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**Working Paper**

## Multinational companies, technology spillovers and firm survival: evidence from Irish manufacturing

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Research Paper 2000/12

# **Multinational Companies, Technology Spillovers and Firm Survival: Evidence from Irish Manufacturing**

by

**Holger Görg and Eric Strobl**

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# **Multinational Companies, Technology Spillovers and Firm Survival: Evidence from Irish Manufacturing**

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**H. Görg and E. Strobl**

## **Abstract**

This paper examines the effect of the presence of multinational companies on firm survival in the host country. We postulate that MNCs can impact positively on firm survival through technology spillovers, and negatively through the crowding out of rivals. We study the nature of the effect of multinationals using a Cox proportional hazard model which we estimate using firm level data for Irish manufacturing industries. Our results show that, controlling for other firm and sector-specific effects, the presence of multinationals has a life enhancing effect on indigenous firms in high tech industries, suggesting the presence of technology spillovers. We do not find any effect of MNC presence on indigenous low tech firms, however. We also discover that there are negative effects of the presence of MNCs on the survival of foreign firms in low tech sectors, while there is no evidence of an effect from the presence of multinationals on the survival of foreign high tech firms.

## **Outline**

1. Introduction
2. Data Set
3. Estimation of Survival Functions
4. Modelling Firm Survival using a Hazard Function
5. Conclusions

## Non-Technical Summary

Technology spillovers from foreign multinationals to domestic firms are seen as an important benefit to host countries from attracting foreign investment. These spillovers are frequently studied empirically in a regression framework, regressing productivity in host country firms on a proxy for the extent of foreign presence in the sector, and a number of other firm and industry specific variables.

The present paper takes the analysis of technology spillovers a step further. We postulate that an increase in productivity through technology spillovers will, all other things equal, reduce a host country firm's average cost of production. This has obvious benefits for the firm, and we are concerned in this paper with the benefit associated with firm survival. Our analysis is based on the insight that a firm's probability of survival increases as its price-cost margin increases, which implies that a reduction in average cost following technology spillovers should increase the firm's probability of survival, all other things equal.

However, multinationals can also have negative effects on firm survival. For example, if domestically-based firms face high fixed costs, then multinationals, by increasing output may force domestic firms to reduce production, thus increasing their average costs of production. This will reduce firms' chances of survival, *ceteris paribus*.

We examine the effect of multinational companies on firm survival in the host country empirically, using firm level data for Irish manufacturing industries for the period 1973 to 1996. Ireland appears to be a model example to study this effect since its industrial structure is heavily dependent on foreign multinationals. We study the effect of multinationals on firm survival in the host country using a Cox proportional hazard model where we relate the survival of a firm to a number of explanatory variables, including a proxy for the presence of foreign multinationals in the sector.

Our results show that, controlling for other firm and sector-specific effects, the presence of multinationals has a life enhancing effect on indigenous firms in high tech industries, suggesting the presence of technology spillovers. We do not find any effect of MNC presence on indigenous low tech firms, however. While there may potentially have been opportunities for spillovers in this case, our results suggests that the lack of such may be due to the inability of indigenous low tech firms to absorb the relevant knowledge. We also find that there are negative effects of the presence of MNCs on the survival of foreign firms in low tech sectors, while there is no evidence of an effect from the presence of multinationals on the survival of foreign high tech firms.

## 1 Introduction

Multinational companies and the associated foreign direct investment (FDI) can have various effects on the host country over and above the inflow of physical capital. In particular, foreign direct investment can lead to the inflow of superior knowledge into the economy, which can be adapted by host country firms.<sup>1</sup> Multinational companies (MNCs) find it profitable to invest abroad because they own firm-specific assets, one of which is the multinational's access to superior production technology (Caves, 1971; Hymer, 1976). The inflow of superior knowledge can lead to technology spillovers to host country firms, improving their productive efficiency as they learn from MNCs (Findlay, 1978; Wang 1990). Technology spillovers can occur through different channels, for example, through arms' lengths relationships between host country suppliers and MNC customers, where suppliers learn new production technologies through contacts with customers, or through staff movements from MNCs to host country firms (Blomström and Kokko, 1998).

There have been a number of empirical studies of the presence of technology spillovers between MNCs and host country firms, such as Caves (1974) for Australia, Globerman (1979) for Canada, Blomström (1989) and Kokko (1994, 1996) for Mexico, Haddad and Harrison (1993) for Morocco, and Aitken and Harrison (1999) for Venezuela. These studies usually regress productivity in host country firm  $i$ , measured as either labour or total factor productivity, on a number of firm and industry variables. To check for technology spillovers, they also include a proxy for the extent of MNC investment in the sector in which firm  $i$  operates. The results are mixed, showing that the effects of FDI on technology are different for different countries and sectors.

The mixed results provide evidence for the claim that technology spillovers will only take place if there is a technology gap between the technology transferring and the receiving firm (Wang and Blomström, 1992; Glass and Saggi, 1998). In other words, if host country firms used the same level of technology as MNCs there would be no potential for spillovers; they will only benefit if they use a relatively backward technology compared to MNCs. The presence of such a technology gap can be expected to vary across countries and industries, as suggested by the empirical studies.

An increase in productivity through technology spillovers will, all other things being equal, reduce a host country firm's average cost of production, which has obvious benefits for the firm. In this paper, we are concerned with the benefit associated with firm survival.

Audretsch (1991, 1995) argues that the probability of firm  $i$  remaining in industry  $j$  at time  $t$  is determined by a firm's price cost margin, i.e., the degree to which price exceeds a firm's average cost. According to this argument a firm's ability to increase price and/or reduce average cost will have a positive effect on firm survival, *ceteris paribus*. In this framework, technology spillovers from MNCs and the associated increase in productivity enable host country firms to produce at lower average cost for a given level of production, which increases their price-cost-margins. All other things equal, this leads to a higher probability of survival for host country firms.

The presence of multinationals can also have negative effects on the survival of indigenous firms, however. As Aitken and Harrison (1999) argue, foreign firms producing at lower marginal costs than indigenous firms have an incentive to increase output and attract demand away from indigenous firms. This will cause host country rivals to cut production which, if they face fixed costs of production, will raise their average cost as fixed costs have to be spread out over a smaller quantity and, therefore, reduce their probability of survival. Also, to the extent that the presence of multinationals leads to higher wage demands in the economy, this will increase a firm's average costs. This, all other things being equal, will also reduce its probability of survival. Whether the effect of MNCs on the survival of host country firms is, on average, positive or negative is, therefore, ambiguous and needs to be decided empirically.

We address this issue using the example of the Republic of Ireland, which appears to be a model example to study the effect of multinationals on firms' survival due to the importance of MNCs for its economy. Data from the Irish Central Statistics Office show that foreign multinationals in Ireland accounted for roughly 47 percent of manufacturing employment and 77 percent of net output in manufacturing in 1996. The corresponding figures in 1983 (the first year for which these data are available) were 38 percent and 58 percent respectively, which illustrate the increasing importance of multinationals for Irish manufacturing industries. While indigenous manufacturing industry tended to be concentrated on traditional and food-sector manufacturing activities, MNCs have invested primarily in modern high tech sectors. This has led to a rapid increase in the significance of the high tech sectors for the Irish economy and has arguably contributed to Ireland's high rates of economic growth in the 1990s (Barry and Bradley, 1997; Görg and Ruane, 2000).

From the perspective of this paper, the increasing role of MNCs provides us not only with cross-sectional but also intertemporal variation in the degree of FDI.

We investigate whether the presence of multinational companies in sector  $j$  has any effect on the survival of firms in the same sector, *ceteris paribus*. In examining the effect of MNCs on the survival of host country firms we distinguish between the impact of MNCs on Irish-owned (indigenous) firms and on foreign-owned firms (i.e., other MNCs) located in the host country, the latter essentially serving as a natural control group. As regards indigenous firms, we would expect a potential technology gap to exist between them and MNCs (due to MNCs' firm-specific assets) which creates the opportunity for technology spillovers between the two groups of firms. As to the effect of MNCs' presence on other foreign-owned firms in the host country, the potential for positive spillovers may be less since all MNCs may be expected to use a similarly high level of technology. The negative effects of MNC presence may, however, affect both indigenous and foreign firms.

There have been several studies of firm survival for Ireland which relate to our paper.<sup>2</sup> Kearns and Ruane (2000), in their analysis of the effect of R&D undertaken in a foreign-owned firm and subsequent survival of that firm, conclude that the scale of R&D activity lengthens a multinational's duration over which it will stay in Ireland. Konings and Walsh (1997) analyse the survival of all manufacturing firms (both indigenous and foreign) that started up in the 1980s and find that firms operating in high tech sectors have a higher probability of survival than firms in low tech sectors. From a regional perspective, Killen and Ruane (1998) examine whether firm survival rates are different for firms located in Ireland's peripheral and core regions, and whether there are differences between indigenous and foreign firms in this regard. They find that survival rates are higher for indigenous firms located in core regions but lower for foreign firms compared to peripheral regions. To the best of our knowledge, however, the effect of MNCs on the survival of firms has not received any in-depth attention in the literature, either international or Irish, to-date.

In our empirical analysis we find that the presence of MNCs has positive effects on the survival of indigenous firms in high tech industries, suggesting the presence of technology spillovers, while we do not find any evidence for spillovers to indigenous low tech firms. The presence of MNCs also appears to have a negative effect on the survival of other foreign firms in low tech sectors, possibly through crowding out, but no effect on other foreign high tech firms.



The remainder of the paper is structured as follows. In Section 2 we discuss briefly the dataset used, while Section 3 presents the estimation of simple Kaplan-Meier survival functions as a first step towards analysing firm survival. Section 4 goes one step further by estimating a hazard function. Section 5 summarises our results and presents some concluding comments.

## **2 Data Set**

In order to investigate the relationship between nationality of ownership and firm survival we use data taken from the Employment Survey which is carried out annually by Forfás, the policy and advisory board for industrial development in Ireland. The survey has been undertaken since 1973 and data are available to us for the period 1973 to 1996. The main advantages of the survey are that it covers virtually all known active manufacturing companies, and that the response rate is generally over 99 per cent, thus providing a sample of over 17,000 firms. For these firms we are provided with information on employment, nationality of ownership, sector of location, and start-up year, amongst other things. A firm is classified as being foreign-owned if 50 percent or more of its shares are held by foreign owners.

Given the nature of our data set, the observed life times of some of the firms in the sample is necessarily left truncated while others are right censored, and these phenomena are appropriately dealt with in all estimations in the paper.<sup>3</sup> In total our sample covers 17,789 firms, 4,658 of which existed at the beginning of our sample period and 6,667 of which existed at the end of our sample period. Of those that existed in the beginning only 1,632 remained at the end of our sample period.

Table 1 provides summary measures of the foreign and indigenous sub-sectors of Irish manufacturing for the years 1973, 1984 and 1996. The foreign multinational sector has steadily increased its share of manufacturing employment from roughly 33 to 45 per cent. The number of foreign multinational firms is substantially smaller than that of indigenous firms resulting in a considerably larger average size for foreign firms. Additionally, while there was a notable average age difference at the start of our sample period between indigenous and foreign firms, this has now largely disappeared.

We have also grouped the 68 sub-sector classifications used throughout this paper into two broader groups – high and low technology sectors – in order to provide and compare

summary statistics for indigenous and foreign firms within sectors of different technology intensity.<sup>4</sup> The statistics show that indigenous high tech firms are considerably smaller than foreign high tech firms, and while their average size has fallen since 1973 the size of foreign firms has risen over the sampling period. The indigenous firms in this broad sectoral group were also on average older than their foreign counterparts in 1973 but by the end of our sample period were relatively younger. In the low technology sectors, in contrast, the average size of both foreign and indigenous firms has fallen, although that of indigenous firms still remains substantially smaller. A similar trend in terms of age that we found for the high tech sectors is also apparent for the low tech sectors – indigenous firms originally somewhat older are in 1996 on average younger than their foreign counterparts.

*[Table 1 here]*

### 3 Estimation of Survival Functions

As a first step in examining and comparing indigenous and foreign firm survival we calculate Kaplan-Meier (K-M) survival functions, given by:

$$\hat{S}(t) = \prod_{j|t_j \leq t} ([n_j - d_j]/n_j) \quad (1)$$

where  $n_t$  is the population alive and  $d_t$  is the number of failures respectively at time  $t$ .

A priori we would expect the survival functions of foreign and indigenous firms to be different since foreign firms are, in many cases, parts of established multinational networks, whereas indigenous firms are mainly new firms at entry. This implies that survival, if understood as a learning process in the spirit of Jovanovic (1982), has to be understood differently. For foreign firms "learning" means adapting to the new local environment, while for indigenous firms it is the more standard learning process of firms learning about their relative efficiency after market entry.

In order to investigate whether there are differences within our sample with regard to nationality of ownership of firms, we calculated the K-M survival functions for indigenous and foreign firms and these are graphed in Figure 1. Although these do not appear to be substantially different, with that of foreign firms lying marginally above that of indigenous firms, a log rank test for the equality of survival functions can decisively reject the

hypothesis that the two survival functions are equal (the chi-squared test statistic is 8.89, significant at the 1 percent level).

*[Figure 1 here]*

Given that foreign firms are disproportionately more located in high tech sectors it may be that the differences in survival for foreign and indigenous firms are at least partly attributable to this feature. Audretsch (1991, 1995) argues and provides evidence that a major factor impacting on firm survival is a firm's ability to innovate. In a process of creative destruction, firms can only survive if they partake in the innovation process, otherwise they will be overtaken by rivals and, thus, will be forced to exit. While we do not have data on firms' innovation activity, it seems reasonable to assume that the potential for innovation is higher for firms in high tech sectors and, thus, we may expect differences in the survivability of firms in high tech and low tech industries. Also, one may assume that the technology gap between foreign and indigenous firms may be higher in high tech sectors and, hence, that the cost advantage is higher for foreign firms in these sectors.<sup>5</sup>

To control for these factors we also investigated whether survival rates differ within in our two broad technology intensity sectoral groupings, as show in Figures 2 and 3. Clearly, foreign firms have a higher probability of survival in high tech sectors, the log rank chi-squared test statistic is 21.34 and significant at the 1 per cent level. In contrast, there are no apparent differences between the survival functions of indigenous and foreign firms in low tech sectors – the chi-squared statistic of the log rank test of the equality of these is 0.24 and confirms this.

*[Figures 2 and 3 here]*

## **4 Modelling Firm Survival using a Hazard Function**

### *4.1 Specification*

Our primary task in this paper is to determine whether the presence of multinationals has an effect on the survival of both indigenous and foreign firms in Irish manufacturing. In the previous section we found that there are statistically significant differences in firm survival between indigenous and foreign firms, presumably due to differences in the high tech sector. In order to properly disentangle the role of firm and industry specific factors from

that of the presence of MNCs on the survivability of firms in Irish manufacturing we turn to a non-parametric modelling of firms' hazard rates.

We utilise a Cox proportional hazard model (Cox, 1972) as our equation to be estimated. The Cox proportional hazard model is suited for a number of reasons. Firstly, it does not require any restrictive assumptions regarding the baseline hazard, such as for instance a Weibull or lognormal specification. This is appropriate for our purposes, as our main interest is not in the estimation of the underlying baseline hazard (while this has been the main concern in other studies such as McCloughan and Stone, 1998), but in the effect of the presence of MNCs on firm survival. As pointed out in the literature on survival analysis, the non-parametric modelling approach of the Cox proportional hazard model is advantageous if the parametric form of the underlying baseline hazard function is not known with certainty. Moreover, the Cox model allows us to explore the effect of time varying firm and industry specific explanatory variables, which a Weibull or lognormal specification would not allow.

The Cox proportional hazard model specifies the hazard function  $h(t)$  to be the following:

$$h(t) = h_0(t)e^{(b_1MNC_t + b_2SIZE_t + b_3MES_t + b_4HERF_t + b_5GROW_t + b_6OWN + b_7TECH + b_8BEU)} \quad (2)$$

where  $h(t)$  is the rate at which firms exit at time  $t$  given that they have survived in  $t-1$  and  $h_0$  is the baseline hazard function (the parametric form of which is not specified) when all of the covariates are set to zero. The covariates capture the effect of firm and industry characteristics on firm survival.  $MNC$  is a proxy for the presence of multinationals in a sector and is defined as the share of employment by MNCs in sector  $j$  at time  $t$ .<sup>6</sup>  $SIZE$  is the firm's size in terms of employment at time  $t$  and is included because it can now be considered to be a stylised fact that small firms generally have lower probabilities of survival than large firms (see, for example, Audretsch and Mahmood, 1995; Mata and Portugal, 1994; McCloughan and Stone, 1998). Also, Mata et al. (1995) find that current firm size is a better predictor of firm failure than initial size and we, therefore, include size at time  $t$  in our regression.

The minimum efficient scale of the industry,  $MES$ , is measured as the log of median employment size in sector  $j$  due to the lack of more appropriate data.<sup>7</sup> Our a priori

expectation as to the sign of the coefficient is ambiguous. On the one hand, one may expect firms entering industries with large minimum efficient scale to have lower probabilities of survival than firms entering other industries, as small entrants may find it difficult to attain the efficient level of production unless they experience sufficient growth in their infancy (Audretsch, 1991; Mata and Portugal, 1994). On the other hand, as Audretsch (1991) points out, industries with high MES are usually also industries showing high price cost margins, which should increase firm survival.

*HERF* denotes the Herfindahl index of sector  $j$ , which is found to be a significant explanatory variable in the study of firm survival in Portugal undertaken by Mata and Portugal (1994). Again, the expectation of the effect of market concentration on firm survival is not clear-cut. Higher market concentration may lead to higher price-cost-margins in the industry which, *ceteris paribus*, should increase a firm's probability of survival. However, firms in highly concentrated markets may be subject to fierce aggressive behaviour by rivals which may reduce chances of survival.

*GROWTH* is the net sectoral growth rate. Audretsch (1991) argues that industry growth may elevate the price above the long-run average cost, i.e., increase firms' price-cost-margin which would, all other things equal, affect survival rates positively. The sectoral growth rate also allows us to control for other sector specific cyclical effects which may impact on firm survival.

The specification of equation (2) also includes a number of dummy variables. *OWN* is a nationality of ownership dummy taking on the value of one if the firm is foreign and zero otherwise, and *TECH* is a dummy variable equal to one if the firm is located in a sector categorised to be of high technology use. The dummy variable *BEU* takes the value of one if the firm came into existence prior to Ireland's entry into the European Union (EU) in 1973 and is intended to control for different policy regimes at the time of start-up.<sup>8</sup> Finally, we also include time dummies to control for year specific macroeconomic effects.

#### 4.2 Results

The results of estimating different variations of the hazard model described in (2) are presented in Table 2.<sup>9,10</sup> All estimations are stratified by sector, which allows for equal coefficients of the covariates across strata (sectors), but baseline hazards unique to each stratum (sector). As can be seen, the log likelihood and Wald tests provide satisfactory

support for our model specifications. All coefficients have been converted to hazard ratios and hence when these take on a value greater than one should be interpreted as decreasing firm survival, *ceteris paribus*, or if they take on a value less than one should be interpreted as increasing firm survival, all other things equal.

*[Table 2 here]*

The results for the estimation using data for the entire sample are given in column (i) of Table 2. We find that a greater presence of MNCs, measured in terms of share of employment in foreign firms, acts to increase the survival of firms. This may be due to the existence of technology spillovers from MNCs to other firms in the sector, as argued above. This would lead to a reduction of average cost for the benefiting firm which, *ceteris paribus*, increases its probability of survival.

Firm size turns out to affect firm survival positively, i.e., small firms face a higher hazard of exit than do large firms. As pointed out above, this is a fairly standard finding in studies of firm survival; our result is, thus, in line with a large body of other empirical studies. Our results also suggest that, the higher the level of industry concentration, the less likely a firm is to survive. This may indicate that firms in highly concentrated industries are subject to fierce competition, which reduces their likelihood of survival. The coefficient on minimum efficient scale, another variable picking up industry characteristics, is statistically insignificant in the estimation suggesting, perhaps, that the Herfindahl index picks up all industry effects.<sup>11</sup>

Not surprisingly, we find that benevolent economic sectoral conditions, as measured by the sectoral growth rate, decrease the hazard of firm exits. In other words, fast growing markets appear to increase firm survival. This finding is in line with Mata and Portugal (1994) who also find that, for Portuguese firms, fast growing markets make survival easier for new entrants.

Turning to our dummy variables, we find that, controlling for other factors, foreign firms have a lower rate of survival than indigenous firms, i.e., foreign firms are more likely to exit the industry. Thus, while the Kaplan-Meier survival functions above suggested that foreign firms have higher survival rates our regression results indicate that, once we control for other factors, foreign firms have a higher chance of exiting than indigenous firms. This may be due to foreign firms being more footloose than indigenous firms, i.e., all other

things being equal, a foreign multinational company may find it easier to transfer production facilities from one country to another than a comparable indigenous firm to shut down production.

We also find that firms located in high tech sectors are less likely to survive, or more likely to exit, once other sector and firm specific factors are controlled for, than are firms in low tech sectors.<sup>12</sup> If the high tech dummy were a proper proxy for firms' innovative activity we would expect that high tech firms were less likely to exit than low tech firms, as was found by Kearns and Ruane (2000). This suggests that the dummy seems to be a poor proxy for innovative activity, and may be capturing other features of high tech sectors that induce firms to exit more easily than firms in low tech sectors. Moreover, innovative activity may not just be limited to those firms with higher technological intensity.

Finally, we find that firms that started up before Ireland's entry into the EU have a lower rate of survival than those that were born after this policy regime change. This may not be surprising given that many of these firms would have still enjoyed tariffs and other forms of protection until Ireland's EU entry. As Walsh and Whelan (2000) argue, many of such firms failed to adapt to the new challenges of the opened-up markets and subsequently declined since then.

As seems plausible by our results on the ownership and technology dummies in column (i), we decompose our sample into foreign and indigenous firms within high and low tech sectors to obtain more homogenous comparison groups. This reveals a number of interesting features, as shown in columns (ii) to (v).

Within the high tech sectors (column (ii) and (iii)) foreign ownership presence only acts to increase a firm's chance of survival within the indigenous group, but no longer so for foreign firms. This may suggest that, since foreign firms can be expected to use similarly high levels of technology, the lack of a technology gap leaves no potential for technology spillovers from foreign firms to other foreign firms. This indicates that, for firms in the high tech sectors, only indigenous firms benefit (in terms of higher probabilities of survival) from the presence of foreign firms, while foreign firms themselves are not affected by the presence of other foreign firms in the same sector.

Firm size is statistically significant for both indigenous and foreign firms, increasing firm survivability. Industry characteristics, namely minimum efficient scale, sectoral

concentration and sectoral growth are statistically insignificant for both foreign and indigenous co-habitators of the high tech sectors. The insignificance of industry factors presumably indicates the importance of firm characteristics in determining the survival of high tech firms.<sup>13</sup> Characteristics of the high tech industry in Ireland may be largely irrelevant to firms in particular if they are operating at a global scale.

The fact that a firm was born before EU entry only plays a deteriorating role for foreign firms in high tech industries. This may suggest that foreign high tech firms that started up before 1973 may have adjusted more slowly to the change from protectionism to free trade after Ireland's accession to the European Union.

In the low tech group (columns (iv) and (v)) we find that the presence of MNCs in a sector does not appear to have any positive effect on firm survival. In fact, foreign presence acts to reduce the probability of survival for foreign firms in the high tech sectors. This suggests that there may be crowding out in this sub-sector, with foreign firms crowding out other foreign low tech firms and, thus, reducing their probability of survival. As regards indigenous low tech firms, our results show that the presence of MNCs does not appear to impact on firm survival in either direction. This could indicate that, even though there is a technology gap between these firms which creates a potential for technology spillovers, these do not take place, perhaps because indigenous low tech firms are not able to absorb the potential spillovers (see, Kokko, 1996). In other words, the technology gap between these two groups of firms is too wide, indigenous firms do not have the capability to learn from foreign firms.

Similar to the previous results we find that firm size increases the probability of survival for both groups of firms. While MES and the level of concentration are statistically insignificant, sectoral growth plays a life enhancing role for both foreign and indigenous low tech firms. The coefficient on BEU is only statistically significant for indigenous firms which indicates that the fact that a firm existed in Ireland before 1973 only reduces the chances of survival for indigenous firms, but not for foreign firms.

## **5 Conclusions**

This paper examines the effect of the presence of multinational companies on firm survival in the host country. We postulate that MNCs can impact positively on firm survival through technology spillovers. If such technology spillovers take place, the receipt of a



superior technology by the recipient firm will lower its average cost of production which, all other things being equal, will increase a firm's probability of survival. However, multinationals can also have negative effects on firm survival. If domestically-based firms face high fixed costs, then multinationals, by increasing output may force domestic firms to reduce production, thus increasing their average costs of production. This will reduce firms' chances of survival, *ceteris paribus*. Moreover, foreign multinationals may crowd out domestic rivals by increasing the wage rate in the economy.

We study the nature of the effect of multinationals using data for the Irish economy, an economy with high levels of involvement of foreign MNCs. In our empirical analysis, using a Cox proportional hazard model we find that, controlling for other firm and sector specific effects, the presence of multinationals has a life enhancing effect on indigenous firms operating in high tech sectors. This suggests that there may be technology spillovers taking place between foreign and indigenous firms in high tech industries, whereby indigenous firms learn new production technologies, thus enabling them to produce at lower average costs.

We do not find any evidence of an effect from the presence of multinationals on the survival of indigenous low tech firms. While there may potentially have been opportunities for spillovers in this case, our result suggests that the lack of such may be due to the inability of indigenous low tech firms to absorb the relevant knowledge. If this is the case, there would clearly be scope for policy intervention targeted at assisting low tech indigenous firms to increase their learning ability.

We also find that there are no apparent effects of the presence of MNCs on the survival of foreign firms in high tech sectors, possibly due to the lack of any substantial technology gap between such firms. There are, however, negative effects on foreign firms in low tech sectors, indicating that MNCs crowd out other foreign firms in low tech industries.

In a related paper (Görg and Strobl, 1999) we find econometric evidence to suggest that the presence of multinationals has a positive effect on entry of indigenous firms. The results in this paper suggest that this positive effect is not only confined to fostering the entry of indigenous firms, but also acts to increase the probability of survival of such firms, at least in high tech sectors. In the context of this paper, we postulate that this positive effect may be due to technology spillovers from foreign MNCs to indigenous firms.

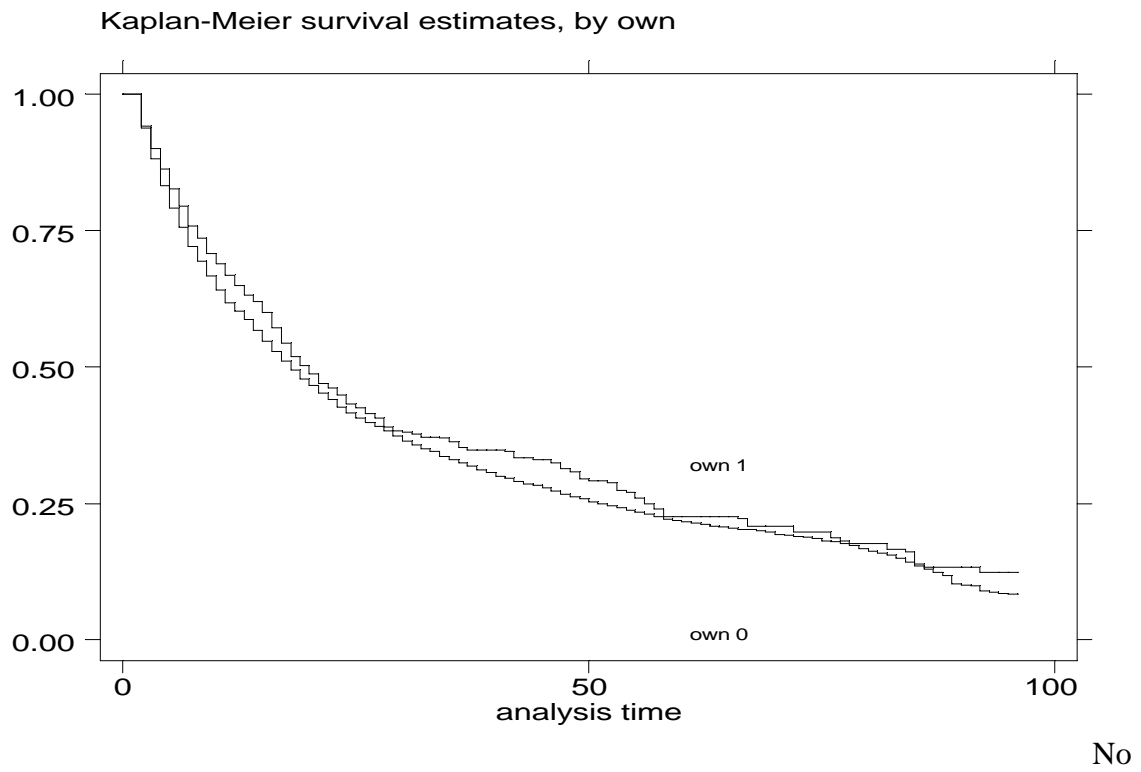
## Tables

**Table 1: Descriptive Statistics**

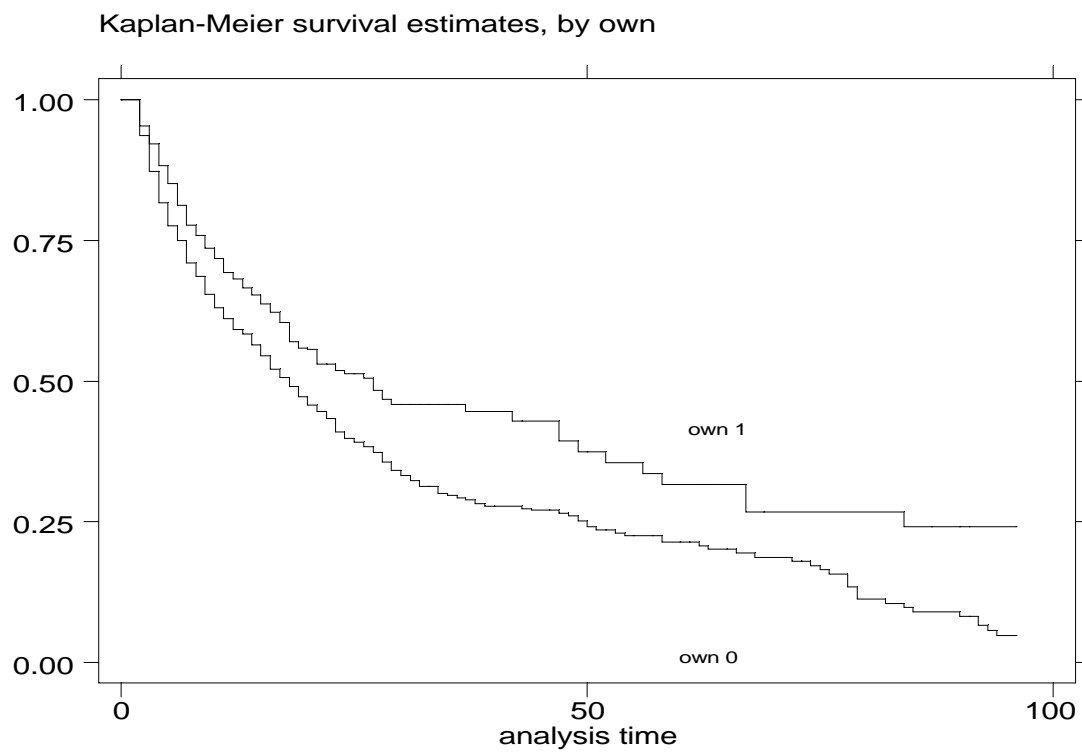
<i>Sample</i>		<b>1973</b>	<b>1984</b>	<b>1996</b>
<b>Indigenous</b>	<i>employment</i>	151741	126687	120728
	<i>firms</i>	4039	6448	5830
	<i>age</i>	21	17	19
	<i>size</i>	38	20	21
<b>Foreign</b>	<i>employment</i>	73827	80550	97559
	<i>firms</i>	619	861	837
	<i>age</i>	16	15	20
	<i>size</i>	119	94	117
<b>Indigenous / High Tech</b>	<i>employment</i>	11492	12452	16726
	<i>firms</i>	313	651	805
	<i>age</i>	17	12	14
	<i>size</i>	37	19	21
<b>Foreign / High Tech</b>	<i>employment</i>	14924	30767	54519
	<i>firms</i>	137	328	377
	<i>age</i>	16	12	17
	<i>size</i>	109	94	145
<b>Indigenous / Low Tech</b>	<i>employment</i>	140249	114235	104002
	<i>firms</i>	3726	5811	5025
	<i>age</i>	21	17	20
	<i>size</i>	38	20	21
<b>Foreign / Low Tech</b>	<i>employment</i>	58903	49783	43040
	<i>firms</i>	482	536	460
	<i>age</i>	16	17	22
	<i>size</i>	122	93	94

**Table 2: Results of the Cox Regression**

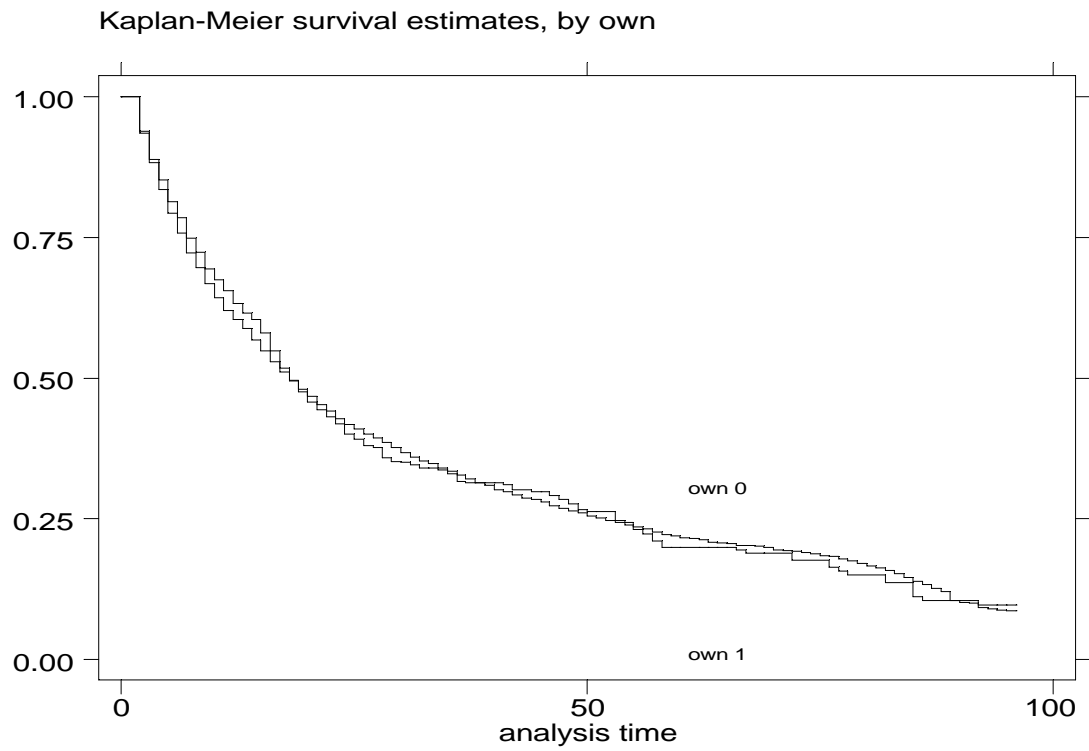
	High Tech			Low Tech	
	(i) All	(ii) Foreign	(iii) Indigenous	(iv) Foreign	(v) Indigenous
MNC	0.711*** (0.051)	3.857 (7.397)	0.166** (0.138)	4.049*** (2.182)	0.927 (0.211)
SIZE	0.993*** (0.001)	0.992*** (0.002)	0.986*** (0.004)	0.994*** (0.001)	0.992*** (0.001)
MES	1.001 (0.009)	1.070 (0.092)	1.027 (0.042)	1.010 (0.019)	1.011 (0.014)
HERF	1.001** (0.000)	1.000 (0.002)	1.000 (0.002)	1.003* (0.001)	1.001 (0.001)
GROW	0.317*** (0.051)	0.630 (0.643)	2.275 (1.434)	0.228** (0.140)	0.270*** (0.048)
OWN	1.127*** (0.056)	--	--	--	--
TECH	1.273* (0.163)	--	--	--	--
BEU	1.129*** (0.053)	1.934** (0.524)	1.221 (0.200)	1.092 (0.164)	1.113** (0.060)
# of obs.	149555	6771	14641	11803	116340
# of subj.	14388	596	1495	1080	11217
Log Likelihood	-36683	-690	-3025	-1417	-28871
Wald Test	4570878	70	129	12969	851

**Figures****Figure 1: Kaplan-Meier survival functions by nationality of ownership**

te: own = 1 indicates foreign ownership, 0 indicates Irish ownership

**Figure 2: Kaplan-Meier survival functions by nationality for high tech firms**

Note: own = 1 indicates foreign ownership, 0 indicates Irish ownership

**Figure 3: Kaplan-Meier survival functions by nationality for low tech firms**

Note: own = 1 indicates foreign ownership, 0 indicates Irish ownership

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## Notes

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<sup>1</sup> See Caves (1996) for a survey of the possible effects of foreign direct investment on the host country. Blomström and Kokko (1998) and Pack and Saggi (1997) present concise surveys of the literature on FDI and technology spillovers.

<sup>2</sup> There have also been numerous empirical studies of firm survival for other countries, for example, Audretsch (1991), Audretsch and Mahmood (1995) for the US; Audretsch et al. (2000) for the Netherlands; Mata and Portugal (1994), Mata et al. (1995) for Portugal; Santarelli (1998) for Italy; Disney et al. (1999) for the UK. Perhaps the paper most closely related to ours is the recent study of the determinants of the survival of foreign multinationals in UK manufacturing industries by McCloughan and Stone (1998).

<sup>3</sup> All estimations were performed using STATA version 6.0, which can be used to control appropriately for left truncation and right censoring.

<sup>4</sup> The classification of sectors into high tech and low tech is based on an OECD classification as used by Kearns and Ruane (2000). Accordingly, high tech sectors are Aerospace, Computers & Office Machinery, Electronics & Communications, Pharmaceuticals, Scientific Instruments, Electrical Machinery, Motor Vehicles, Chemicals, Non-electrical Machinery.

<sup>5</sup> There are numerous other reasons why one may expect differences in the survival between high tech and low tech firms. For example, high tech firms may be better suited to compete on world-wide markets. Also, a number of the sectors identified as high tech are sectors which produce "weightless goods", i.e., goods which have a very high value-to-weight ratio, and one may assume that the production of those goods is more easily transferable internationally than the production of bulky low tech goods. The issue of weightless goods has been discussed extensively by Danny Quah, see, for example, Quah (1999).

<sup>6</sup> All sector specific variables are calculated for the 68 sub-sector classifications commonly used by the Irish Central Statistics Office.

<sup>7</sup> In an alternative specification we defined MES as (the log of) average firm size in the industry. These results, which are not reported here but can be obtained from the authors upon request, yield similar results to the results obtained using average firm size.

<sup>8</sup> See, for example, O'Sullivan (1999) and Ruane (1999) for reviews of Irish industrial policy.

<sup>9</sup> In all regressions we control for possible heteroskedasticity among firms.

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<sup>10</sup> The reported regression results are based on the sample of firms described above which includes incumbents as well as new entrants. We also estimated the survival regressions using new entrants only. The results, which can be obtained from the authors upon request, are qualitatively similar to the results reported here.

<sup>11</sup> We also estimated (2) without *HERF* but the results, which can be obtained from the authors, are essentially unchanged.

<sup>12</sup> We also experimented with including interaction terms between the high tech dummy variable and ownership, size, and the policy change dummy variable, but all interaction terms were insignificant. Results are available from the authors upon request.

<sup>13</sup> Similar results which suggest the importance of firm characteristics, and the relative insignificance of industry characteristics for firm survival were obtained by Audretsch and Mahmood (1995) for US manufacturing.