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Why are Multinationals "Footloose"?

By

Tomohiko Inui, Richard Kneller, Toshiyuki Matsuura and Danny McGowan

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The Authors

Tomohiko Inui is a Research Fellow in the Economic and Social Research Institute, Cabinet Office and Nihon University, Richard Kneller is an Associate Professor and Reader in Economics in the School of Economics, University of Nottingham and GEP Research Fellow, Toshiyuki Matsuura is a Professor of Economics at Keio University, Danny McGowan is a Research Student in GEP and School of Economics, University of Nottingham

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Abstract

This paper investigates why multinational ownership is found to increase the probability that a plant will exit. It does so by using Japanese plant data linked to firm data. Plants belonging to a multinational are 9 percentage points more likely to exit when plant, firm and industry characteristics are conditioned on. We find that the "footloose" effect is attributable to multinationals closing their weakest plants. Plants that are small, capital un-intensive and have low input intensities relative to the firm are more vulnerable to closure within multinationals. We also find a strong similarity between the plants that are shut by multiplant firms regardless of whether they have overseas affiliates or not.

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

Keywords: Multinational Firms, Multiplant Firms, Exit, International Trade

Outline

Non-Technical Summary

Plants owned by multinational firms are known to possess characteristics that reduce their likelihood of closure compared to non-multinationals. Their plants are generally larger more capital intensive and more productive, all factors shown in numerous contexts to be negatively associated with the probability of exit. Conditional on these superior characteristics, multinational firms are however more likely to shut their plants. Bernard and Jensen (2007) find for example that in the United States multinational ownership increases the probability of plant death by 4.5%, controlling for a wide ranging set of plant and firm characteristics. Similar evidence has been found for manufacturing plants in Belgium by van Beveren (2006), Sweden by Bandick (2007), Japan by Kimura and Kiyota (2006) and Chile by Alvarez and Görg (2005). As a consequence of evidence such as this, multinationals have become labelled as 'footloose'.

The theories used to explain the 'footloose' nature of multinational firms emphasise vertical over horizontal FDI motives. Under vertical FDI multinational firms change the geography of their production plants in response to changes in local costs. They relocate low skill intensive activities for example, in countries that are low-skill abundant. It has also been argued that wage costs, labour unrest, tax incentives and governmental subsidies are pivotal to the multinational location decision.

Using data for Japan from 1994 to 2005 we firstly confirm that domestic multinationals are footloose. Plants belonging to a multinationals are 9 percentage points more likely to exit, when conditioned on a range of plant, firm and industry characteristics. We next explore the type of plants that are shut by multinationals, their relative characteristics compared to the rest of the firm, but also the behaviour of multinationals with other multi-plant firms that do not have overseas affiliates. We find from this a strong similarity in the type of pants that are shut. Plants are more likely to be closed if they are small, have low capital intensities and properties associated with the likelihood of offshoring, they produce intermediate inputs, are high wage or high levels of import. Finally, we explore whether it is this process of plant closure that explains why MNEs have been described as footloose. We find support for this view, indeed once we control for the characteristics of plants relative to the rest of the firm multinationals are actually significantly more likely to retain production in the home country. The footloose effect of MNEs is attributable to multinationals closing their weakest plants.

1. Introduction

Plants owned by multinational firms are known to possess characteristics that reduce their likelihood of closure compared to non-multinationals. Their plants are generally larger more capital intensive and more productive, all factors shown in numerous contexts to be negatively associated with the probability of exit. Conditional on these superior characteristics, multinational firms are however more likely to shut their plants. Bernard and Jensen (2007) find for example that in the United States multinational ownership increases the probability of plant death by 4.5%, controlling for a wide ranging set of plant and firm characteristics. Similar evidence has been found for manufacturing plants in Belgium by van Beveren (2006), Sweden by Bandick (2007), Japan by Kimura and Kiyota (2006) and Chile by Alvarez and Görg (2005). As a consequence of evidence such as this, multinationals have become labelled as 'footloose'.

The theories used to explain the 'footloose' nature of multinational firms emphasise vertical over horizontal FDI motives.[1] Under vertical FDI multinational firms change the geography of their production plants in response to changes in local costs (as in for example Antras and Helpman, 2004). They relocate low skill intensive activities for example, in countries that are low-skill abundant.[2] Empirically much of the literature has focused on the factors that make locations relatively attractive, either generally or specific determinants, rather than linking those FDI decisions and the closure of production units in a different location however. [3] Cowling and Sugden (1999) argue that wage costs, labour unrest, tax incentives and governmental subsidies are pivotal to the multinational location decision. This view is echoed by Hood and Young (1997) who stress that multinationals in the United Kingdom only have "shallow roots" and are not fully integrated into the local economy.[4] Or more narrowly Devereux and Griffith (1998) alternatively focus on the roles of taxation and agglomeration. They find that conditional on producing in Europe, industries with

[1] Under horizontal FDI all stages of the production process are replicated in a different location. Models of this type include Markusen (1984) and Brainard (1997).
[2] In practice FDI decisions often contain elements of both horizontal and vertical motives. For theoretical models consistent with this view see Helpman (1984) Venables (1999) and Yeaple (~~~~).
[3] A more comprehensive review of this literature can be found in Blonigen (2005).
[4] Similarly, the ability of multinationals to shift production across borders is emphasised by Rodrik (1997) as an explanation for multinational's relatively higher elasticity of demand for labour.

lower effective tax rates attract more U.S. multinationals. Finally, recent theories of economic geography suggest that firms within the same industry may be drawn together through spillovers created by agglomeration effects. Evidence in support of these models can be found in Devereux and Griffith (1998) and Head et al. (1995).

A smaller number of papers have focused on the consequences of outward FDI decisions for other aspects of the firm. Head and Ries (2002), Brainard and Riker (1997a,b) and Braconier and Ekholm (2000) all find that firms undertaking outward FDI is associated with changes in employment levels and the skill-mix of workers at home. Most closely associated with this paper is the work of Simpson (2008). Using data for the UK she finds that overseas investment in low-wage economies leads to changes in the structure of firms, the closure of plants. These effects are found to be strongest for multinationals operating in low-skilled industries with affiliates located in low-skill abundant countries compared to firms in the same industry not investing in low wage countries.

We build on this literature to investigate additional aspects of the adjustment process made by multinational firms. Using data for Japan from 1994 to 2005 we firstly confirm that domestic multinationals are footloose. Plants belonging to a multinationals are 9 percentage points more likely to exit, when conditioned on a range of plant and firm characteristics. We next explore the type of plants that are shut by multinationals, their relative characteristics compared to the rest of the firm, but also the behaviour of multinationals with other multi-plant firms that do not have overseas affiliates. The data on plants are sufficiently rich that we can do this for a wide range of characteristics including their size, capital intensity, average wage bill and material intensity. We find from this a strong similarity in the type of pants that are shut. Plants are more likely to be closed if they are small, have low capital intensities and properties associated with the likelihood of offshoring, they produce intermediate inputs, are high wage or high levels of import. Finally, we explore whether it is this process of plant closure that explains why MNEs have been described as footloose. We find support for this view, indeed once we control for the characteristics of plants relative to the rest of the firm multinationals are actually significantly more likely to retain production in the home country. The footloose effect of MNEs is attributable to multinationals closing their weakest plants.

The rest of the paper is proceeds as follows. Section 2 describes the dataset we use. In Section 3 we investigate the magnitude of the "footloose" effect. Section 4 studies the determinants of exit within multiplant firms. In Section 5 we address why multinationals are "footloose". Finally, conclusions are drawn in Section 6.

2. Data and Summary

Our primary data sources are the linked longitudinal data sets of the Census of Manufactures (COM) and the Basic Survey of Japanese Business Structure and Activities (BSJBSA) for the period 1994-2005. The COM data is an establishment-level dataset administered by the Ministry of Economy, Trade and Industry (METI). The COM data covers all plants with more than 3 employees located in Japan and includes information on plant characteristics, such as their location, number of employees, tangible assets, and value of shipments. Summary statistics of the main plant variables are provided in Table 1.

Table 1: Plant Variables for the Entire Sample

Variable	Obs	Mean	Std. Dev.	Min	Max
Plant Size Number of Employees	169590	225	489	10	21309
Capital Millions of Japanese Yen	169590	5119	23240	.07	1052705
TFP Total Factor Productivity	169590	.96	.35	-4.81	4.36
Wages Millions of Japanese Yen	169590	4.84	1.79	.03	90.55
Intermediate Inputs Millions of Japanese Yen	169590	6669	39879	.10	4276681
Sales Millions of Japanese Yen	169590	11321	54454	2.88	5855928

Note: TFP is calculated in logarithms.

The plant data is linked to the BSJBSA, a firm-level survey also conducted by METI. The survey includes all firms with more than 50 employees or with capital in excess of 30 million yen. This data source provides information on corporate characteristics such as R&D activity, exports, imports, the foreign ownership ratio, foreign direct

investment, and financial details. The use of the BSJBSA restricts our regression analysis to include only firms with more than 50 employees, while the 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. Given our interest in the behaviour of multi-plant firms these are not thought to be serious exclusion restrictions. The average size of multiplant firms within our dataset is 514, while for multinationals this figure is even higher at 2,549. In comparison single plant firms are approximately 7% of this size.

There are 23,100 observations of multinational firms within the data, 16,970 of multi-plant firms that are not multinational and 74,264 observations of single plant firms. These multinationals are mostly Japanese owned; foreign owned firms represent around 1 percent of all firms.[5] Summary statistics of the firm variables are shown in Table 2.

Table 2: Firm-Level Variables by Firm Type

Variable	MNE	Multiplant	Single Plant
Observations	23100	16970	74264
Age *In years*	49	45	41
Size *Number of workers*	1490	514	190
Capital per Worker *Millions of Japanese yen*	20.92	15.36	14.22
Firm TFP *Total Factor Productivity*	1.01	.96	.95
R&D Complexity *R&D divided by firm sales*	.02	.01	.01
Intermediate Inputs *Millions of Japanese yen*	71924	15410	5052
Foreign Ownership Dummy *1 if a foreign firm holds more than 50% of capital*	.01	.01	.01
Export Dummy *1 if the firm exports*	.78	.24	.18
Import Dummy *1 if the firm imports*	.65	.19	.15

[5] Görg and Strobl (2005) also use the 50% criteria. The value rises (but remains low) to 1.8% if we define foreign ownership according to the International Monetary Fund's definition as being when a foreign firm holds in excess of 25% of capital.

In addition to the differences in average size multinationals and multi-plant firms are shown to be different in Table 2 across a number of dimensions. There is for example a clear decline in productivity and capital intensity from multinationals to multiplant firms and standalone enterprises. Japanese firms appear to be highly globalised: 25% export, 21% import and 11% conduct FDI. However, these patterns are far from uniform across firm type. Over 80% of multinational firms export while only 17% of single plant firms have any sales abroad. Overall it would seem that Japanese MNEs display characteristics relative to other types of firm that are consistent with those found elsewhere in the literature (see for example the reviews in Greenaway and Kneller, 2007, and Wagner, 2007).

To identify plant entry and exit, we use a unique identification number given to each plant. 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, an exiting plant is one that was observed at *t-1* but not at time *t*. A limitation of the data is that it is not possible to identify firm closure separately from employment falling below 3 and therefore exit from the sample.[6]

In Table 3 we report the entry and exit rates for each year of our sample and by the type of firm. A general observation would be that the percentage of firms that either enter or exit in the sample is low in Japan. Throughout the sample there are 2,230 instances of entry and 3,392 observations of exit. This feature of Japanese manufacturing has been previously commented on by Caballero et al. (2003), Peek and Rosengren (2003) and Ahearne and Shinada (2005). It is however consistent with the high average age of firms reported in Table 2, which even for single plant firms is over 40 years. We conclude from this average age that the low rate of exit is not likely explained by the size threshold imposed on the Japanese census data of 3 employees. This rate of exit is much lower than that found for other developed countries such as the US, where Bernard and Jensen (2004) calculate 32 per cent of plants are shut over a 5 year period. Finally, the table also reveals that the rate of plant exit is similar amongst single, multi-plant firms and MNEs.

[6] We are more confident that we are not misclassifying mergers and acquisition as exit. The number of mergers in Japan is low. Shimizu (2001 cited in Kimura and Fujii, 2003) reports that of all companies listed on the Tokyo Stock Exchange between 1949 and 1998 of 1273 only 78 have conducted mergers.

Table 3: Annual Entry and Exit Rates

Year	Sample Average		MNE		Multi (ex. MNE)		Single Plant	
	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	.03	.03	.03	.03	.03	.03
1999	.01	.03	.01	.03	.01	.04	.01	.03
2000	.01	.03	.01	.03	.01	.03	.01	.03
2001	.02	.03	.01	.03	.02	.03	.02	.03
2002	.01	.03	.02	.03	.01	.02	.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	-

Note: Exit rates are computed as the annual average rate of exit across three digit industries

In Table 4 we compare the characteristics of continuing, entering and exiting plants, again separated by their organisation. In general the table shows that continuing plants are on average larger, have higher capital intensities, have greater sales, use more intermediate inputs and are more productive than exiting or entering plants. They pay higher wages than entering plants, but lower wages than exiting plants. On average, continuing plants are the most productive. Exiting plants are smaller, use fewer intermediate inputs and have fewer sales than either continuing or entering plants. They also pay higher wages. On average Table 4 suggests that these plants are not as productive as continuing plants, but are more productive than entrants.

Ownership also appears to matter. There is considerable heterogeneity in the size, productivity and capital intensity of plants depending on their owners and whether they enter, exit or continue. Multinationals' plants pay higher wages, have higher sales and use more intermediate inputs, regardless of whether they are an entering, exiting or continuing plant. T-tests reveal that non-MNE owned plants are significantly smaller, less capital intensive and have lower TFP and wages than multinational owned plants.[7]

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

Table 4: Characteristics of Continuing, Entering and Exiting Plants by Firm Type

Variable	Firm Type MNE	Multiplant	Single Plant
Continue			
Observations	51381	40013	72699
Plant Size *Number of Employees*	423	144	136
Capital per Worker *Millions of Japanese Yen*	25.59	14.41	12.23
Plant TFP *Millions of Japanese Yen*	1.03	.94	.92
Plant Wages *Total Factor Productivity*	5.57	4.51	4.51
Intermediate Inputs *Millions of Japanese Yen*	15558	3156	2530
Plant Sales *Millions of Japanese Yen*	26275	5478	4320
Exit			
Observations	1316	1237	839
Plant Size *Number of Employees*	207	76	97
Capital per Worker *Millions of Japanese Yen*	28.22	14.77	11.76
Plant TFP *Millions of Japanese Yen*	1.02	.88	.90
Plant Wages *Total Factor Productivity*	6.16	4.56	4.53
Intermediate Inputs *Millions of Japanese Yen*	6819	1678	1721
Plant Sales *Millions of Japanese Yen*	11678	2904	3004
Enter			
Observations	680	798	752
Plant Size *Number of Employees*	244	112	107
Capital per Worker *Millions of Japanese Yen*	30.79	19.37	15.90
Plant TFP *Millions of Japanese Yen*	.95	.86	.89
Plant Wages *Total Factor Productivity*	4.94	3.86	4.35
Intermediate Inputs *Millions of Japanese Yen*	8205	2513	2197
Plant Sales *Millions of Japanese Yen*	14447	4285	3480

3. What is the Magnitude of the "Footloose" Effect?

Generally we find that the plants that are most vulnerable to closure in Japan are similar to those studied in other countries by Dunne et al. (1989), Görg and Strobl (2003), Mata and Portugal (1994), Bernard and Sjoholm (2003) and Bernard and Jensen (2007). Plants that are large, productive and capital intensive are less likely to exit. For example, a one standard deviation increase in plant size reduces the probability of exit by 43 percentage points. Of the firm characteristics it is size that has the strongest effect on reducing the probability of death; the point estimates on the capital intensity and TFP variables are substantially lower at 0.09 and 0.05.[8] Contrary to Bernard and Jensen's (2007) findings for the United States, high-wage Japanese plants are more likely to exit.

Unlike in studies of other countries we do not find firm exporting status to affect survival. Although exporters are often believed to be less likely vulnerable to closure, the reason why this should be is not necessarily apparent. However, international engagement matters when the firm imports. In this case a plant is 3 percentage points more vulnerable to closure, a first indication that offshoring may be a motive behind the decision to shut plants. We also find that a one standard deviation increase in firm R&D intensity makes a plant 5 percentage points more likely to die although this variable becomes insignificant when we the multiplant dummy is included in regression 2.

Conditional on these plant characteristics we also find evidence that multinational firms are 'footloose'. Within regression 1 we find that plants belonging to multinational firms are 13 percentage points less likely to survive.[9] In regression 2 we test whether this effect is specific to multinationals or affects the closure decision of all multi-plant firms, even if they have no overseas investments. The existing evidence is ambiguous on this point. 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, while Mata and Portugal (1994) and

[8] 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

[9] When domestic and foreign multinational dummies are used the result remains. Domestic multinationals are 13 percentage points more likely to closedown their plants. The effect is smaller for foreign multinationals at 3 percentage points though highly significant.

Bandick (2007) find the contrary results for Portugal and Sweden respectively. For Japan we find that multiplant firms are 18 percentage points more likely to close their plants but that the "footloose" effect remains. Adding the indicator of whether the firms owns more than a single plant accounts for around 30% of the multinational effect in regression 1.

Table 5: Multivariate Probits of Plant Exit

	Regression				
	(1)	(2)	(3)	(4)	(5)
Multinational Dummies					
Multinational Dummy	.13***	.09***	.01	.42***	1.65***
	(12.49)	(8.33)	(1.12)	(6.02)	(8.27)
Plant-level Variables					
Size	-.43***	-.40***		-1.24***	.29***
	(-29.50)	(-29.63)		(-29.03)	(-30.28)
Capital Intensity	-.09***	-.09***		-.22***	.81***
	(-8.79)	(-9.32)		(-7.71)	(-9.47)
TFP	-.05***	-.05***		-.32***	.73***
	(-5.29)	(-5.18)		(-3.59)	(-4.85)
Wages	.11***	.11***		.91***	2.05***
	(9.02)	(9.23)		(9.15)	(9.02)
Firm-level Variables					
Export Dummy	.02	.01	-.01	.00	1.01
	(1.28)	(.49)	(-.62)	(.07)	(.21)
Import Dummy	.03***	.03***	.02*	.17**	1.18***
	(2.97)	(2.62)	(1.72)	(2.42)	(2.60)
Multiplant Dummy		.18***	.22***	1.00***	2.44***
		(19.79)	(23.73)	(17.24)	(17.25)
R&D Intensity	.05***	.01	-.06***	.00	1.00
	(5.32)	(1.36)	(-5.98)	(1.43)	(1.34)
Industry-level Variables					
Grubel-Lloyd Index	-.02	-.02	-.03	-.07	.90
	(-.44)	(-.35)	(-.68)	(-.40)	(-.73)
LWPEN	.02	.02	.03	.03	1.02
	(.23)	(.34)	(.44)	(.21)	(.14)
OTHPEN	-.06	-.06	-.05	-.15	.91
	(-.77)	(-.81)	(-.62)	(-.62)	(-.54)
Sunk Costs	-.03***	-.03***	-.03***	-.02	.96***
	(-2.74)	(-2.73)	(-2.47)	(-1.05)	(-2.82)
Industry Dummies	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Number of Observations	131559	131559	131559	15627	131669
Pseudo R^2	.13	.15	.07	-	-

Notes: Standardised coefficients reported in regressions 1 to 3. Logit coefficient estimates are reported in 4 and hazard ratios are reported in 5. Z-scores are clustered at the firm level and reported in parentheses. The industry dummies include controls for the both the plant and firm's industry. ***, ** and * indicate significance at the 1, 5 and 10 percent level of confidence.

In regression 3 we test the extent to which the evidence for multinationals being more likely to close plants is conditional on the inclusion of other plant controls. We test this by excluding the other plant controls. We continue to observe that multiplant firms and importers are significantly more likely to shutdown their plants however, the multinational dummy is now insignificant. Consistent with Bernard and Jensen's (2002) findings for the United States we find that this view of multinationals as footloose is conditional. More generally multinationals are no more likely to closedown their plants than non-multinationals.

Of the remaining industry level control variables included in regression 2 of Table 5, only industry sunk costs are found to have a significant effect on exit. This supports evidence from Dunne et al. (1988, 1989), Bernard and Jensen (2007) for the US, Geroski (1991a, 1991b) for the UK and Greenaway et al. (2008) for Sweden. For Japan we do not find industry measures of globalisation to affect exit. This contrasts with the evidence from Bernard et al. (2006) who found that imports from both low-wage and other countries increase the probability that a plant will die in the United States, and is a feature of the results discussed in greater detail in Inui et al. (2009).

In the remaining regressions of the table we consider the robustness of our 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 4 in Table 5 repeats the regression in column 2 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 4 and 5 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. Importers and multiplant firms remain more likely to close plants, as are multinationals. Sunk costs continue to be the sole significant industry-level determinant of exit. The only departure from the initial results is that sunk costs are insignificant when the rare events logit estimator is used.

4. Exit within Multiplant Firms

Given that multinational firms have been shown to be more likely to shut their plants, an interesting question that follows from this is, can we identify the characteristics of those plants and the possible motives behind their closure. In Table 6 we consider these questions separately for multiplant firms that only have operations domestically and those with foreign affiliates. In the following regressions the plant variables are measured relative to the firm. For example, the size ratio is the natural logarithm of the number of plant employees divided by the number of workers employed by the firm. Similar measures are constructed for capital and input intensity. Difficulties in comparing productivity across possibly different industries of the firm lead us to exclude this variable from this part of the analysis.

A striking feature of the results in Table 6 is the high degree of similarity between the type of plants that are closed by multinationals and domestic multiplant firms. For example, regardless of whether the firm has affiliates abroad or not, plants that are large and capital intensive relative to the firm are significantly less likely to exit. For multinational firms there is again the suggestion that this decision to shut plants may be associated with the decision to move production out of Japan, to offshore. Relatively high wage plants owned by multinational firms are 6 percentage points more likely to close, but we do not find any such effect for domestic multiplant firms. This may be because domestic multiplant firms are constrained by keiretsu networks

and the added necessity of locating within an industrial cluster to fulfil just-in-time contracts.

To capture the how the plant's position in the production chain affects its survival we also include a measure of the input intensity of the plant relative to the firm. Input intensity is defined as the ratio of intermediate inputs to sales. We interpret higher values as indicating upstream production[10]. The results suggest that multinationals and domestic multiplant firms are more likely to close plants producing intermediate inputs rather than final goods. The magnitude of the effect is again not drastically different between multinationals and other multi-plant firms; a one standard deviation change increase in relative input intensity raises the probability of exit by 32 and 27 percentage points at MNE and multiplant firms respectively. Given that one motive for closing upstream plants producing intermediate inputs is to take advantage of lower production costs abroad it would seem that this has affected all multi-plant firms within Japan to a similar extent and not disproportionately multinational firms.

[10] Another possibility is that input intensity could be measuring a plant's value added to production.

Table 6: Multivariate Probits of Plant Exit within Multiplant Firms

	Regression		
	(6)	(7)	(8)
Firm Type	**MNE**	**Multi**	**Both**
Plant-level Variables			
$Size^{Plant}/Size^{Firm}$	-.51***	-.41***	.06
	(-21.91)	(-21.81)	(1.60)
$Capital\ Intensity^{Plant}/Capital\ Intensity^{Firm}$	-.12***	-.13***	-.01
	(-8.53)	(-10.17)	(-1.04)
$Wages^{Plant}/Wages^{Firm}$	.06***	-.02	.06***
	(4.44)	(-1.08)	(4.20)
$Input\ Intensity^{Plant}/Input\ Intensity^{Firm}$	.32***	.27***	-.13
	(11.29)	(11.42)	(-.90)
Firm-level Variables			
Multinational Dummy			.01
			(.07)
Export Dummy	.01	-.03	.05
	(.37)	(-1.46)	(1.43)
Import Dummy	.02	.03*	-.02
	(1.10)	(1.76)	(-.70)
Same Industry Dummy	-.00	-.00	-.00
	(-.13)	(-.01)	(-.07)
R&D Intensity	-.01	-.07***	.03**
	(-.55)	(-3.88)	(2.00)
Industry-level Variables			
Grubel-Lloyd Index	-.00	.00	.03
	(-.05)	(.03)	(1.05)
LWPEN	.09	.08	.07
	(.83)	(.62)	(1.56)
OTHPEN	-.08	-.24	.00
	(-.64)	(-1.64)	(.03)
Sunk Costs	-.06***	-.01	-.06**
	(-2.73)	(-.44)	(-2.03)
Industry Dummies	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Number of Observations	31520	33177	64825
Pseudo R^2	.16	.14	.14

Notes: Standardised coefficients reported. Z-scores are clustered at the firm level and reported in parentheses. The industry dummies include controls for the both the plant and firm's industry. The multinational dummy includes domestic and foreign multinationals. The number of observations in regression 8 exceeds the number in 6 and 7 because in the larger sample fewer observations are dropped due to collinearity. ***, ** and * indicate significance at the 1, 5 and 10 percent level of confidence.

The explanation behind the significance of the importer variable in Table 5 would appear to be the behaviour of non-MNE multiplant firms. Importing multinationals are not more likely to close their plants, whereas plants belonging to domestic multiplant firms that import are 3 percentage points more likely to exit. Indeed this

variable represents one of the few significant differences in the determinants of behaviour between MNEs and non-MNEs. We take its significance to indicate that the mode of offshoring differs between these two types of firm. For example, as shown by the relative wage variable, multinationals offshore through relocating their operations abroad but domestic multiplant firms outsource production instead (they import from non-affiliates rather than affiliates). This is in line with Antas and Helpman (2004) who suggest that the costs of relocating production abroad are greater than those associated with outsourcing. These results also suggest that when studying the consequences of outward FDI decisions on the performance of the firms further insight would be gained if the analysis were broadened to include all offshoring decisions.

We also include in the regression a variable indicating whether the plant operates in the same 3 digit industry as the firm itself. Kimura and Fujii (2003) have previously suggested that plant closure in Japan was attributable to firm's expansion into industries outside their core competencies in the 1980s. We do not find this to be the case. Similarly exporting status continues to be an insignificant determinant of exit. Elsewhere in the literature exporters have been found to be less likely to close due to their superior characteristics (see The International Study Group on Exports and Productivity, (2007) for a cross-country comparison). Finally there are reasons to believe that that a firm's R&D expenditure may affect the markets in which a firm operates. Baldwin and Gu (2004) find Canadian exporters to perform more R&D than non-exporters. For Spain, Perez et al. (2004) find that R&D intensity lowers the hazard rate. Kimura and Kiyota (2003) also find Japanese firms which conduct R&D face lower hazard rates. R&D intensity lowers the probability of exit only among domestic multiplant firms where a one standard deviation increase in firm R&D intensity reduces the threat of closure by 7 percentage points.

The effect of the industry-level variables remains similar to those found in Table 5, in particular the globalisation variables are again not found to affect closure among multiplant firms. The sunk cost variable remains significant. A one standard deviation increase in sunk costs reduces exit by 6 percentage points but only for MNE owned plants.

In regression 8 we test whether the behaviour of MNEs and non-MNEs can be more formally accepted as different. We pool the observations on all multi-plant firms and then include a multinational dummy variable which takes the value of 1 if the firm is either a domestic or foreign multiplant multinational and zero if the owner is a domestic multiplant firm and then interact this variable with the plant, firm and industry variables. For reasons of space we report the coefficient estimates for the interactions between the multinational variable and the plant, firm and industry variables only. The results of the full model may be found in Appendix Table 2.

The results from this regression confirm that multinationals and multi-plant non-MNEs behave similarly in their choice about which plants to shut. In this sense domestic MNEs are no more likely to shutdown plants than domestic multiplant firms. The interactions only show a few significant differences between the criteria used to close plants across these firms. Specifically, multinationals are significantly more likely to close high wage plants and those in industries with low sunk costs. Likewise R&D intensity interaction shows that domestic multiplant firms with high R&D intensities are significantly less likely to close plants than similar multinationals.

5. Why are Multinationals "Footloose"?

The results in the previous section showed that multinationals are more likely to close relatively small, capital un-intensive, high-wage and upstream plants. Given that on average MNEs plants display superior performance characteristics compared to non-MNEs, in this section of the paper we consider whether it is this process of closing plants that are weaker *relative* to the rest of the firm that explains why MNEs were found to be footloose in Table 5.

To examine this question we return to the regression model explaining plant closure across all firm types to which we add an interaction term between the MNE (0/1) indicator with relative plant variables from Table 6. To examine which of the relative plant variables has the strongest effect on the direct MNE variable, the 'footloose' effect, we introduce these one at a time across regressions 9 to 12 and then include all of them in regression 13.

Comparing across regressions 9 to 12 it is clear that two of the relative plant measures are capable of explaining all of the footloose effect of MNEs from Table 5, relative size and relative input intensity, whereas the plant's capital intensity and its relative wage costs has little or no effect on the size or significance of the MNE indicator. The results from regression 9 suggest that plants that are small in size are more likely to close, to which we can also add that there is an additional effect on that probability for those plants that are small compared to the rest of the multinational firm. We find a similar additional effect from capital intensity of MNE plants, although unlike the size variables this reduces the size of the MNE effect by 11 per cent. Regression 11 also suggests an effect from input intensity of the plant compared to the rest of the MNE, but this enters with the unexpected sign compared to the results found in Table 6. Regression 13 suggests that this finding may be a consequence of excluding the other firm level controls. In this regression we find that size, relative capital intensity, but now also relative wage explains why MNEs are footloose.

Table 7: Determinants of the "Footloose" Effect

	Regression										
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Multinational Dummy	.00	.08***	.09***	-.01	.01	.05***	.09***	.09***	.04***	.04***	-.39***
	(.29)	(7.62)	(8.52)	(-.35)	(.71)	(4.09)	(8.01)	(8.13)	(3.27)	(3.08)	(-4.83)
Multiplant Dummy	.16***	.18***	.18***	.16***	.17***	.05***	.16***	.18***	-.44***	-.31***	-.11
	(16.71)	(19.49)	(19.88)	(15.03)	(16.19)	(3.86)	(16.43)	(19.36)	(-9.88)	(-4.27)	(-1.34)
Plant Relative to Firm Variables Interacted with the Multinational Dummy											
$Size^{Plant}/Size^{Firm}$	-.11***				-.13***						.11***
	(-7.58)				(-5.99)						(3.94)
Cap^{Plant}/Cap^{Firm}		-.02***			-.03***						-.02*
		(-2.76)			(-3.56)						(-1.83)
$Wage^{Plant}/Wage^{Firm}$			.01		.02***						.04***
			(1.37)		(2.66)						(3.60)
$Input\ Intensity^{Plant}/Input\ Intensity^{Firm}$				-.13***	.04						-.59***
				(-5.00)	(1.21)						(-5.35)
Plant Relative to Firm Variables Interacted with the Domestic Multiplant Dummy											
$Size^{Plant}/Size^{Firm}$						-.18***				-.07**	-.11***
						(-13.52)				(-2.55)	(-3.78)
Cap^{Plant}/Cap^{Firm}							-.07***			-.06***	-.05***
							(-7.34)			(-6.32)	(-4.90)
$Wage^{Plant}/Wage^{Firm}$								-.02**		.00	-.02*
								(-2.28)		(.20)	(-1.68)
$Input\ Intensity^{Plant}/Input\ Intensity^{Firm}$									-.70***	-.47***	-.20*
									(-14.04)	(-4.73)	(-1.87)
Plant-level Variables											
Size	-.38***	-.40***	-.40***	-.41***	-.38***	-.35***	-.40***	-.40***	-.45***	-.41***	-.44***
	(-27.82)	(-29.72)	(-29.62)	(-31.44)	(-26.20)	(-24.54)	(-29.77)	(-29.88)	(-36.24)	(-21.51)	(-22.17)
Capital Intensity	-.10***	-.08***	-.09***	-.10***	-.09***	-.11***	-.03**	-.09***	-.12***	-.06***	-.06***
	(-10.48)	(-7.41)	(-9.22)	(-9.97)	(-7.95)	(-11.18)	(-2.51)	(-9.53)	(-12.22)	(-4.85)	(-4.84)
TFP	-.05***	-.05***	-.05***	-.05***	-.05***	-.05***	-.05***	-.05***	-.07***	-.06***	-.06***
	(-5.42)	(-5.24)	(-5.12)	(-5.49)	(-5.33)	(-5.65)	(-5.52)	(-5.29)	(-7.58)	(-7.01)	(-7.22)
Wages	.10***	.11***	.10***	.10***	.09***	.09***	.11***	.12***	.09***	.09***	.08***
	(8.46)	(9.26)	(8.11)	(8.87)	(7.01)	(8.15)	(9.06)	(9.01)	(7.58)	(6.80)	(6.20)
Firm-level Variables											
Export Dummy	.00	.01	.01	.00	.00	.00	.01	.01	.00	.00	.00
	(.30)	(.51)	(.48)	(.37)	(.30)	(.14)	(.50)	(.49)	(.13)	(.13)	(.18)
Import Dummy	.03***	.03***	.03***	.03***	.03***	.03**	.03***	.03**	.02**	.03**	.03**
	(2.68)	(2.64)	(2.68)	(2.69)	(2.82)	(2.41)	(2.65)	(2.52)	(2.15)	(2.24)	(2.36)
R&D Intensity	.01	.01	.01	.01	.00	-.02	.01	.01	-.02	-.02**	-.02*
	(.49)	(1.24)	(1.47)	(1.07)	(.46)	(-1.56)	(.85)	(1.04)	(-1.51)	(-2.09)	(-1.81)
Industry-level Variables											
Grubel-Lloyd Index	-.02	-.02	-.01	-.02	-.02	-.01	-.02	-.02	-.01	-.01	-.02
	(-.41)	(-.34)	(-.33)	(-.38)	(-.36)	(-.30)	(-.38)	(-.39)	(-.32)	(-.33)	(-.38)
LWPEN	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.01
	(.33)	(.31)	(.34)	(.31)	(.30)	(.34)	(.30)	(.31)	(.32)	(.30)	(.22)
OTHPEN	-.06	-.06	-.06	-.06	-.05	-.05	-.06	-.06	-.05	-.05	-.05
	(-.80)	(-.77)	(-.79)	(-.82)	(-.73)	(-.73)	(-.79)	(-.81)	(-.66)	(-.67)	(-.64)
Sunk Costs	-.03***	-.03***	-.03***	-.03***	-.03***	-.03***	-.03***	-.03***	-.03***	-.03***	-.03***
	(-2.73)	(-2.75)	(-2.73)	(-2.71)	(-2.75)	(-2.75)	(-2.76)	(-2.73)	(-2.77)	(-2.79)	(-2.73)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	131559	131538	131559	131559	131538	131559	131538	131559	131559	131538	131538
Pseudo R^2	.15	.15	.15	.15	.15	.16	.15	.15	.16	.16	.16

Notes: Standardised coefficients reported. Z-scores are clustered at the firm level and reported in parentheses. The industry dummies include controls for the both the plant and firm's industry. ***, ** and * indicate significance at the 1, 5 and 10 percent level of confidence.

Our results demonstrate that multinationals are not inherently "footloose". Rather they point to multinationals closing weaker plants. A similar process was found for

multi-plant non-MNEs in Table 6. In the remainder of the table we therefore repeat the analysis to investigate whether we can explain why multiplant ownership increases the probability of exit and to see if closure at these firms is similar to the patterns we observe among multinationals. We model these as an interaction term between a dummy variable indicating non-MNE multi-plant firms. Again we introduce the relative plant characteristics one at a time in regressions 14 to 17 and then all together in regression 18. It is worth noting that as we still include in the regression the multi-plant indicator (MNEs and non-MNEs) the inclusion of these new relative plant characteristics terms also tends to affect the estimated marginal effect found on the MNE indicator.

In regressions 14 to 17 the interactions between the multiplant dummy and the plant-to-parent variables show that, like multinationals, multiplant firms are also less prone to closing large, capital intensive and downstream plants. Indeed relative plant size appears to be the most important driver of the effect multiplant ownership has on plant survival since it explains 72% of the multiplant coefficient. Unlike with multinationals, the multiplant dummy remains significant and positive in regressions 14 to 16 however. A difference between multi-plant and non-multi-plant firms remains. The inclusion of the relative input intensity of the plant shows that multiplant firms are 70 percentage points less likely to close upstream plants. However, unlike in the previous regressions, when we condition on a plants relative material intensity multiplant firms are 44 percentage points less likely to close a plant relative to all other types of firm. In regression 18 these results persist though they are smaller and the relative wage variable becomes insignificant.

Finally, in regression 19 we include the interaction effects between the plant relative to parent variables and the multinational and multiplant non-MNE indicators. Perhaps most strikingly from this regression we now find that, conditional on plant, firm, industry and interaction effects, relative to single plant domestic firms multinationals are actually 39 percentage points less likely to shutdown their plants. It appears that the ‘footloose’ effect is more than attributable to multinational firms, or indeed all multi-plant firms, closing weaker plants. Once we account for this difference in behaviour we find that domestic MNEs are actually deeply embedded into their home economies.

6. Conclusions

This paper has investigated why multinational ownership is frequently found to raise the probability of plant death using unique Japanese data that links plant data with firm data. We find that the multinational "footloose" effect is attributable to multinationals closing their weakest plants. Specifically, small and downstream plants face significantly higher exit likelihoods when they are owned by a multinational firm even when we control for a host of plant, firm and industry determinants of death.

The above results have a potentially interesting implication for aggregate productivity growth in Japan. Within the Melitz model of heterogenous firms and international trade, trade liberalisation is welfare improving because it leads to the death of the least productive firms. Subsequently, their output is then reallocated towards more productive firms within the industry which raises aggregate productivity. An assumption of the model is that the least productive firms will always be the ones that exit. However, our results suggest that when a plant is weaker compared to other units within the same firm, but both larger and more productive relative to other firms in the same industry, its death could disrupt the positive effect that increased globalisation is predicted to have on aggregate industry productivity. Based on a Griliches and Regev decomposition of aggregate productivity growth we find for Japan that this effect is small. Entry and exit account for 0 per cent of total aggregate productivity growth.[11] This is perhaps explained by the Japanese context however, which has been characterised by both low productivity growth (references) and low rates of entry and exit (Caballero et al., 2003; Peek and Rosengren, 2003; Ahearne and Shinada, 2005; and Inui et al., 2009). It would therefore be interesting to investigate this possible negative effect of globalisation in other contexts.

[11] This finding is robust to the use of a Foster, Haltiwanger and Krizan decomposition.

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Appendix

Total Fator Productivity

There are 48 manufacturing industries in our dataset. Total factor productivity (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

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

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 to 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 Variables

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)[12]. 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. (2008) for Sweden. In their results, the estimated coefficient on imports from outside the OECD is twice as large as that for OECD imports.

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 sectors they operate in currently. It has been established by Greenaway et al. (2008) 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:

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

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

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. Sunk costs also play a key role in determining exporting behaviour (Roberts and Tybout, 1997) and can affect the distribution of productivity in the industry (Aw et al. {2002}).

Appendix Table 1: Industry-level Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Grubel-Lloyd Index Trade that is intra-industry	144739	.50	.27	.01	1.00
Sunk Costs Minimum of entry and exit rates	155714	.01	.01	.00	.05
Import Competition Imports divided by apparent consumption	121760	.09	.09	.00	.67
LWPEN Low-wage imports	121760	.03	.04	.00	.28
OTHPEN Imports from all other countries	121760	.06	.06	.00	.55

Appendix Table 2: Multivariate Probits of Plant Exit within Multiplant Firms

	Regression		
	(6)	(7)	(8)
Firm Type	**MNE**	**Multi**	Both
Plant-level Variables			
$Size^{Plant}/Size^{Firm}$	-.51***	-.41***	-.51***
	(-21.91)	(-21.81)	(-21.94)
$Capital\ Intensity^{Plant}/Capital\ Intensity^{Firm}$	-.12***	-.13***	-.12***
	(-8.53)	(-10.17)	(-9.85)
$Wages^{Plant}/Wages^{Firm}$	.06***	-.02	-.02
	(4.44)	(-1.08)	(-1.32)
$Input\ Intensity^{Plant}/Input\ Intensity^{Firm}$	.32***	.27***	.39***
	(11.29)	(11.42)	(11.45)
Firm-level Variables			
Export Dummy	.01	-.03	-.03
	(.37)	(-1.46)	(-1.45)
Import Dummy	.02	.03*	.04*
	(1.10)	(1.76)	(1.82)
Same Industry Dummy	-.00	-.00	-.00
	(-.13)	(-.01)	(-.20)
R&D Intensity	-.01	-.07***	-.06***
	(-.55)	(-3.88)	(-3.93)
Industry-level Variables			
Grubel-Lloyd Index	-.00	.00	-.00
	(-.05)	(.03)	(-.06)
LWPEN	.09	.08	.06
	(.83)	(.62)	(.70)
OTHPEN	-.08	-.24	-.09
	(-.64)	(-1.64)	(-.93)
Sunk Costs	-.06***	-.01	-.01
	(-2.73)	(-.44)	(-.52)
Interaction Terms			
Multinational Dummy			.01
			(.07)
x $Size^{Plant}/Size^{Firm}$			.06
			(1.60)
x $Capital\ Intensity^{Plant}/Capital\ Intensity^{Firm}$			-.01
			(-1.04)
x $Wages^{Plant}/Wages^{Firm}$			.06***
			(4.20)
x $Input\ Intensity^{Plant}/Input\ Intensity^{Firm}$			-.13
			(-.90)
x Export Dummy			.05
			(1.43)
x Import Dummy			-.02
			(-.70)
x Same Industry Dummy			-.00
			(-.07)
x R&D Intensity			.03**
			(2.00)
x Grubel-Lloyd Index			.03
			(1.05)
x LWPEN			.07
			(1.56)
x OTHPEN			.00
			(.03)
x Sunk Costs			-.06**
			(-2.03)
Industry Dummies	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Number of Observations	31520	33177	64825
Pseudo R^2	.16	.14	.14

Notes: Standardised coefficients reported. Z-scores are clustered at the firm level and reported in parentheses. The industry dummies include controls for the both the plant and firm's industry. The multinational dummy includes domestic and foreign multinationals. The number of observations in regression 8 exceeds the number in 6 and 7 because in the larger sample fewer observations are dropped due to collinearity. ***, ** and * indicate significance at the 1, 5 and 10 percent level of confidence.