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## The evolution of the firm size distribution and nationality of ownership

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CORE DISCUSSION PAPER  
2004/22

**The Evolution of the Firm Size Distribution and Nationality of  
Ownership**

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**Abstract**

It has recently been shown that the firm size distribution is initially skewed to the right and then evolves over time to become more lognormal, and argued that this is likely due to firms initially facing financial constraints, see Cabral and Mata(2003). We conjecture that, if this is true, then such a pattern should be much less apparent for multinational companies for which financial constraints are generally considered to be lower than non-multinationals. Moreover, such a difference may be re-enforced by the fact that multinationals are less likely to face selection issues. These propositions are confirmed using plant level Irish manufacturing data.

Keywords: Firm Size Distribution, National of Ownership, Financial Constraints

JEL classification: F23, L11, L60

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## 1. Introduction

In a recent study Cabral and Mata (2003) examine in detail the evolution of the firm size distribution using a data set of Portuguese manufacturing firms. While conventional wisdom has it that the firm size distribution is approximately log normal (see, e.g., Sutton 1996), they document for the first time that the firm size distribution is initially significantly skewed to the right and only over time evolves to become more lognormal. They conjecture that this pattern arises because firms initially face financial constraints and, therefore, only over time grow to reach their optimal size. Some supportive evidence is shown for this by using the entrepreneur's age and education as a proxy of the financial constraints faced by the firm.

One should note, however, that Cabral and Mata (2003) pool data for all firms in manufacturing and by doing so do not consider potential heterogeneity across different types of firms. One cause of heterogeneity is due to different nationality of ownership of firms. It is well known, for example, that foreign firms in a host country are on average larger size than domestic firms.<sup>1</sup> Yet, none of the studies documenting differences in average sizes between foreign and domestic firms examine empirically the distribution of firm sizes or indeed the evolution of the firm size distribution (FSD) by nationality of ownership. This is what we set out to do in this paper.

There are at least two reasons why we may expect the FSD for multinationals to differ significantly from that of domestic establishments. Firstly, and closely related to the argument by Cabral and Mata (2003), foreign multinationals may be expected to be less financially constrained than domestic firms. Hence, they can choose to set up at optimal size, compared to domestic firms which are likely to enter an industry at less than optimal size due to greater financial constraints. While the issue of financial constraints for domestic vs. multinational firms is still under-researched, Harrison and

McMillan (2003) have recently provided evidence that in Cote d'Ivoire only domestic firms face financial constraints.<sup>2</sup> This is intuitively plausible, as foreign firms have many means of financing their operations, not least foreign direct investment, i.e., capital transfers from the parent company. Hence, they are less likely to be reliant on the domestic capital market.

Secondly, as formalised in the model by Helpman, Melitz and Yeaple (2004), multinationals face larger sunk investment costs than purely domestic firms and therefore only the most productive firms tend to locate abroad. This implies that these firms are less affected by selection issues as discussed by Jovanovic (1982) and therefore may not only start up at a larger size than domestic firms but are less likely to follow a similar size evolution.

## **2. Data**

We analyse the evolution of the FSD distinguishing foreign and domestic owned firms using data for the Republic of Ireland. The Irish economy provides arguably a model example for such an analysis given that it is heavily dependent on multinational companies, which accounted for roughly one half of manufacturing employment in 2000.<sup>3</sup>

Our data source is the Forfás Employment Survey which is an annual exhaustive manufacturing plant level survey, conducted since 1972 and available to us up to 2000. Given the high response rate (usually over 99 percent) the data set covers virtually the entire population of all manufacturing plants. All in all, over 15,411 manufacturing

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<sup>1</sup> See, for instance, Doms and Jensen (1998) for the US, Girma et al. (2001) for the UK and Ruane and Görg (1996) for Ireland.

<sup>2</sup> See Harrison, Love and McMillan (2002) for related research.

<sup>3</sup> This is apparent from the data used in this paper.

plants are covered in the survey, 1,910 of which are foreign-owned. Given the extensive coverage, the data set is ideal for the study of the evolution of the FSD.<sup>4</sup>

The survey includes, amongst other things, information on the nationality of ownership, the start-up year, and the level of employment each year. Forfás defines foreign plants as plants that are majority-owned by foreign shareholders, i.e., where there is at least 50 per cent foreign ownership.<sup>5</sup> Individual plant identifiers allow us to follow the life cycle of each plant as far as this falls within our sample period. One should note that, in contrast to Cabral and Mata (2003) who proxied a plant's age by the longest tenure of its employees, we have an exact measure of age from information on the start-up year. This, undoubtedly, represents an advantage as one can logically consider that the older a plant gets, the less likely is the longest tenure of its employee to be a good measure of the plant's age.

### 3. Empirical Analysis

We utilise the data just described to estimate firm size density distributions. Using the entire sample set we depict in Figures 1 and 2 the non-parametric kernel density distribution estimates of the plant size, measured as log employment, of six different age groups for domestic and foreign firms, respectively.<sup>6,7</sup> As can be seen, for domestic plants the distribution appears to be substantially skewed to the right for young plants. This feature of the distribution, however, appears to fade as one moves up different age groups. These two observations are in line with the findings by Cabral and

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<sup>4</sup> One should note that we are using plant level data here to draw conclusions regarding firm size. However, in Ireland there are only a handful of multi-plant (in terms of these locating in Ireland) firms, so that these are essentially the same.

<sup>5</sup> While, arguably, plants with lower foreign ownership should still possibly considered to be foreign owned, this is not necessarily a problem for the case of Ireland since almost all inward foreign direct investment has been greenfield investment rather than acquisition of local firms (see Barry and Bradley, 1997).

<sup>6</sup> We also experimented with breaking down our sample into different subperiods. However, these all produced qualitatively similar results.

<sup>7</sup> We use the optimal smoothing parameter as suggested by Fox (1990).

Mata (2003). In contrast, even though the mean size of foreign plants increases over the life cycle, there is no such right skewness apparent in any of the age groups. This indicates that the FSD for the two nationality groups are indeed different.

One possibility may be that our results for domestic plants are due to sample selection bias – i.e., the right skewness of domestic plants, particularly at earlier ages, is driven by non-surviving plants that exit at an early age. In contrast, one would not expect such selection mechanisms to take place for multinationals since foreign affiliates benefit directly from the experience and other firm-level assets of their parent companies, providing them with a initial distinctive advantages over domestic plants in the host country, see Markusen (1995, 2002).

We investigate this issue with non-parametric kernel density estimates for different cohorts of firms. Specifically, we estimate the size distribution of the first year of plants that exit the market before reaching age ten, the size distribution of the first year of plants that survive at least ten years, and the size distribution of these survivors at age 10.<sup>8</sup> Figure 3, showing these estimates for domestic plants, indicates that both surviving and non-surviving plants have a size distribution characterized by similar right skewness and thus that sample selection bias cannot be driving the earlier graphical results. Rather, those domestic plants that survive grow in size over time, in line with the predictions by Jovanovic (1982). As expected, there is in Figure 4 also no evidence of sample selection bias of survival driving the results for foreign affiliates. Instead there is apparently simply a slight shift in the mean size for foreign plant survivors, but no change in the skewness.

In order to verify our results more formally, we, following Cabral and Mata (2003), employ a parametric test based on the extended gamma distribution, where  $w = (\ln$

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<sup>8</sup> This necessarily truncates our sample to years up to and including 1990.

$s - \mu)/\sigma$  is a function of plant size  $s$  with mean  $\mu$  and standard deviation  $\sigma$  and has the p.d.f.:

$$q = 0 : \\ |q|(q^2)^{q-2} \exp(q^2(qw - \exp(qw)))/\Gamma(q^2) \\ q \neq 0 : \\ (2\pi)^{-1/2} \exp\left(-\frac{1}{2}w^2\right)$$

such that  $\Gamma$  is the gamma function. Accordingly, if  $q=0$  then  $w$ , and hence firm size  $s$ , follows the standard lognormal distribution. On the other hand, if  $q<0$  there is right skewness, while  $q>0$  implies left skewness.

The results of employing this test to our foreign and domestic plant sub-samples in total and by age group are given in Table 1.<sup>9</sup> As can be seen, for domestic plants one cannot reject right skewness across any of the age groups. However, the absolute value of the coefficient noticeably declines across age groups, indicating that the distributions are tending more towards log normality. For example, one observes that the size of the coefficient of plant births are more than five times larger than those that are at least 30 years old. Nevertheless, even the very old plants still display a size distribution characterized by significant right skewness. However, as pointed out by Cabral and Mata (2003), there is no a priori reason for why the process that drives plant size towards a symmetric distribution should reach its steady state by age 30.

From the parametric regression results one can also see, in contrast, that there is no evidence of right skewness for foreign plants. As a matter of fact, while foreign plant births seem to follow a log normal size distribution, as they get older their distribution tends towards left skewness.

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<sup>9</sup> Conducting these tests for surviving plants only produced qualitatively similar results.

#### **4. Conclusions**

This paper examines the evolution of the size distribution of plants with different nationality of ownership. It, hence, provides a link between two recent literature: that concerned with firm level heterogeneity in terms of firm nationality (Helpman, Melitz and Yeaple, 2004) and the empirical IO literature examining the evolution of the firm size distribution (Cabral and Mata, 2003). We find that the FSD and its evolution for domestic plants is indeed substantially different from that for foreign owned firms. While it takes time before domestic plants reach their optimal size, the same is not true for multinationals. This indeed suggests that age and financial constraint are binding for domestic plants but not for multinational companies.



## References

- Cabral, L. M. B. and Mata, J. (2003). “ On the Evolution of the Firm Size Distribution: Facts and Theory”, *American Economic Review*, 93, 1075-1090.
- Doms, M.E. and J.B. Jensen, 1998, Comparing wages, skills, and productivity between domestically and foreign-owned manufacturing establishments in the United States, in: R. Baldwin, R. Lipsey and J.D. Richardson, eds., *Geography and Ownership as Bases for Economic Accounting* (Chicago: Chicago University Press), 235-255.
- Fox, J. 1990, Describing univariate distributions, in J. Fox and J.S. Long, eds., *Modern methods of data analysis* (Sage).
- Girma, S., D. Greenaway and K. Wakelin, 2001, Who benefits from Foreign Direct Investment in the UK?, *Scottish Journal of Political Economy* 48, 119-133.
- Harrison, A.E. and M.S. McMillan, 2003, Does direct foreign investment affect domestic credit constraints, *Journal of International Economics*, 61, 73-100.
- Harrison, A.E., I. Love and M.S. McMillan, 2002, Global capital flows and financing constraints, NBER Working Paper 8887.
- Helpman E., M.J. Melitz and S.R. Yeaple, 2004, Export versus FDI with heterogeneous firms, *American Economic Review*, forthcoming.
- Jovanovic, B., 1982, Selection and evolution of industry, *Econometrica*, 50, 649-670.
- Markusen, J.R., 1995. The boundaries of multinational enterprises and the theory of International Trade. *Journal of Economic Perspectives* 9(2), 169-189.
- Markusen, J.R. 2002. *Multinational Firms and the Theory of International Trade*. MIT Press.
- Ruane, F. and H. Görg, 1996, Aspects of foreign direct investment in Irish manufacturing since 1973: Policy and performance, *Journal of the Statistical and Social Inquiry Society of Ireland*, 27, 37-85.
- Sutton, J, 1996, Gibrat’s Legacy, *Journal of Economic Literature*, Vol. 35, No. 1. (Mar., 1997), pp. 40-59.

Figure 1: Domestic Plants

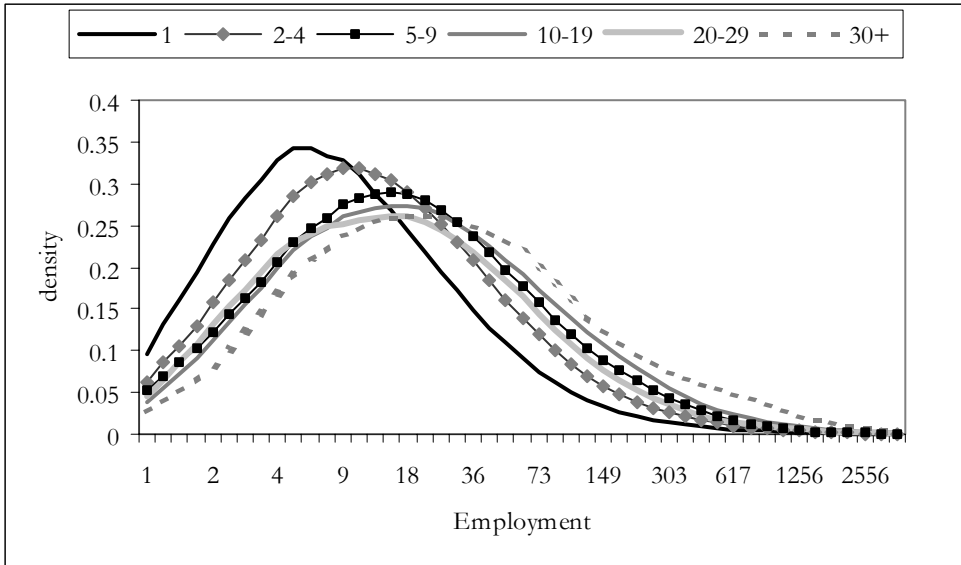
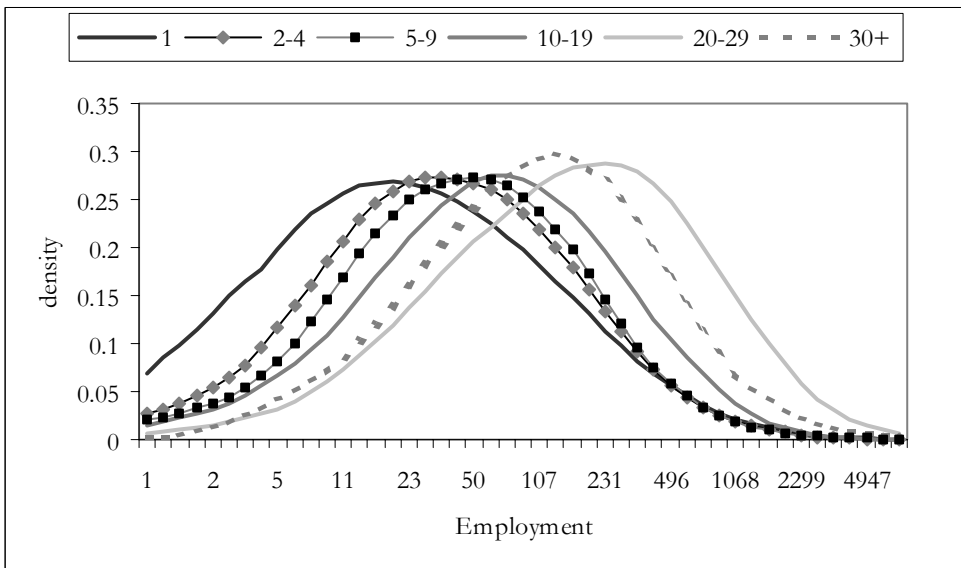
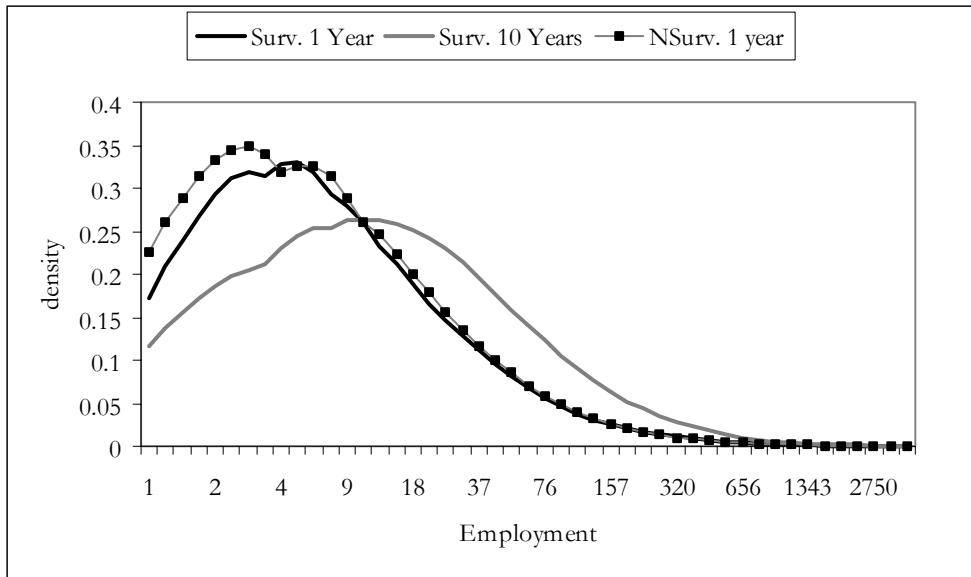


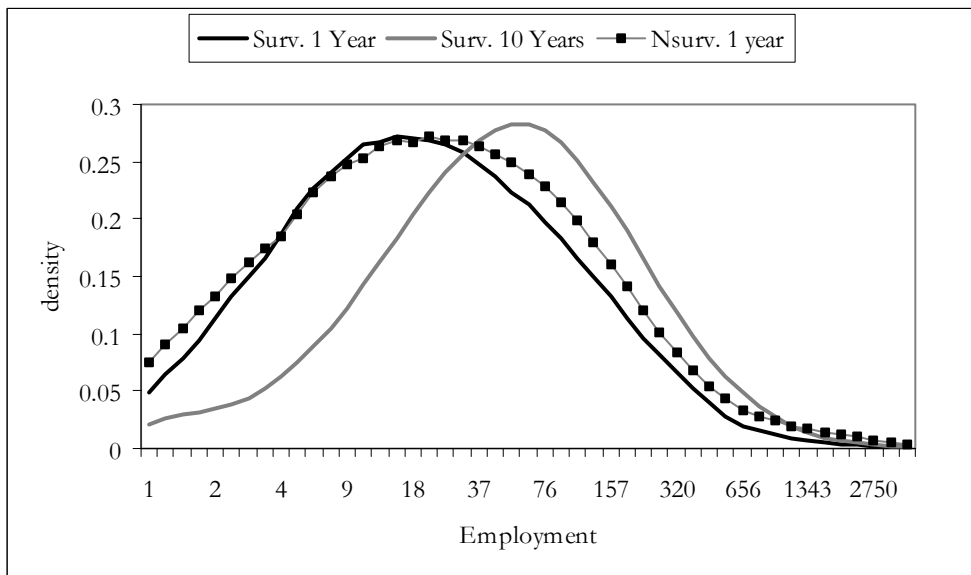
Figure 2: Foreign Plants



**Figure 3: Domestic Plants by Survival**



**Figure 4: Foreign Plants by Survival**



**Table 1: Skewness Test – Estimates of  $q$**

	<i>Domestic</i>	<i>Foreign</i>
<b>All Plants</b>	-0.487* (0.008)	0.289* (0.017)
<b>Age &lt;=1</b>	-1.164* (0.046)	-0.160 (0.075)
<b>Age 2-4</b>	-0.617* (0.019)	0.108* (0.041)
<b>Age 5-9</b>	-0.447* (0.016)	0.194* (0.034)
<b>Age 10-19</b>	-0.317* (0.014)	0.357* (0.030)
<b>Age 20-29</b>	-0.223* (0.020)	0.490* (0.047)
<b>Age &gt;=30</b>	-0.266* (0.020)	0.224* (0.015)

Notes: (1) \* signifies 1 per cent significance level.