are defined at the three-digit level. ***, ** and * indicate significance at the 1, 5 and 10 percent levels.

Regression 4 reports the results for multinational firms and regression 5 for multi-plant firms without overseas affiliates. [16] We label these for ease as multi-plant firms. In many aspects the type of plants shut by these two types of firm are very similar, indeed it is not obvious from these results as to why multinationals have been singled out as the main cause of hollowing

[16] The MNE firms include a small number of foreign multinationals. In regression 1 of Appendix Table A5 we re-run the MNE regressions but only include domestic MNEs. The results are not substantively different to the MNE results in Table 5. In regression 2 of Appendix Table A5 we test for differences in the coefficients between domestic and foreign multinationals. No statistically significant differences are found at conventional levels.

out in Japan. Conditional on unobserved 3 digit industry fixed effects for the firm and for the plant, the results of regression 4 show that multinational plants that are large relative to the firm are less likely to exit, as are more capital intensive plants. These are the same types of plant that are less vulnerable to closure within multi-plant firms. The effects of size and capital intensity are also similar for multinational and multi-plant firms, indeed we cannot reject the hypothesis that multinationals and multi-plant firm react identically to the same change in size or capital intensity when we pool the observations into a single regression. A one standard deviation increase in the size ratio reduces the exit probability by 0.44 percentage points for multinational firms and by 0.31 percentage points for multi-plant firms. For the capital intensity ratio the comparative values are 0.10 percentage points and 0.15 percentage points. We also find for both types of firm no evidence that those plants that lie within a different 3-digit industry to the firm are more vulnerable to exit. Increased focus on the core activities of the firm does not appear to have been a significant driver of exit over this time period.

The differences in the determinants of plant closure instead relate primarily to the variables that capture motives for offshoring. There is evidence from regression 4 that MNEs are more likely to shut high cost plants for example. A one standard deviation increase in the plant-to-firm wage ratio increases the probability of plant exit by 0.08 percentage points. For multi-plant-firms this factor was not important, perhaps reflecting the need under just-in-time delivery to be close to final producers. We also find that MNEs shut plants based on the capital and material intensity of the plant. MNEs are significantly less likely to shut plants that are capital and material intensive, which we take to mean further along the production chain relative to the rest of the firm. The effect of these variables is of a similar size to those for the other plant characteristics. A one standard deviation increase in the relative capital intensity of the plant's industry relative to the industry of the firm reduces exit by 0.15 percentage points. For relative material intensity the value is 0.11 percentage points. Finally, we find for both multinational and multi-plant firms whether the firm imports or not is not a good predictor of the plants that are shut. This might occur because this variable is measured at the level of the firm, although, given that we find that the export status of the firm does affect the likelihood the firm will shut plants, perhaps a better explanation is that offshoring and importing of inputs are not identical concepts.

Consistent with the results in Table 3 we continue to find no role for the globalisation variables within the regression. The level and the structure of trade have no effect on the volume of plant exit within Japan. Given the contrast between these results and those found for other OECD countries again suggests some common institutional factors that limits the amount of exit (or entry) that occurs.

Why is the rate of TFP growth within firms so low?

Table 1 suggests that within plant productivity growth to be one of the key restraints on aggregate productivity growth in Japan. Using a model similar to that in Griffith et al. (2003) we investigate the determinants of productivity growth within plants. A similar model is used by Bernard and Jones (1996) to investigate productivity convergence in industries across 14 OECD countries. The model begins with a neoclassical production technology,

$$A_{ijt} = KA_{jt}^{F} \qquad (4)$$

where i represents a given plant, j indexes the industry in which the plant operates and t denotes time. A_{ijt} represents plant productivity, K is a shift parameter and A A_{jt}^{F} represents Total Factor Productivity (TFP) at the frontier plant. A general dynamic relationship between plant and frontier productivity may be expressed as,

$$\ln A_{ijt} = \beta_0 + \beta_1 A_{jt}^{F} + \beta_2 A_{jt-1}^{F} + \alpha_1 A_{ijt-1} + \varepsilon_{it} \qquad (5)$$

To arrive at the error correction model we must see when (5) would be consistent with (4). This requires that all factors which would cause divergence from equilibrium are equal to zero. Through rearranging (5) we obtain the error correction model,

$$\Delta \ln A_{ijt} = \beta_0 + \beta_1 \Delta \ln A_{jt}^{F} + \gamma \left(\ln A_{jt-1}^{F} - \ln A_{ijt-1} \right) + \varepsilon_{ijt} \qquad (6)$$

The terms on the right hand side capture the effect of productivity transfer. The term $\Delta \ln A_{jt}^{F}$ allows plant productivity growth to depend directly upon productivity growth at the frontier plant. The frontier is assumed to be the plant with the highest TFP in the plant's 3-digit industry at time t. Plant productivity growth also depends on how far the plant lies behind frontier. The larger is $\left(\ln A_{jt-1}^{F} - \ln A_{ijt-1} \right)$ the greater the potential for technology transfer or productivity upgrading. Hence, β_1 denotes the strength of the link between productivity growth at the frontier establishment and non-frontier plants while γ captures the speed of productivity convergence.

We then estimate the relationship posited above using OLS. A full set of time dummy variables are included to capture the effect of macroeconomic and stochastic shocks on productivity. The results show that Japanese plants behave in similar fashion to those in other countries. As in Griffith et al. (2003) we find a positive and significant effect of the growth in the frontier establishment on non-frontier plant's productivity growth. In regression 1 of Table 6 a one standard deviation increase in productivity at the frontier establishment causes a 14 percentage point increase in plant *i*'s productivity growth. As in the United Kingdom there is also evidence of productivity convergence. Plants operating behind the productivity frontier have, on average, 31 percentage points higher productivity growth.

Table 6: Productivity Catch-up

Variable	(6)	(7)	(8)	(9)	(10)	(11)
ΔTFP_{Fjt}	.14***	.15***	.15***	.14***	.14***	.15***
	(31.25)	(28.54)	(28.44)	(30.37)	(31.71)	(28.22)
$TFPGAP_{ijt-1}$	.31***	.31***	.29***	.31***	.30***	.28***
	(35.01)	(13.32)	(12.31)	(30.94)	(24.71)	(8.99)
$LWPEN_{jt-1}$		-.16***				-.18***
		(-6.49)				(-6.81)
$OTHPEN_{jt-1}$			-.10***			-.03
			(-3.61)			(-.93)
GL_{jt-1}				.02		.07***
				(1.28)		(3.28)
FIRM R&D $INTENSITY_{ijt-1}$					.05***	.05***
					(3.75)	(3.46)
Interaction Terms						
$TFPGAP_{ijt-1}$						
x $LWPEN_{jt-1}$		-.01				.06
		(.44)				(1.60)
x $OTHPEN_{jt-1}$			-.04			-.08**
			(-1.29)			(-2.20)
x GL_{jt-1}				-.01		-.04**
				(-.49)		(-2.25)
x FIRM R&D $INTENSITY_{ijt-1}$					-.02	-.02
					(-1.61)	(-1.39)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	141975	118715	118715	141975	141975	118342
R^2	.06	.06	.06	.06	.06	.06

Notes: Standardised coefficients. Robust t-statistics reported in parentheses. ***, ** and * indicate significance at the 1, 5 and 10 percent levels.

In regressions 7 to 11 we examine the effect imports, intra-industry trade and firm R&D intensity have on plant-level productivity growth. International trade has been shown elsewhere to affect productivity (see for example Keller and Yeaple, 2003 for evidence from the United States). Of interest here, given the earlier results for the closure of firms and plants, we find import penetration to be a negative determinant of within plant productivity growth. A one standard deviation increase in imports from low-wage countries reduces plant productivity growth by 0.16 percentage points. Imports from other countries have a smaller effect: the coefficient estimate is -0.10. Building on the evidence above that import penetration has not had a strong effect on the exit of firms or plants this would suggest that more firms have lower productivity growth because of increased import penetration than might otherwise have been the case. The industrial structure of Japan would appear to be part of the explanation behind the low rate of productivity improvement within Japanese firms.

Intra-industry trade is not a significant determinant of productivity growth but we find that a one standard deviation increase in firm R&D intensity raises the productivity of its plants by 5 percentage points. When all four variables and their interactions with the TFP Gap variable are included in column 7 we continue to find that low-wage imports reduce productivity growth while firm R&D intensity increases it. However, the variable measuring imports from other countries is now insignificant but the coefficient on intra-industry trade estimate of 0.07 is robust. We now observe that intra-industry trade and imports from other countries reduce the speed of convergence by 4 and 8 percentage points, respectively. In spite of these findings we continue to find convergence in TFP. The elasticity on the TFP Gap variable (0.09) implies that the half life of the productivity gap between the average frontier productivity and the average plant productivity is 7.7 years. This is a fairly rapid rate of productivity growth and suggests that the reason for the low rate of within plant change is not explained by a low elasticity on the TFP Gap variable rather country-specific factors are responsible.

5. Conclusions

This paper examines the role of MNEs and globalisation in Japanese productivity performance from 1994 to 2005. In so doing we attempt to understand which of the explanations for low productivity growth during its so called ‘lost decade’ have greatest support. In many aspects of behaviour we find that Japanese firms are similar to those found in other developed countries. This includes the type of firms and plants that are closed and the determinants of within firm productivity change. The areas of greatest difference appear to stem principally from the low rate of entry and exit, which is itself partly explained at least by the lack of an effect from import competition. The increased share of consumption accounted for by goods from low wage economies has not significantly affected the rate of rate at which firms are closed. In this sense increased globalisation is not the cause of Japan's economic problems, although given the evidence from other countries perhaps the more relevant question is why not. The evidence points to the low entry and exit rates as at least part of the answer. Even where we find a negative effect from globalisation on productivity changes within firms, the number of firms this affects is greater because of low entry and exit rates.

The literature has focused on the strict bankruptcy laws in Japan. It is of some surprise then that according to the World Bank's Ease of Doing Business Indicators Japan ranks as the country in which the costs of closing a business (measured as the recovery rate in bankruptcy) are *lowest* out of the 183 countries that make up the sample. It is however relatively more difficult to open a business: Japan's ranking in the ease of opening a new business in that dataset is 91 (out of 183) in between Mexico and Uzbekistan. The role of low entry rates in Japan is worthy of future attention.

We find some evidence that supports the view that Japanese multinationals are a cause of its low productivity growth. The closure of plants by MNEs that are relatively productive compared to others within the same industry did serve as a drag on overall productivity growth. However, these exit rates, while high compared to single plant firms, are low by international standards and this behaviour is not very different from that found for multi-plant firms without foreign affiliates. Why multinational firms have therefore been singled out for criticism is not clear, although we do find evidence that the pattern of closure is consistent with the production of intermediate goods and services being offshored to low wage economies.

References

Ahearne, A. and Shinada, N. (2005) Zombie Firms and Economic Stagnation in Japan, International Economics and Economic Policy, Springer, vol 2(4), 362-381, December

Alvarez, R. and Görg, H. (2005) Multinationals and Plant Exit: Evidence from Chile, International Review of Economics & Finance, 18(1), 45-51

Aoki, M. (1990) Towards an Economic Model of the Japanese Firm, Journal of Economic Literature, 28(1), 1-27

Audretsch, D. and Mahmod, T. (1995) New Firm Survival: New Results Using a Hazard Function, The Review of Economics and Statistics, 77(1), 97-103

Audretsch, D., Houweling, P. and Thurik, A. (2000) Firm Survival in the Netherlands, Review of Industrial Organization, 16(1), 1-11

Aw, B., Chen, X. and Roberts, M. (1997) Firm-level Evidence on Productivity Differentials, Turnover and Exports in Taiwanese Manufacturing, NBER Working Papers 6235, National Bureau of Economic Research

Aw, B., Chung, S. and Roberts, M. (2002) Productivity, Output, and Failure: A Comparison of Taiwanese and Korean Manufacturers, NBER Working Papers 8766, National Bureau of Economic Research

Bandick, R. (2007) Multinationals and Plant Survival in Swedish Manufacturing, University of Nottingham GEP Discussion Papers 07/31

Bernard, A. and Jensen, B. (2004) Why Some Firms Export, The Review of Economics and Statistics, MIT Press, 86(2), 561-569, 04

Bernard, A. and Jensen, B. (2007) Firm Structure, Multinationals, and Manufacturing Plant Deaths, The Review of Economics and Statistics, 89(2), 193-204

Bernard, A. and Jones, C. (1996) Comparing Apples and Oranges: Productivity Convergence and Measurement Across Industries and Countries, American Economic Review, 86(5), 1216-1239

Bernard, A. and Sjoholm, F. (2003) Foreign Owners and Plant Survival, Tuck Business School Working Paper No. 03-30

Bernard, A., Jensen, B. and Schott, P. (2006) Survival of the Best Fit: Exposure to Low Wage Countries and The (Uneven) Growth of US Manufacturing Plants, Journal of International Economics, 68, 219-237

Caballero, R., Hoshi, T. and Kashyap, A. (2003) Zombie Lending and Depressed Restructuring in Japan, Working Paper, University of Chicago

Cowling, K. and Tomlinson, P. (2000) The Japanese Crisis – A Case of Strategic Failure?, The Economic Journal, 110(464), 358-381

Cowling, K. and Tomlinson, P. (2001) The Problem of Regional "Hollowing Out" in Japan: Lessons for Regional Industrial Policy, Warwick Economic Research Papers No. 625

Dunne, T., Roberts, M. and Samuelson, L. (1988) Patterns of Firm Entry and Exit in U.S. Manufacturing Industries, RAND Journal of Economics, The Rand Corporation, 19(4), 495-515, Winter

Dunne, T., Roberts, M. and Samuelson, L. (1989) The Growth and Failure of U.S. Manufacturing Plants, The Quarterly Journal of Economics, 104(4), 671-698

Foster, L., Haltiwanger, J. and Krizan, C. (1998) Aggregate Productivity Growth: Lessons from Microeconomic Evidence, NBER Working Papers 6803, National Bureau of Economic Research

Geroski, P. (1991) Innovation and Small Firms: Zoltan J. Acs and David B. Audretsch, (MIT Press, Cambridge, MA, 1990) pp. 212, International Journal of Industrial Organisation, 9(3), 473-474

Geroski, P. (1991) Innovation and the Sectoral, Economic Journal, 101(409), 1438-1451

Görg, H. and Strobl, E. (2002) Multinational Companies and Indigenous Development: An Empirical Analysis, European Economic Review, 46(7), 1305-1322

Görg, H. and Strobl, E. (2003) Multinational Companies, Technology Spillovers and Plant Survival, Scandinavian Journal of Economics, 105(4), 581-595

Greenaway, D., Gullstrand, J. and Kneller, R. (2008a) Firm Heterogeneity and the Geography of International Trade, GEP Research Paper 2008/41

Greenaway, D., Gullstrand, J. and Kneller, R. (2008b) Surviving Globalisation, Journal of International Economics, 74, 264-277

Griffith, R., Redding, S. and Simpson, H. (2003) Productivity Convergence and Foreign Ownership at the Establishment Level, CEPR discussion paper DP3765

Griliches, Z. and Regev, H. (1995) Firm Productivity in Israeli Industry 1979-1988, Journal of Econometrics, 65(1), 175-203

Haltiwanger, J. (1997) Measuring and Analyzing Aggregate Fluctuations: the Importance of Building from Microeconomic Evidence, Review, Federal Reserve Bank of St. Louis

Hayashi, F. and Prescott, E. (2002) The 1990s in Japan: A Lost Decade, Review of Economic Dynamics, 5(1), 206-235

Hopenhayn, H. (1992) Entry, Exit and Firm Dynamics in Long Run Equilibrium, Econometrica, 60(5), 1127-1150

Johnson, C. (1982) MITI and the Japanese Miracle: The Growth of Industrial Policy 1925-75, Stanford, Stanford University Press

Jorgenson, D. and Motohashi, K. (2005) Information Technology and the Japanese Economy, Journal of the Japanese and International Economies, 19(4), 460-481

Keller, W. and Yeaple, S. (2003) Multinational Enterprises, International Trade and Productivity Growth: Firm-Level Evidence from the United States, NBER Working Paper 9504, National Bureau of Economic Research

Kimura, F. and Fujii, T. (2003) Globalizing Activities and the rate of Survival: Panel Data Analysis on Japanese Firms, The Japanese and International Economies, 17, 538-560

Kimura, F. and Kiyota, K. (2006) Exports, FDI and Productivity: Dynamic Evidence from Japanese Firms, Review of World Economics, 142(4), 695-719

King, G. and Zeng, L. (2001) Exploring Rare Events in International Relations, International Organization, 55, 3, 693-715

King, G. and Zeng, L. (2001) Logistics Regression in Rare Events Data, downloaded fromhttp://gking.harvard.edu/files/0s.pdf on 26/06/2009

Krugman, P. (1999) The Return of Depression Economics, 1st ed. London: Penguin Books

Kwon, H., Narita, F. and Narita, M. (2009) Resource Reallocation and Zombie Lending in Japan in the 1990s, RIETI Discussion Paper Series 09-E-052

Maddison, A. (2009) Statistics on World Population, GDP and Per Capita GDP, 1-2006AD (Last update: March 2009, horizontal file, copyright Angus Maddison) Available at: http://www.ggdc.net/maddison [Accessed 16 November 2009]

Makin, J. (1996) Japan's Disastrous Keynesian Experiment, Economic Outlook (December)

Makin, J. (2008) Japan's Lost Decade: Lessons for the United States in 2008, Economic Outlook (March)

Mata, J. and Portugal, P. (1994) Life Duration of New Firms, Journal of Industrial Economics, Blackwell Publishing, 42(3), 227-45, September

Mata, J. and Portugal, P. (2002) The Survival of New Domestic and Foreign Owned Firms, Strategic Management Journal, 23, 323-343

Melitz, M. (2003) The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity, Econometrica, 71(6), 1695-1725

Nishimura, K., Nakajima, T. and Kiyota, K. (2005) Does the Natural Selection Mechanism still work in Severe Recessions? Examination of the Japanese Economy in the 1990s, Journal of Economic Behaviour and Organization, 58, 53-78

Ozler, E. and Taymaz, E. (2004) Does Innovativeness Matter for Competitiveness in Developing Countries? The Case of Turkish Manufacturing Industries, Research Policy, 33, 409-424

Peek, J. and Rosengren, E. (2005) Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan, American Economic Review, 95(4), 1144-1166
Perez, S., Llopis, A. and Llopis, J. (2004) The Determinants of Survival of Spanish Manufacturing Firms, Review of Industrial Organisation, 25(3), 251-273
Roberts, M. and Tybout, J. (1997) The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs, American Economic Review, 87(4), 545-564
Segarra, A. and Callejón, M. (2003) New Firm's Survival and Market Turbulence: New Evidence from Spain, Review of Industrial Organization, 20(1), 1-14
The Economist "Manufacturing in Japan: (Still) made in Japan April 7th-14th 2004 Edition
The Economist "No Exit" June 20th – 26th 2009 Edition
Whittaker, D. (1997) Small Firms in the Japanese Economy, Cambridge, Cambridge University Press

Appendix

The data we use in this paper is from the Japanese "Census of Manufacturers" and the "Basic survey on Overseas Business Activities" conducted annually by METI. The "Census of Manufacturers" comprises 169,590 plant-level observations from 1994 to 2005. This longitudinal plant data set covers all establishments with more than 4 employees. Establishments with less than 10 employees do not report information on tangible assets, necessary for estimating TFP. This places a restriction on the plants that are included in the regression when investigating the causes of productivity change in Section 3 and should be born in mind when interpreting the results generated. Information is provided on the three-digit industry in which a plant operates[17]. The plant-level variables include size (measured by the number of employees), capital per worker, sales, TFP (measured relative to the industry and in logs), wage rates and the volume of intermediate inputs used. Summary statistics of the plant-level variables are provided in Table A1.

Table A1: The Plant-Level Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Capital Millions of Japanese Yen	169590	5119	23240	.07	1052705
Exit 1 if the plant exits	169590	.02	.14	0	1
Entry 1 if the plant enters	169590	.01	.11	0	1
Intermediate Inputs Millions of Japanese Yen	169590	6669	39879	.10	4276681
Plant Size Number of Employees	169590	225	489	10	21309
Sales Millions of Japanese Yen	169590	11321	54454	2.88	5855928
TFP Total Factor Productivity	169590	.96	.35	-4.81	4.36
Wages Millions of Japanese Yen	169590	4.84	1.79	.03	90.55

This data on plants is matched with that on firms from the "Basic survey on Overseas Business Activities" also conducted annually by METI. Firms with less than 50 employees are not required to submit information. Again this restricts the firms that can be used within the more formal econometric analysis. From this dataset we draw information on firm age, size, capital-labour ratios, whether it has multiple plants and whether the firm has any

[17] A list of industries is included in Appendix Table A4

overseas investments (FDI). Summary statistics of the firm-level variables are shown in Table A2.

Table A2: The Firm-Level Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Age *In years*	114334	43	15.77	0	161
Size *Number of workers*	114334	501	2056	50	80500
Capital per Worker *Millions of Japanese yen*	114334	15.74	26.42	.00	2151
Firm TFP *Total Factor Productivity*	114334	.97	.15	-3.53	2.80
R&D Complexity *R&D divided by firm sales*	114334	.01	.03	0	6.84
Intermediate Inputs *Millions of Japanese yen*	114334	20100	133073	1	8210527
Foreign Ownership Dummy *1 if foreign firm holds more than 50% of capital*	114334	.01	.09	0	1
FDI *1 if outward loans and investment >0*	114334	.20	.40	0	1
Multiplant Dummy *1 if the firm has more than one plant*	114334	.25	.43	0	1
Export Dummy *1 if the firm exports*	114334	.31	.46	0	1
Import Dummy *1 if the firm imports*	114334	.26	.44	0	1

The manufacturing establishments are split into 48 industries and 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 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.

Industry-Level Variables

In the empirical section we investigate how both firm and industry level variables affect the decision to close a plant. Globalisation has been shown to cause exit. The source of import competition in the US affects plant survival and causes firms to adjust their product mix (Bernard and Jensen, 2002; Bernard et al., 2006). We disaggregate import penetration into low-wage import penetration (LWPEN) and import penetration from all other countries (OTHPEN)[18]. These measures are calculated as:

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

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

Bernard et al. (2006) find that both forms of import competition raise the probability of closure. A one standard deviation increase in LWPEN increases the probability of plant exit by 2.2 percentage points which is considerably greater than the effect of OTHPEN. Similar results are found by Greenaway et al. (2008b) for Sweden. In their results, the estimated coefficient on imports from outside the OECD is twice as large as that for OECD imports. Both sources of competition have a positive and significant effect on closure.

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

[18] Countries are deemed to be low-wage where they have a GDP less than 5% that of Japan.

and exit sectors they operate in currently. It has been established by Greenaway et al. (2008b) that firms do not just closedown their operations, they switch to new industries too. Using Swedish manufacturing data they find that intra-industry trade leads to exit through plant closure, and, mergers and acquisition. This is also found by Bernard et al. (2006) for 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 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.

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. For example, Aw et al. (2002) find 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 exporting behaviour (Roberts and Tybout, 1997).

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. (2008b). For each industry and year, sunk costs are calculated as the minimum of either the entry or exit rate. In steady-state equilibrium, entry and exit rates should be equal and 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 8. 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. Imports represent 9% of Japanese output with a third of this coming from low-wage countries.

Table A3: Industry-level 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 rates	169590	.01	.01	.00	.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

Table A4: Three Digit Plant Industries in the Dataset

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

Table A5: Domestic MNEs

Variable	Regression (1)	(2)
MNE Type	Domestic	All
Plant-level Variables		
$Size^{Plant}/Size^{Firm}$	-.44***	-.47***
	(-19.22)	(-3.31)
Capital $Intensity^{Plant}$/Capital $Intensity^{Firm}$	-.10***	.05
	(-4.25)	(.49)
$Wages^{Plant}/Wages^{Firm}$	.08***	.18
	(4.82)	(1.04)
Same Industry Dummy	.00	-.06
	(.11)	(-.35)
Firm-level Variables		
Export Dummy	.02	1.20
	(.79)	(1.22)
Import Dummy	.01	.96
	(.60)	(.90)
Firm Exports	-.10**	-1.20
	(-2.48)	(-1.35)
Firm Imports	-.05	-1.12
	(-1.28)	(-1.09)
R&D Intensity	-.08***	1.32
	(-4.31)	(1.22)
Industry-level Variables		
Grubel-Lloyd Index	.03	-.00
	(.27)	(-.01)
LWPEN	.05	.05
	(.41)	(.38)
OTHPEN	-.03	-.03
	(-.21)	(-.24)
Sunk Costs	-.07***	-.07***
	(-2.97)	(-3.08)
Industry Capital $Intensity^{plant}$/Industry Capital $Intensity^{firm}$	-.15***	-.09**
	(-3.44)	(-2.00)
Industry Material $Intensity^{plant}$/Industry Material $Intensity^{firm}$	-.11***	-.11***
	(-3.20)	(-3.15)
Domestic Multinational Dummy		.12
		(.40)
x $Size^{Plant}/Size^{Firm}$		-.00
		(-.02)
x Capital $Intensity^{Plant}$/Capital $Intensity^{Firm}$		-.17*
		(-1.69)
x $Wages^{Plant}/Wages^{Firm}$		-.10
		(-.58)
x Same Industry Dummy		.06
		(.36)
x Export Dummy		-.58
		(-.57)
x Import Dummy		-.49
		(-.45)
x Firm Exports		.53
		(.60)
x Firm Imports		.65
		(.63)
x R&D Intensity		-1.38
		(-1.28)
Industry Dummies	Yes	Yes
Year Dummies	Yes	Yes
Number of Observations	30688	31248
Pseudo R^2	.14	.15

Notes: Standardised coefficients in all regressions. Z-scores clustered at the firm level are reported in parentheses. Industry dummies are defined at the three-digit level. ***, ** and * indicate significance at the 1, 5 and 10 percent levels.