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Foreign Ownership and Firm Hazard During Crises: The Moderating Role of Industry's Technological Intensity

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Abstract: Despite foreign and domestic firms have been found to differ on survival and exit risks during crises, we believe that other factors may moderate this foreignness effect, as the technological intensity of the industry. The results show that foreign firms operating in more technology-intensive industries face lower hazards during crises, so the resulting competitive advantage may offset the uncertainty inherent in innovative activities. The conclusions are important for policymakers and managers.

Keywords: Crisis; Foreign Ownership; Hazard; Survival; Technological Complexity

JEL Classification Number: D21, E32, F23, L60

1. Introduction

The literature on organizational ecology and firm survival have been showing that firm exit is countercyclical and that there is a detrimental impact of macroeconomic instability upon firms' survival and their dynamics (e.g., Audretsch and Acs, 1994; Bhattacharjee et al., 2009). However, particular groups of firms are also suggested to be better able to surpass the difficulties of a crisis. Foreign multinationals are expected to survive longer than domestic firms (DF) during crises, owing to *multinationality* advantages and the sunk costs associated to their investment (Chung et al., 2008; Desai et al., 2004). Conversely, foreign-owned firms (FF) may be more footloose under economic instability, being able to shift production among locations with better economic conditions, supporting the well-known liability of foreignness (Álvarez and Görg, 2009; Zaheer, 1995).

What remains somewhat overlooked in the literature is which factors may moderate or explain this foreignness effect, overall and during crises. In this paper we attend on the industry's environment as a moderating factor of foreignness effect upon firm exit during crises, namely the industry's technological intensity, controlling also for other determinants likely to affect firm hazards. Technological intensity and innovation

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activities are often pointed as a discriminating factor between FF and DF, with the former being more concentrated in industries with higher R&D intensity and greater technological complexity (Kuemmerle, 1999; Markusen, 1995). Accordingly, FF may face higher exit risks due to the uncertainty inherent to their higher technological activity or may survive longer owing to potential competitive advantages arising from their operations in more innovative industries (Agarwal, 1996; Buddelmeyer et al., 2010). We analyze these contradictory hypotheses under business cycle effects.

We use a unique dataset to overcome this gap in the literature, contributing also to the empirical evidence on firm exit determinants and the foreign multinationals' impact overall and during crises. The results are thus important for policymakers, managers and academics.

2. Data and Methodology

We use the longitudinal database '*Quadros de Pessoal'*, from GEP of the Portuguese Ministry of Labor and Social Solidarity. The database collects data from a compulsory questionnaire to all firms with wage earners in Portugal since 1982. We follow Mata and Portugal's (2002) procedures to identify entry and exits. We rely on discrete duration models (Singer and Willett, 1993), since conventional approaches as linear regression or binary choice models are ill-suited to properly conduct survival analyses. We estimate a piecewise constant hazard model, where exit rates are assumed to be constant within each interval (year), but different between intervals. The hazard function in interval t, accounting for the effects of covariates, is defined as:

$$h(t \mid X_{t-1}) = exp(\lambda t) * exp(\beta X_{t-1}), \quad t = 1, \ldots, T$$

where the sequence of $\exp(\lambda t)$ gives the evolution of the exit rates and β denotes the vector of coefficients associated to a set of explanatory variables (namely, firm's and industry's characteristics, and macroeconomic control (Table 1)). The effect of covariates upon hazard rates is assumed to be proportional (Cox, 1972), as the following reparameterization, estimated by maximum likelihood methods, shows:

$$\log h(t \mid X_{t-1}) = \lambda_t + \beta X_{t-1}, \quad t = 1, \ldots, T$$

The model is separately estimated for Low-Tech (LT), Medium-Low-Tech (MLT) and Medium-High/High-Tech (MH-HT) industries. We used OECD classification of manufacturing industries based on technology. Medium-High and High-Technology industries were joined in the analysis, due to the high level of aggregation of economic activities in the database.

Table 1: Variables Used

Core variable	Own*Downturn	Interaction between foreign ownership and downturn periods
Firm-Level	Size	Ln (no. employees)
	$Size^2$	Squared value of Ln (no. employees)
	Age[a]	No. years since the firm entry
	Age^2	Squared no. years since the firm entry
	Ownership	Dummy = 1 if, at least, 50% of the capital is held by foreign investors, 0 otherwise
	Firm Performance	Ln (Firm Turnover / Firm Employment)
	Human Capital	No. workers with a college degree / Total no. workers
	Urban	Dummy = 1 if the firm operates in the districts of Porto or Lisbon, 0 otherwise
Industry-Level	MES	Median of 2-digit industry's employment (Minimum Efficient Scale)
	HH Index	Sum of the squared share of FF in total 2-digit industry's employment
	Industry Agglomeration	Share of 2-digit industry's employment in total Manufacturing employment
	Foreign Share	Share of FF's employment in total 2-digit industry's employment
	Export Intensity[b]	2-digit industry Exports / 2-digit industry GVA
	Industry Growth	Ln (2-digit industry $Employment_t$) – Ln (2-digit industry $Employment_{t-1}$)
	Entry Rate	Entrants' employment in year t / 2-digit industry total employment in year t
	Industry Dummies	Dummy = 1 for each 2-digit industry where the firm operates, 0 otherwise
Macro-Level	Downturn	Dummy = 1 for 1991, 1992, 1993, 2001, 2002, 2003, 0 otherwise

Note: [a] When data for the foundation year was not available, we considered the year of admission of the first worker entering the firm. [b] Data on Exports and Gross Value Added is from National Institute of Statistics and Bank of Portugal, respectively.

3. Empirical Results

Our unbalanced panel of 18 cohorts (1988-2005) comprises 87.027 firms, from which 55.622 exited over the period. Over this time span, including two downturn periods in the

Portuguese economy (1991-93; 2001-03), characterized by declines in GDP, consumption, investment and unemployment increases, FF have been reallocating themselves from LT towards more technology intensive industries, while DF still remain strongly concentrated in labor-intensive industries with low levels of technological complexity. Using life-table and Kaplan-Meier methods (Kalbfleish and Prentice, 1980), we compared the survival rates of FF and DF across different industries.

Table 2: Survival Rates of Domestic and Foreign Firms

	DF			**FF**		
Years	LT	MLT	MH-HT	LT	MLT	MH-HT
1	0.80	0.83	0.82	0.89	0.90	0.92
5	0.45	0.52	0.51	0.63	0.64	0.69
10	0.29	0.37	0.36	0.47	0.53	0.54
15	0.17	0.25	0.23	0.36	0.44	0.46
Median Survival Time	4	6	6	9	11	11

Test of equality of survival functions over industries

Test	χ^2 (Prob.> χ^2)	χ^2 (Prob.> χ^2)
Log-Rank	428.79 (0.000)	5.43 (0.066)
Wilcoxon	309.94 (0.000)	3.04 (0.218)

Unconditionally, FF have higher survival rates than DF. Moreover, survival rates are lower in LT than in other industries, for both groups of firms, which suggest that technological intensity positively impacts on firm survival. Technological complexity of industries is significant for DF's survival rates (differences are statistically significant at 1% level), but ambiguous for FF's survival patterns. Table 3 presents the estimation results controlling for firm's and industry's specificities, where we search for potential different exit patterns of FF and DF across different industries during economic slowdowns.

We find that foreign ownership only matters for firm exit in more technology-intensive industries. On average, FF have 29% higher hazard rates than DF in MH-HT industries, supporting the liability of foreignness hypothesis associated with the risks and uncertainly of innovation activities. However, the foreignness effect changes during downturn periods. Despite economic slowdowns have a positive impact on firm exit (though lower in more technologically complex industries), FF operating in more technologically complex industries face about 18% lower exit risks than their domestic counterparts. Actually, more

technology-intensive FF seems to be better able to thrive a crisis, acting as potential stabilizer agents.

Table 3. Estimation Results

	LT	MLT	MH-HT
	Model 1	**Model 2**	**Model 3**
Constant	-1.0936***	-0.2818	-6.4570***
Age	0.0121***	0.0171***	0.0113***
Age squared	-6.03e-06***	-8.47e-06***	-5.57e-06***
Size	-0.5156***	-0.7110***	-0.5701***
Size squared	0.0423***	0.0770***	0.0506***
Firm Performance	-0.0232***	-0.0676***	0.0245**
Human Capital	0.1849***	0.4480***	0.3047***
Ownership	0.0349	0.1821	0.2908**
Urban	0.1650***	0.0010	0.2063***
Downturn	0.1032	0.2198***	0.0736***
Own*Downturn	0.1618	-0.2663	-0.1777***
MES	-0.0428***	-0.0521	0.1870***
HH Index	17.2676**	4.3666	-76.0279***
Industry Agglomeration	-0.1389	-0.0082	18.0945***
Exports/VAB	0.2309***	-0.1656*	-0.3502***
Industry Growth	0.0517**	0.0009	-0.1344
For. Presence in Industry	-1.3974**	1.8668***	1.7676*
Entry Rate	3.3725***	1.0476	4.4959***
Industry dummies	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes
N	239821	38422	84219
χ^2	8447.20	1389.35	2998.10
Log Likelihood	-88385.42	-11817.18	-27950.56

Note: *, ** and *** indicate significance at 10%, 5% and 1% respectively.

4. Conclusion

Despite foreign-owned firms (FF) may differ from domestic firms (DF) on survival and exit risks during crises, we believe that some factors may moderate or explain the foreignness effect. We used the Portuguese empirical setting to test whether the industry's technological intensity interfere with the foreign ownership effect during economic

slowdowns. We conclude that exit is countercyclical in all industries. Regarding the foreignness effect, only FF operating in more technology-intensive industries faces higher hazards than their domestic counterparts, may be due to the uncertainty inherent in high-tech activity. However, they are the only group presenting lower hazards during crises, suggesting that operating in a technologically complex industry may become a competitive advantage under turbulent conditions. The results point that improving the technological intensity of firms' activities may improve their survival prospects and that some stabilizer effects may arise from the presence of foreign high-tech multinationals during crises.

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