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Working Paper
10/2015

LUISS
Academy

LUISS Guido Carli / School of European Political Economy
Working paper n. 10/2015
Publication date: November 2015
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ISBN 978-88-6856-046-1

LUISS Academy is an imprint of
LUISS University Press – Pola s.r.l. a socio unico
Viale Pola 12, 00198 Roma
Tel. 06 85225485
e-mail lup@luiss.it
www.luissuniversitypress.it

ECONOMIC CRISIS AND FIRM EXIT: DO INTANGIBLES MATTER?

Fabio Landini[a,b], Alessandro Arrighetti[c], and Andrea Lasagni[c]

Abstract

The crisis in the Euro area has caused several business closures, especially in the EMU periphery. In this paper we use an original firm-level dataset on Italy to study the determinants of firm exit during the crisis, having a particular focus on the role of intangibles. We argue that intangibles strengthen the firm's resilience capacity, and this in turn improves the firms' ability to cope with adverse and unexpected shocks. We obtain two main results: first we show that intangibles significantly reduce the probability of firm exit, especially during the initial phase of the crisis; second, we find that financial constraints become more relevant than intangibles in explaining firm exit at later stages of the crisis. Thus, the process of firm selection during the crisis has undergone a rapid transformation, with distortions that may lead even skilled firms to exit. Some of the implications of these findings for the EU recovery policies are discussed.

Keywords: *intangibles, firm exit, EU crisis, industry dynamics*

JEL codes: **D22** (Firm Behaviour: Empirical Analysis); **L21** (Business Objectives of the Firm); **L25** (Firm Performance: Size, Diversification, and Scope); **O32** (Management of Technological Innovation and R&D).

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1. Introduction

The crisis in the euro area has left its mark on the corporate landscape. Nearly all the EMU countries have seen aggregate business closures over the past few years. According to Eurostat[1] between 2008 and 2012 the Eurozone has experienced a 7% drop in the number of active manufacturing firms, with an average death rate of nearly 6%. Such a drop has been particularly acute in the Eurozone periphery. In Italy and Spain, for instance, the firm average death rate has ranged between 6% and 9% and the overall drop in active manufacturing firms has been of 9% and 17% respectively. These data are worrisome especially when firm exit entails the loss of accumulated capabilities that are not replaced by the capabilities and skills of new entrants, as it seems to be the case in the EU periphery.

The economic literature has devoted a great deal of attention to study the determinants of firm exit and survival. Work in industrial dynamics, for instance, suggests that firm exit is negatively related to age and size (Dunne et al., 1988; Audretsch, 1991; Agarwal and Gort, 1996; Sutton, 1997) as a consequence of successful path-dependent organizational learning, scale efficiencies, and market power. Organization and innovation scholars emphasize instead the role of the technological capabilities of firms (Hall, 1987), suggesting the existence of an innovation premium in firm's survival (Cefis and Marsili, 2012). With specific reference to the recent economic crisis, moreover, a small but growing literature[2] has stressed the importance of factors directly associated with macroeconomic shocks, such as financial constraints and the firm's sensitivity to changes in aggregate demand and trade.

In this paper we contribute to this literature by studying the relation between intangible assets and firm exit. Although the literature on intangible assets is extensive, to date, scholars have devoted relatively little attention to the role that these assets play in the face of the on-going global crisis. This is probably due to the general belief that intangible-related activities have little to do with economic crisis. In this view, major decreases of demand are expected to bring about (if anything) a reduction of intangible investments, so that the latter are perceived more as consequences of the crisis than as causes of variation in firm's responses (Filippetti and Archibugi, 2011; Laperche et al., 2011). However, an emerging body of research suggests that firm's assets, including intangibles, can be important determinants of the firm's capability to adapt to unexpected environmental changes (Lengnick-Hall and Beck, 2005). This literature refers to the concept of firm's *resilience capability* and argues that intangibles can indeed contribute to firm performance in time of crisis.

On this basis, the present paper investigates whether intangible assets have played a role in affecting the probability of firm exit during the recent crisis. In particular we ask if, in presence of an economic recession, firms that invested in intangible assets have lower probability of exit than firms that did not (or relatively little) invest in intangibles. Notice, that the answer to this question is anything but trivial since investments in intangibles entail certain degree of sunk costs, which inevitably expose firms to greater financial risk. In this sense we may expect intangible assets to play a positive role only if the gain in terms of sustained resilience more than compensate the cost of financing.

We test our hypothesis on a sample of Italian manufacturing firms. We choose Italy because it

[1] Our own elaboration on data available at http://ec.europa.eu/eurostat/data/database (Accessed on: 4th of September 2015).

[2] As suggested by Cleassens et al. (2012) the relatively small dimension of this literature is probably due to the fact that frim-level data for many countries are only released with a long lag.

is one of the Eurozone countries that have been most severely hit by the economic downturn. Moreover, we could exploit preferential access to a large firm-level dataset with detailed information on both intangible investments and firm's death for the period 2006-2013. Overall, we obtain two main results: first we show that intangible assets significantly reduce the probability of firm exit, especially during the initial phase of the crisis; second, we show that firms exit tend to be explained by different variables depending on the time period that we consider. While early exit (i.e. before 2010) tend to be associated mainly with the market in which the firms operate and intangible assets, late exit is explained for the most part by financial constraints. Moreover, we find that neither size nor age seem to play a relevant role in explaining firm exit during the crisis. The implications of these findings for the European recovery policy are also discussed.

The paper is organised as follows. Section 2 discusses the literature. Section 3 presents the dataset, the variables and some descriptive statistics. Section 4 discusses the empirical strategy. Section 5 shows the results. Section 6 lists some robustness checks. Finally, Section 7 concludes.

2. Theoretical and empirical background

The determinants of firm exit and survival are the focus of an extensive literature (see for instance Dunne et al., 1988; Klepper and Simons, 1997; Agarwal and Gort, 2002; Klepper and Thompson, 2006; Santarelli and Vivarelli, 2007). In industrial economics it is usually argued that firm size and age positively affect the probability of survival. As new firms acquire experience through production and learning they improve their internal efficiency (Jovanovic, 1982). In presence of market selection this leads to an increase in the chances of survival over the lifecycle of a firm, along with the firm size. These predictions have been tested in a number of studies. While some contributions focus on the link between firm survival and the current size of all firms (Evans, 1987; Hall, 1987; Doms *et al.*, 1995), other works investigate the effect of the firm's initial size on post-entry survival (Dunne et al., 1988; Mata and Portugal, 1994; Audretsch, 1995; Baldwin, 1995). Some of these studies find a positive association between survival and firm size and age, although the relationship can be non-linear, with the survival likelihood that increases with firm size, but at a decreasing rate (see Evans, 1987; Hall, 1987). The significance and even the sign of the relationship can also vary across cohorts of entrants (Wagner, 1994), industries (Audretsch et al., 1999) and stages of the product life cycle (Agarwal and Audretsch, 2001). Moreover, with specific reference to age, an inverted U-shaped function is observed in some cases, with the likelihood to survive increasing soon after entrance and then decreasing in later years (Audretsch and Mahmood, 1994; Wagner, 1994).

In addition to size and age, the existence of financial constraints is also considered an important driver of firm exit. Financial constraints can hamper the firm's ability to make strategic plan ahead and at the same time they may increase the firm's sensitivity to external shocks. Winker (1999) and Becchetti and Trovato (2002), for instance, find that the perceived credit constraints have negative effects on the firm's innovation expenditures and overall investment, and that this in turn affects firm's performance. With specific reference to firm exit Holtz-Eakin et al. (1994) exploit a unique dataset matching personal wealth data to survival rates among US entrepreneurs and they show that inheritances reduce the probability of firm exit. They interpret this finding as evidence for the existence of a negative relation between credit constraints and firm survival.

If financial constraints are relevant in general, they may be even more important during the downturns of the business cycle. On this respect Cleassens et al. (2012) argue that the 2008-2009 crisis impacted on firm performance through a combination of two main channels: a financial one that has affected the firm's ability to access credit, and a real one that has operated mainly through a contraction of internal demand and trade. Their estimates reveal that, in economic terms, the real channel was more important than the financial one, particularly in 2009. Medina (2012) and Wu (2012) find similar results. With specific reference to the Eurozone Demelis et al. (2013) indicates a strong dependence of firm performance on credit expansion before the crisis. However, post-2008 the credit crunch seems to affect only slow-growth firms and especially those operating on domestic bank-dominated economies. Remarkably, all these contributions measure firm performance mainly in terms of growth in profit and sales. To the best of our knowledge very few contributions (see Godart et al. 2012; Wagner and Weche Gelübcke, 2013; Wagner, 2013; Clarke at al., 2012; Arrighetti et al., 2015) have so far dealt with the issue of firm survival in the context of the on-going economic crisis.

A useful framework to study the drivers of firm exit in periods of economic downturn is to distinguish between external and internal factors. External factors include all the variables that are external to the firms and may affect firm survival. They obviously embrace most of the variables already considered by the previous literature, such as changes of aggregate demand and financial shocks. They also include factors related to institutional and technological features of the context in which firms operate, such as the geographic region and the industry. Internal factors include instead all the firm-specific characteristics that help facing sudden environmental changes. Some of them are structural factors, such as size, age and financial tightness, some others can be related to the managerial and organizational capabilities of a firm. On this last point the recent literature on managerial practices (Bloom and Van Reenen, 2010), which has attracted growing attention even among economists, suggests that 'soft' skills and abilities of firms can indeed be important drivers of firms' overall performance.

In this paper our main focus is on the role played by internal factors and in particular intangible assets. The latter have been the focus of a growing literature in the recent years. Differently from the standard "R&D centric" approach to innovation, and in line with more recent trends such as the "system approach" to innovation (Carlsson et al., 2002) and the "open-innovation mode" (Chesbrough, 2003), this literature has stressed the importance of additional factors as key drivers of firm's innovation, such as designs, software, blueprints, technology licences, and trademarks (Montresor and Vezzani, 2014). These assets are generally referred to as intangibles and their contribution has been analysed with respect to different dimensions of economic activity. At the macro-level, for instance, growth-accounting exercises have shown that intangible assets explain a larger share of labour-productivity growth than tangible assets in a number of countries (Corrado et al., 2005, 2009; Fukao et al., 2009; Marrano et al., 2009; Borgo et al., 2013). At the micro-level a number of studies have pointed to the existence of a positive link between intangible assets and firm's productivity (Marrocu et al., 2012; O'Mahony and Vecchi, 2009; Bartel, 2007; Bontempi and Mairesse, 2008; Jiménez-Rodríguez, 2012; Hall et al., 2013; Battisti et al., 2014), market value (Hall et al., 2005; Greenhalgh and Rogers, 2006; Sandner and Block, 2011; Hulten and Hao, 2008), and export (Delgado-Gómez and Ramírez-Alesón, 2004). None of these studies, however, has considered the impact of intangible assets on the chances of firm exit.

We argue that during economic downturns intangible assets can mitigate the risk of failure via the strengthening of the firm's resilience capacity. Within the frame of the resource-based

(Penrose, 1959, Barney, 1991, 2001) and capability-based theory of the firm (Dosi et al., 2000) resilience capacity is defined as the unique blend of cognitive, behavioural, and contextual properties that increase a firm's ability to respond to environmental changes (Lengnick-Hall and Beck, 2005). Faced with an economic crisis, resilient firms have lower chances of exit because they are better capable of interpreting unfamiliar situations, to devise new ways of confronting these events (e.g. to develop new routines), and to mobilize people, resources, and processes to transform these choices into reality. Indeed, discussions on organizational resilience have recently become more salient as substantial disruptions associated with an unpredictable environment create a climate of uncertainty and crisis (Coutu, 2002; Horne & Orr, 1998; Mallak, 1998, Lengnick-Hall et al., 2011).

According to Lengnick-Hall et al. (2011) the resilience capability depends on two main groups of factors: the amount and variety of resources available within the firm, and the firm's capability to combine these different resources and develop new routines. While the former can be interpreted as a level and variety effect, the second is a dynamic capabilities effect that includes processes of capabilities recombination and creation. In both cases, intangible assets play an important role. As suggested by Teece et al. (1997), in fact, intangibles are not only key in determining the firm's (specific) assets position but also in shaping the path through which new capabilities are generated (think for instance about the role of knowledge management software in favouring assets recombination). When coping with economic downturns firms endowed with intangible assets have a larger portfolio of assets they can rely on (variety effects) as well as a better capacity of combining them (dynamic capabilities effect) to plan their strategic responses. Everything else equal, we should thus expect firms with intangible assets to have lower probability of exit during a crisis than firms without (or only limited) intangible assets.

The quality of the assets accumulated within firms has already been considered as driver of firm exit and survival. Hall (1987), for instance, shows that the probability of firm exit decreases with the share of accumulated R&D expenditures in the total capital of the firm. Similar results have been found considering the type of entrepreneur's education and quality of human capital available within the firm (Bates, 1990; Brüderl et al., 1992; Gimeno et al., 1997). Doms et al. (1995) and Colombo and Delmastro (2001) link firm exit to the quality of the physical assets and show that firms employing advanced manufacturing equipment have lower chances of exit. In so far as the output of the innovation process is concerned, Cefis and Marsili (2005) and Buddelmeyer et al. (2010) study the relationship between firm innovative performance and survival and they find that the former positively impacts on the latter. None of these studies, however, consider intangible assets in the sense defined above. Moreover, no specific link is made between intangible assets and resilience capacity at time of crisis.

3. Data, variable and descriptive analysis

3.1 Data

We use data collected from two sources: the first wave of the MET survey and the AIDA-BVD database. Using these sources we are able to integrate comprehensive data on intangible assets and exit, at firm level. The MET survey is a survey conducted by an Italian private research centre (*Monitoraggio Economia e Territorio*) every two years on a sample of nearly

25,000 Italian manufacturing firms (with partial sample overlap among the different waves).[3] The sample ensures high representativeness in terms of firm size (4 dimensional classes), region of origin (20 regions) and industry of activity (10 sectors disaggregated following the 3-digits ATECO 2002 classification). It includes firm-level information on the company's internal structure, including information on the firm's size, the types of investments realized and the reference markets. The nice feature of the first wave is that it was conducted during the summer of 2008, few months before the bankruptcy of Lehman Brothers. It therefore contains detailed information on the pre-crisis characteristics of firms, specifically years 2006-2007.

The AIDA-BVD database contains all Italian firms' disaggregated balance sheet and profit and loss statement information for the period 2007–2014. Moreover it contains information on the present status of the firms (active vs. non-active vs. merged vs. acquired), which we use to distinguish between alive and exited firms (see below). After having selected the firms that result active in 2007 we match the information of the AIDA-BVD datasets with the responses to the MET survey and obtain a final sample of 4,746 firms.[4] The original sample representativeness in terms of firm size, region of origin and industry of activity is preserved.[5]

Thus, we obtain an unbalanced panel with information in three time-horizons. First, we have firm-level information on both the internal structure and the financial position before the crisis, i.e., years 2006-2007. Second, we have access to the disaggregated balance sheet of all firms during the crisis, i.e. the period 2007-2014. Finally, we can identify the firms that are still alive and those that have exited the market by 2014. This data allows us to study the determinants of firm exit, and eventually to distinguish among different types of firm behaviour throughout the recession.

3.2 Variables

Our key variable distinguishes between alive and exited firms. Information contained in the AIDA-BVD database allows us to detect firms that being active in 2007 have changed their status before 2015. On this basis we develop an algorithm (see Appendix A.1) that allows us to identify firms that effectively exited the market (see also Arrighetti et al., 2015). Differently from the previous literature (see Agarwal and Audretsch, 2001; Cefis and Marsili, 2005) we can distinguish between exit due to the death of the firm and exit occurred through merger and acquisition. In the present paper we focus only on the former, while the firms subject to merger and acquisition are taken out of the sample. Unfortunately, we are unable to observe when exit actually occurred so that the first dependent variable that we consider (*EXIT*) is just a dummy variable that takes value 1 if a firm exited the market before 2015, and zero otherwise.

In addition to the firm status in 2014, however, we have information on the evolution of firm's sales for all the period 2007-2014. On this basis we construct a second variable that distinguishes between firms that most likely exited relatively early and firms that most likely

[3] The MET survey share many features of the Capitalia's Survey on Manufacturing Firms, another business survey carried out in Italy, which covers the periods ending respectively in 1997, 2000, 2003 and 2006.

[4] The reduction in the size of the original sample is due to the availability of disaggregated balance sheets in the AIDA-BVD database (see subsection 3.2).

[5] Tables reporting on the sample's representativeness are available from the authors upon request.

exited late. In making such distinction we take as temporal threshold the year 2010, so that we can map into the conventional differentiation between "first" and "second" crisis, where the former is usually associated with the subprime mortgage crisis of 2008-2010 that started in US and then spread around the world, and the latter refers to the European debt crisis that started in 2010 and is still on-going. In particular, we classify as "early exit" the firms that for the years 2011, 2012, and 2013 report more than 90% reduction in sales with respect to 2007. The value 90% is clearly arbitrary and it is introduced to control for possible noise in sales data. We run some robustness checks considering different values and find that results do not change (see below). "Late exit" firms are obviously defined as the difference between the firms that have exited the market before 2015 and the ones that exited the market early. Thus, we define a discrete variable *STATUS* taking value 1 if the firm is alive in 2014, 2 if the firm is "early exit" (i.e. exited the market before 2010), and 3 if the firm is "late exit" (i.e. exited the market after 2010).

Among the regressors our focus is on intangible assets. In the literature, there are several possible ways of measuring intangible assets. Here, we follow a balance sheet-type of approach, which consider the stocks originally reported as assets on companies' asset and liability balance sheets. In particular, we consider a subset of the assets usually reported under the item "intangible fixed assets", i.e., "research and advertisement expenditures", "patents", "licenses and trademarks".[6] In doing so, we differ from some previous contributions based on similar data (e.g., Marrocu et al., 2012) that instead consider the aggregate value "intangible fixed assets". We make this choice because the item "intangible fixed assets" also includes goodwill, whose capitalisation is highly subject to managers' discretion and thus is difficult to interpret. On the contrary, the items that we consider in our measure should be objective expenses incurred by the firms.[7] The sum of these three assets is then normalised by each firm's total asset size to compute the firm's intangible capital intensity (*ICI*). At any given point in time, ICI_i^t is a proxy of the stock of intangible assets accumulated by firm *i* in period *t*.

As discussed in Arrighetti et al. (2014, 2015) and shown in Figure 1 the distribution of *ICI* is highly concentrated. In all industries and years there exist over 30% of firms that report no investment in intangibles, while the top 10% of firms invest from 2% to 60% of their total assets. This distribution points to the existence of heterogeneity in the propensity to accumulate intangible capital, where the most striking distinction is between those who invest and those who do not. On this basis our main goal is to understand if firms that invest in intangibles indeed enjoy an advantage in the probability of survival when faced with the shortcomings that followed the crisis.

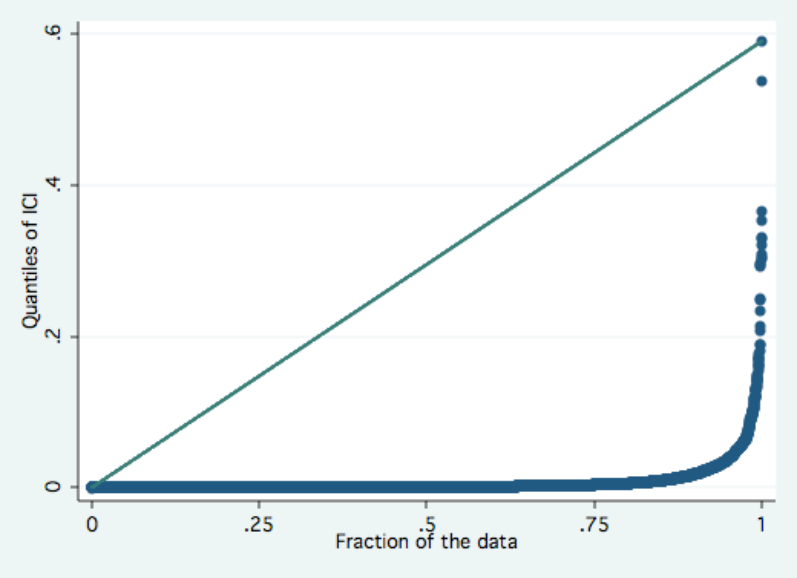
In addition to intangible assets we include in our analysis a set of other variables that are usually associated with firm survival. First, we consider a set of demographic and structural

[6] For more details on the composition of the item "intangible fixed assets" within the frame of the Italian legislation see Italian Civil Code, art. 2424.

[7] One of the main limitations in using company data to measure intangible assets is that firms may fail to give full account of their intangible assets in the balance sheet. This is true especially for firms that adopt international accounting standards such as the IAS 38, which requires that research expenses be entirely expensed. Although this can be a problem in general, it is not relevant in our sample. According to Italian legislation (Law 306/2003 and Legislative Decree n. 38/2005), in fact, IAS 38 applies only to firms that are listed in the Italian Stock Exchange, and none of our firms is. Moreover, from preliminary interviews we had with some of the firms in our sample, we know that they use to report research expenses as intangible assets in their balance sheet. This makes us confident that our measure is indeed a good proxy of firm's intangible assets.

variables such as size measured in terms of number of employees (*SIZE*), age (*AGE*) and the degree of tangible capital intensity (*TCI*). Second, we consider a set of export-related indicators, such as the percentage of sales occurred through export (*EXPORT*) and whether a firm is active in EU (*D_EU*) and extra-EU (*D_EXTRAEU*) markets. Third, we consider a set of financial and profitability indexes, which include a measure of financial exposition (*FINEXP*), a liquidity index (*LIQUID*) and the return on assets index (*ROA*)[8]. A full description of all variables is reported in Appendix A.2.

Figure 1 – Quantile distribution of ICI in 2007



3.3. Descriptive analysis

Table 1 reports some descriptive statistics for the whole sample of firms (column 1), the firms that are alive (column 2) and the firms that exited the market before 2015 (column 3). The last column reports the results of an F-test on the difference between the mean values for alive and exited firms. We notice that exited firms are on average younger (*AGE*), less productive (*LAB_PRDTY*, *ROA*), more financially exposed (*FINEXP*) and less liquid (*LIQUID*) than alive firms. Quite interestingly we find no significant difference for what concerns the firm's orientation towards export (*EXPORT*, *D_EU*, *D_EXTRAEU*) and firm's size (*SIZE*).

With respect to *ICI* the univariate analysis suggests that exited firms tend to be on average more intangible capital intensive than alive firms. Although this result could be interpreted as a signal of a positive relation between *ICI* and the probability of firm exit, it is not necessarily so. As suggested above the accumulation of intangibles requires firms to devote a substantial portion of their financial resources to these assets, with benefits that are frequently delayed in times and possibly uncertain. In this sense the relatively high degree of *ICI* in exited firms is partially associated also with a relatively high degree of financial exposition and low liquidity, so that to establish which effect is predominant is not clear. To have a clearer test of the role of intangible assets we need to move to a multivariate analysis. This is precisely the aim of the next two sections.

[8] Given the relevance that financial indicators are usually attributed in survival analysis and the fact that firm selection occurs mainly at the industry level, in our empirical analysis we normalize all financial indexes, namely *FINEXP*, *LIQUID* and *ROA*, by the industry average.

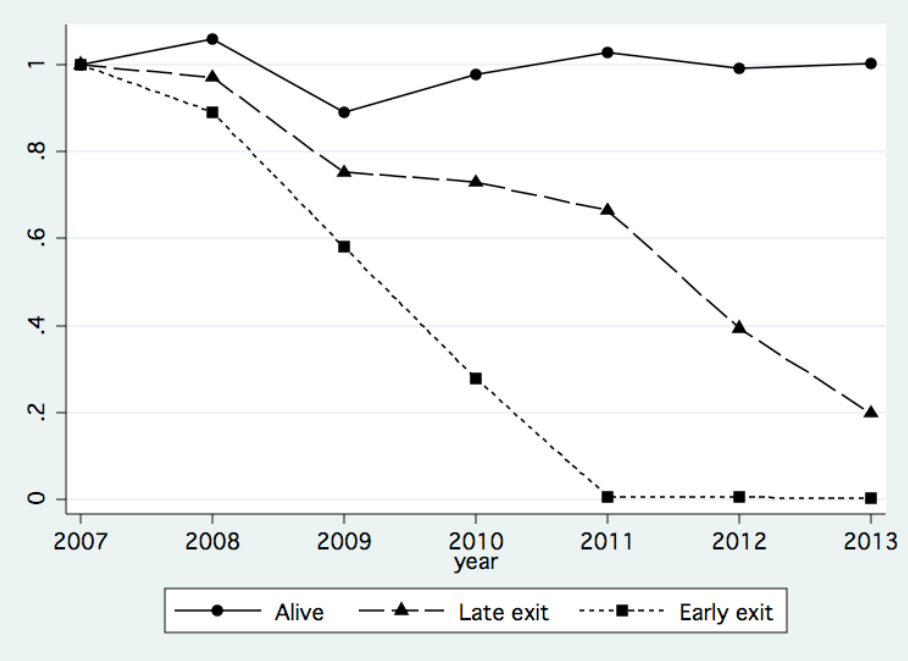
Table 1 – Descriptive statistics

	All (1) (n. 4747)		Alive (2) (n. 4398)		Exit (3) (n. 349)		
	mean	**Sd**	**Mean**	**sd**	**mean**	**sd**	**F-test**
SIZE	87.196	188.961	87.850	192.616	78.935	134.407	
AGE	35.368	18.292	35.494	18.446	33.782	16.163	*
VERT_INT	0.278	0.151	0.279	0.151	0.267	0.158	
D_GROUP	0.328	0.470	0.328	0.470	0.325	0.469	
LAB_PRDTY	57.208	39.190	57.905	39.190	48.404	38.160	***
TCI	0.210	0.163	0.210	0.162	0.206	0.170	
EXPORT	21.589	29.076	21.576	29.016	21.753	29.869	
D_EU (d)	0.059	0.236	0.059	0.236	0.057	0.233	
D_EXTRAEU (d)	0.029	0.169	0.029	0.167	0.040	0.197	
FINEXP (index)	3.079	10.256	2.776	6.987	6.908	28.353	***
LIQUID (index)	0.073	0.104	0.074	0.104	0.057	0.099	**
ROA (index)	0.068	0.083	0.071	0.083	0.032	0.074	***
ICI	0.008	0.028	0.008	0.026	0.011	0.040	**

Legend: *=sig. 10%; **=sig. 5%; ***=sig. 1%

Before moving to the multivariate analysis it is interesting to compare the performance of the three distinct groups of firms that we defined above (i.e. *alive*, *late exit* and *early exit*) throughout the recession. Apart from the interest *per-se*, this could also serve as a check of the quality of our classification. Along these lines Figure 2 reports the evolution of average firm's sales during period 2007-2013 for *alive* firms (close to 90% of the total), *late exit* firms (nearly 8% of the total) and *early exit* firms (nearly 2% of the total). As we can see the crisis had a different impact on each type of firm. All firms experienced a significant reduction in sales in the aftermath of the crisis, i.e. year 2009. Yet, while the "*alive"* firms came back to their initial level of sales and remained at that level throughout all remaining years, the other firms continued their decline. The *early exit* firms reduced their sale by more than 70% in less than 3 years and by 2011 they were already out of the market. The "*late exit"* firms experienced a somewhat less radical decline and after a partial stabilization between 2009 and 2011, they rapidly converged towards exiting the market in the last two years. The reasons behind such degree of heterogeneity in firm responses are the main focus of the remaining parts of the paper.

Figure 2 – Evolution of firm's sales: alive vs. late exit vs. early exit



4. Empirical strategy

We model the probability of firm exit as a function of two main types of variables. On the one hand, we consider systemic variables, such as the industry and the geographic region in which the firm operates. These variables are treated as controls in our analysis. On the other, we consider firm-specific characteristics, with particular attention being paid to intangible capital intensity, as well as to financial and export-related indicators. On this basis, we want to estimate the effect of each of such variables on the probability that a firm exit the market during period 2008-2014.

Formally, the baseline model that we estimate takes the following form:

$$\Pr(EXIT_i = 1) = \Phi\left(XF_i'\beta_F + XC_i'\beta_C\right), \qquad (1)$$

where $\Phi(\cdot)$ is the cumulative distribution function for the standard normal, XF_i is a vector of firm-specific characteristics; XC_i is the vector of control variables; and β_F and β_C are the vectors of parameters to be estimated. Our baseline assumption is that beginning of the crisis acted as an exogenous and unexpected shock for firms, which allows us to identify the parameters in (1). The latter, in particular, are estimated via maximum likelihood (ML) estimation.

Within vector XF_i our main focus is on the effect of intangible assets. As discussed in Section 3 *ICI* exhibits a highly skewed distribution with few firms investing significantly and many others investing nothing. To control for such heterogeneity we replace the continuous variable ICI_i with a dummy variable taking value 1 if ICI_i >0 and 0 otherwise (D_ICI_i). Moreover, we include a set of interaction terms that capture the financial conditions in which intangible investments are undertaken. These interaction terms are computed first by defining a set of robustness indicators D_FINEXP_i, D_LIQUID_i, D_ROA_i, such that $D\_FINEXP_i = 1$ if $FINEXP_i < \underline{FINEXP}$ (0 otherwise), $D\_LIQUID_i = 1$ if $LIQUID_i > \underline{LIQUID}$ (0 otherwise) and $D\_ROA_i = 1$ if $ROA_i > \underline{ROA}$ (0 otherwise) where $\underline{VAR}$ for VAR = {*FINEXP*, *LIQUID*, *ROA*} is the median value

of VAR. Then we multiply these robustness indicators with variable D_ICI_i so that we capture the firms that invest in intangibles within the frame of a relatively robust financial condition. These interaction terms capture the same conceptual construct and are therefore used in alternative one of the other.

In addition to intangibles we include in XF_i other variables that are usually associated with the probability of firm survival such as $SIZE_i$, AGE_i and TCI_i. Moreover, given the international and financial nature of the crisis, especially for the initial period 2008-2010, we include in XF_i also the set of export- ($EXPORT_i$, D_EU_i, $D\_EXTRAEU_i$) and finance-related indicators ($FINEXP_i$, $LIQUID_i$, ROA_i).

In the vector of control variables (XC_i) we include dummies for both the industry (using Pavitt's (1984) classification) and the region of origin (distinguishing between North, Centre and South of Italy). As a robustness check we also test for different types of industry and regional classifications finding that results are robust.

All independent variables in equation (1) are evaluated at the beginning of the period, i.e., years 2006 and 2007. On this basis we use these variables to predict the probability that a firm exit the market within the next 7 years (i.e. before 2015). Given the structure of our data we cannot obviously exclude the possibility of model misspecification and omitted variable bias. To address this issue we saturate vector XC_i with as many variables as we can in order to control for any kind of firm-specific effects (trading-off the risk of running into multicollinearity). Because our concern is especially related to *ICI*, we focus our attention on variables that could be correlated with the accumulation of intangible assets, labour productivity (LAB_PRDTY_i), the degree of vertical integration ($VERT\_INT_i$) as well as a dummy for the firm's belonging to a group (D_GROUP_i). This solution, together with the rather detailed specification of vector XF_i, and the acceptable degree of correlation among regressors (see Table 2), should reduce the risk of omitted variable bias, even though some care must be taken in interpreting the results.

Table 2 – Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) *SIZE*	1.000											
(2) *AGE*	0.216*	1.000										
(3) *VERT_INT*	0.118*	0.042*	1.000									
(4) *D_GROUP*	0.440*	0.037*	0.019	1.000								
(5) *LAB_PRDTY*	0.033*	0.043*	0.022	0.096*	1.000							
(6) *TCI*	0.022	0.074*	0.200*	-0.014	-0.053*	1.000						
(7) *EXPORT*	0.240*	0.096*	-0.024	0.176*	0.065*	-0.036*	1.000					
(8) *D_EU*	0.058*	0.030*	-0.028	0.050*	0.015	-0.014	0.530*	1.000				
(9) *D_EXTRAEU*	0.062*	0.020	-0.022	0.051*	0.036*	-0.040*	0.401*	-0.044*	1.000			
(10) *FINEXP*	-0.056*	-0.099*	-0.034*	-0.033*	-0.084*	0.049*	-0.014	0.012	-0.010	1.000		
(11) *LIQUID*	-0.125*	0.005	0.119*	-0.083*	0.104*	-0.210*	0.029*	0.043*	0.043*	-0.065*	1.000	
(12) *ROA*	-0.027	-0.059*	0.277*	-0.023	0.4120*	-0.141*	0.024	0.016	0.027	-0.127*	0.276*	1.000
(13) *D_ICI*	0.380*	0.040*	-0.050*	0.208*	0.104*	-0.015	0.162*	0.056*	0.035*	-0.037*	-0.137*	-0.032*

Legend: *=sig. 5%

As discussed above the key feature of our dataset is that it allows us to track the behaviour of firms throughout the crisis. In particular we can distinguish between different processes of

firm exit, with some firms rapidly converging toward exit and others facing a more gradual process of selection. For this reason, alongside the baseline model discussed above, we estimate the following multinomial logit model

$$\Pr(STATUS = k) = \frac{\exp(XF_i'\beta_F^k + XC_i'\beta_C^k)}{1 + \sum_{j=1}^{3}\exp(XF_i'\beta_F^j + XC_i'\beta_C^j)} \quad \text{for} \qquad k = 1, 2, 3 \qquad (2)$$

where $STATUS_i$ is a discrete variable distinguishing between *alive*, *late exit* and *early exit* firms. All the other variables are kept the same as in model (1). By comparing the size and significant level of coefficients across these models we will be able to investigate whether similar variables play different roles in explaining exit during distinct phases of the crisis.

5. Results

Table 3 reports the probit estimates on the probability of exit, translated into marginal and impact effects for the continuous and dummy variables, respectively. First we add regressors included in XF_i with the exclusion of intangible-related variables (Model 1). Then we add D_ICI_i to test the isolated effect of intangible assets (Model 2). Finally, we run three additional models in which we include also the interaction between D_ICI_i and the robustness indicators discussed above (Models 3, 4 and 5).

The first interesting result that we obtain concerns the role of intangible assets. Whereas in isolation *D_ICI* is never significant, when it is combined with indicators of a relatively robust financial condition the effect is negative and significant. The size and significance level of the coefficient is consistent across models. This result lends support to the idea that when faced with an economic recession intangible assets can reduce the probability to exit the market, but only when they are combined with a sound financial position, i.e. low debt exposition or high liquidity and/or profitability.

The relevance of the firm's financial position is confirmed also by the results of the finance and profitability indexes, although with some distinction. While *FINEXP* and *ROA* significantly explain the probability of exit, with a positive and negative sign respectively, *LIQUID* turns out not significant. This finding, combined with the negative and significant effect associated with *TCI*, suggests that in the aftermath of the crisis firm selection depends more on the overall solidity of the firm's budget, than on the lack of ready-to-use liquid resources.

Table 3 – Results of the probit estimates on the probability of firm exit

	(1)	(2)	(3)	(4)	(5)
	Dep. Var.: dummy = 1 if the firm exits by 2014, 0 otherwise				
SIZE	0.007	0.018	0.018	0.017	0.019
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
AGE	-0.08	-0.084	-0.071	-0.092	-0.088
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
VERT_INT	0.314*	0.295	0.333*	0.322*	0.28
	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)
D_GROUP	-0.007	-0.006	0.009	-0.009	-0.006
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
LAB_PRDTY	0.000	0.000	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TCI	-0.497***	-0.497***	-0.531***	-0.503***	-0.515***
	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)
EXPORT	0.001	0.001	0.001	0.001	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
D_EU (d)	-0.046	-0.047	-0.038	-0.053	-0.037
	(0.15)	(0.15)	(0.16)	(0.16)	(0.16)
D_EXTRAEU (d)	0.242	0.238	0.239	0.227	0.248
	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)
FINEXP (index)	0.033***	0.033***	0.027***	0.032***	0.033***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LIQUID (index)	-0.032	-0.034	-0.027	-0.034	-0.002
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
ROA (index)	-0.218***	-0.220***	-0.210***	-0.189***	-0.217***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
D_ICI (d)		-0.079	0.041	-0.004	0.034
		(0.07)	(0.07)	(0.07)	(0.07)
D_ICI*D_FINEXP (d)			-0.323***		
			(0.08)		
D_ICI*D_ROA (d)				-0.188**	
				(0.08)	
D_ICI*D_LIQUID (d)					-0.247***
					(0.08)
Regional dummies	*yes*	*yes*	*yes*	*yes*	*yes*
Industry dummies	*yes*	*yes*	*yes*	*yes*	*yes*
Costant	-1.146***	-1.120***	-1.193***	-1.137***	-1.126***
	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)
Obs	4746	4746	4746	4746	4746
LogL	-1178.399	-1177.669	-1168.505	-1175.076	-1172.864
Chi2	131.584***	133.044***	151.373***	138.230***	142.655***

Legend: *=sig. 10%; **=sig. 5%; ***=sig. 1%

Finally, it is interesting to notice that in this estimation we find significant effect neither for export-related indicators (*EXPORT*, *D_EU*, *D_EXTRAEU*) nor for *SIZE* and *AGE*. This result is quite striking given the international nature of the crisis and the emphasis that is usually placed on firm's size and age as drivers of survival. Part of this result, however, may be due to

the relatively long time span that we consider to identify firm exit (2008-2014). It may certainly be possible that some of these variables are significant in explaining exit during the first phase of the crisis while they are not during the second phase. If that is the case the estimates reported in Table 3 do not allow us to have a clear say on the role of these variables.

To solve this issue we report in Tables 4 the multinomial estimates for *early exit* (columns 1-5) and *late exit* (columns 6-10) firms, where the excluded category is always *alive* firms. The hierarchical structure of the models is the same as the above one, where we first estimate the model by excluding intangible assets, then we include *D_ICI*, and finally we add also the interaction terms between *D_ICI* and the robustness indicators D_FINEXP_i, D_LIQUID_i, and $D\_ROA_{i,}$.

By comparing the results across the different models we obtain the following results. Firstly, we find that while *D_ICI* is almost not significant in explaining the probability of late exit (with exception of models 8 and 9 where it takes a positive but only weakly significant sign), it becomes negative and significant in explaining the probability of early exit. This result hold across all the estimated models expects model 3, where the sign is negative but not significant. In the latter case, however, most of the variance related to intangibles is captured by the interaction term with *D_FINEXP,* which takes a relatively large and highly significant sign. Overall, these estimates suggest that intangible assets indeed affected the chance of firm survival, although with some difference depending on the phase of the crisis. While during the initial phase intangible assets significantly reduced the probability of exit, al later stages their contribution became weaker.

Secondly, we find that even among financial constraints and profitability indicators there is some heterogeneity in the way in which they impact on firm exit. While *FINEXP* and *ROA* significantly affect the probability of both early exit and late exit and with the expected signs, *LIQUID* negatively and significantly explains only late exit. This result partially confirms the evidence reported in Table 1 on the limited role of liquid resources, although it suggests that the latter can indeed become relevant as the recession continues. In this sense liquid resources appear more as instruments to deal with prolonged periods of economic contraction, than as tools to draw immediate responses to unexpected shocks.

Table 4 – Results of the multinomial logit estimates on the probability of exit early vs. late

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Early: firms exit before 2010; excluded category firms alive					Late: firms exit between 2010-2014; excluded category: alive				
SIZE	0.003	0.111	0.114	0.112	0.112	0.032	0.02	0.023	0.022	0.019
	(0.11)	(0.12)	(0.12)	(0.12)	(0.12)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
AGE	-0.378*	-0.406*	-0.378*	-0.411*	-0.409*	-0.07	-0.067	-0.039	-0.085	-0.074
	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
VERT_INT	0.298	0.115	0.19	0.131	0.103	0.724*	0.746*	0.790**	0.785**	0.698*
	(0.69)	(0.70)	(0.69)	(0.70)	(0.70)	(0.40)	(0.40)	(0.40)	(0.40)	(0.40)
D_GROUP	0.06	0.078	0.109	0.076	0.079	-0.06	-0.061	-0.036	-0.071	-0.059
	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)
LAB_PRDTY	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TCI	-0.821	-0.818	-0.89	-0.821	-0.841	-0.988**	-0.988**	-1.046**	-1.012**	-1.010**
	(0.71)	(0.70)	(0.70)	(0.70)	(0.70)	(0.43)	(0.43)	(0.43)	(0.43)	(0.43)
EXPORT	-0.011*	-0.01	-0.011	-0.01	-0.01	0.005	0.004	0.004	0.005	0.005
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
D_EU (d)	0.694	0.729	0.75	0.725	0.745	-0.24	-0.243	-0.216	-0.256	-0.222
	(0.65)	(0.66)	(0.66)	(0.66)	(0.66)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)
D_EXTRAEU (d)	1.822***	1.810***	1.831***	1.801***	1.825***	-0.003	0.002	0.022	-0.022	0.019
	(0.65)	(0.66)	(0.66)	(0.66)	(0.66)	(0.43)	(0.43)	(0.43)	(0.43)	(0.43)
FINEXP (index)	0.055***	0.052***	0.042**	0.051***	0.052***	0.058***	0.058***	0.048***	0.057***	0.058***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
LIQUID (index)	0.11	0.092	0.105	0.091	0.114	-0.171***	-0.168***	-0.151**	-0.165***	-0.081
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)
ROA (index)	-0.425***	-0.433***	-0.411***	-0.407***	-0.432***	-0.431***	-0.432***	-0.411***	-0.359***	-0.427***
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.07)	(0.07)	(0.07)	(0.08)	(0.07)
D_ICI (d)		-0.724***	-0.398	-0.660**	-0.583**		0.091	0.291*	0.24	0.297*
		(0.24)	(0.25)	(0.26)	(0.28)		(0.16)	(0.16)	(0.17)	(0.17)
D_ICI*D_FINEXP (d)			-1.024***					-0.571***		
			(0.37)					(0.18)		
D_ICI*D_ROA (d)				-0.166					-0.448**	
				(0.35)					(0.20)	
D_ICI*D_LIQUID (d)					-0.284					-0.495***
					(0.32)					(0.19)
Regional dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Industry dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Costant	-1.674*	-1.514*	-1.680*	-1.533*	-1.519*	-3.047***	-3.082***	-3.222***	-3.123***	-3.095***
	(0.90)	(0.91)	(0.91)	(0.91)	(0.91)	(0.65)	(0.66)	(0.66)	(0.66)	(0.66)
Obs	4746	4746	4746	4746	4746	4746	4746	4746	4746	4746
LogL	-1368.882	-1363.987	-1354.383	-1361.2	-1360.257	-1368.882	-1363.987	-1354.383	-1361.2	-1360.257
Chi2	152.611***	162.401***	181.609***	167.976***	169.862***	152.611***	162.401***	181.609***	167.976***	169.862***

Legend: *=sig. 10%; **=sig. 5%; ***=sig. 1%

The differentiated role of intangible assets and financial and profitability indicators is confirmed also by the results of their interaction terms. In particular, we find that while the interaction terms between *D_ICI* and the robustness indicators is always significant and with a negative sign in models on late exit, it is significant only in one model out of three when we estimate the probability of early exit. These findings confirm once more the fact that the firm's financial and profitability conditions were more relevant as drivers of firm exit during the second phase of the crisis than during the first phase. On the contrary, intangible assets were key resources for survival especially in the immediate aftermath of the downturn.

The third result that we obtain concerns the role of export. In particular, we find that to make a significant proportion of export outside the EU is an important factor in differentiating between early exit and late exit. Indeed, the variable *D_EXTRAEU* is positive and highly significant in explaining the probability of early exit, while it is not significant in explaining late exit. No other export-related indicator is significant in our estimates. The most plausible interpretation of this result is that *D_EXTRAEU* captures the negative effect of the rapid decrease in international trade volumes that followed the 2008 financial crisis. As the volume of international trade increased again during the second phase of the crisis the level of export has become less relevant in explaining firm exit than during earlier stages. In this sense our results confirm the findings of Claessens et al. (2012) on the relevance of trade as a crisis transmission channel, especially in 2008-2009.

Finally, the estimates reported in Table 4 confirm that neither size nor age plays a relevant role in explaining firm exit during the crisis. While size is never significant, age turns out negative but only weakly significant in explaining early exit. These results, obviously, do not undermine the relevance of size and age as determinant of firm exit in general (although the available evidence in this sense is contradicting, see Santarelli and Vivarelli, 2007), but they rather suggest that in presence of negative and unexpected macroeconomic shocks size and age are not characteristics that differentiate among firms responses.

Overall, the results of our estimates provide a fairly encouraging picture concerning the role of intangible assets as divers of firm's resilience. If no distinction is made between "first" and "second" crisis, intangible assets reduce the probability of firm exit, but only if they are accumulated within the frame of a sound financial position. If a distinction between different phases of the crisis is made, intangible assets significantly reduces the probability of early exit, independently of the firm's financial position. This result tends therefore to confirm that firms with intangible assets exhibit greater capacity to cope with adverse and unexpected economic conditions than firms without in tangible assets, especially during the years immediately after the shock occurred.

6. Robustness checks

To increase the reliability of our results, we conduct a series of robustness checks. First of all we change the threshold value to distinguish between early exit and late exit. In the multinomial logit estimates reported in Section 5 we considered a 90% drop in sales for the years 2011, 2012 and 2014 as a proxy for firm exit. Now we run the same estimates considering alternatively 85% and 95% drop in sales as relevant thresholds. Results are reported in Table 5 and 6 respectively. As we can notice most of the previous results hold. Intangible assets (*D_ICI*) significantly reduce the probability of early exit. In the case of late exit intangible assets are significant only when interacted with the financial and profitability indexes. At the same time while *FINEXP* and *ROA* are significant in explaining both early exit

and late exit, *LIQUID* is significant only when regressed against the latter. Furthermore, in line with the previous estimate, *SIZE* and *AGE* keep being not significant (or only limitedly so) in all models.

Given the relevance that size is usually attributed in the literature on firm survival we also tested how our results react to a different specification of *SIZE*. In particular, we estimated both the probit and the multinomial logit models by substituting the continuous measure given by the log of employees with dummy variables for small (< 49 employees) and large firms (> 250 employees). Results are reported in Tables 7 and 8. Interestingly, we find that in this case the role of size changes depending on the model. In the probit estimates, where we do not distinguish between early and late exit, large size is still not significant. In the multinomial logit estimates, on the contrary, large size is positively and significantly associated with early exit and negatively and significantly associated with late exit. Results for all the other variables remain unchanged. If anything, this odd behaviour of the dummy for large firm confirms once more that the relationship between firm size and survival is at least ambiguous.

Table 5 – Results of the multinomial logit estimates on the probability of exit early vs. late: 85% threshold

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Early: firms exit before 2010; excluded category firms alive					Late: firms exit between 2010-2014; excluded category: alive				
SIZE	0.014	0.138	0.140	0.137	0.137	0.027	0.014	0.017	0.016	0.014
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
AGE	-0.417*	-0.450*	-0.427*	-0.449*	-0.451*	-0.069	-0.066	-0.035	-0.086	-0.074
	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
VERT_INT	0.390	0.182	0.243	0.177	0.175	0.676*	0.701*	0.750*	0.744*	0.651*
	(0.71)	(0.73)	(0.72)	(0.73)	(0.73)	(0.40)	(0.40)	(0.39)	(0.39)	(0.39)
D_GROUP	-0.036	-0.017	0.006	-0.018	-0.017	-0.026	-0.028	0.000	-0.039	-0.025
	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
LAB_PRDTY	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TCI	-0.514	-0.520	-0.577	-0.513	-0.530	-1.076**	-1.076**	-1.139***	-1.104***	-1.105***
	(0.73)	(0.72)	(0.72)	(0.72)	(0.72)	(0.42)	(0.43)	(0.43)	(0.43)	(0.43)
EXPORT	-0.01	-0.009	-0.009	-0.009	-0.009	0.004	0.004	0.003	0.004	0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
D_EU (d)	0.766	0.800	0.818	0.807	0.805	-0.249	-0.253	-0.224	-0.267	-0.228
	(0.67)	(0.67)	(0.67)	(0.67)	(0.67)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)
D_EXTRAEU (d)	1.720**	1.706**	1.730**	1.715**	1.712**	0.109	0.113	0.132	0.085	0.133
	(0.69)	(0.70)	(0.70)	(0.70)	(0.70)	(0.41)	(0.41)	(0.42)	(0.41)	(0.42)
FINEXP (index)	0.055***	0.052***	0.042**	0.051***	0.051***	0.058***	0.058***	0.048***	0.057***	0.058***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
LIQUID (index)	0.087	0.064	0.074	0.063	0.077	-0.137**	-0.133**	-0.115*	-0.130**	-0.043
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
ROA (index)	-0.422***	-0.430***	-0.409***	-0.426***	-0.428***	-0.433***	-0.435***	-0.412***	-0.354***	-0.429***
	(0.11)	(0.11)	(0.11)	(0.12)	(0.11)	(0.07)	(0.07)	(0.07)	(0.08)	(0.07)
D_ICI (d)		-0.833***	-0.555**	-0.851***	-0.760**		0.101	0.318**	0.264	0.334*
		(0.25)	(0.27)	(0.28)	(0.30)		(0.15)	(0.16)	(0.16)	(0.17)
D_ICI*D_FINEXP (d)			-0.826**					-0.628***		
			(0.37)					(0.18)		
D_ICI*D_ROA (d)				0.067					-0.500***	
				(0.36)					(0.19)	
D_ICI*D_LIQUID (d)					-0.145					-0.550***
					(0.34)					(0.19)
Regional dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Industry dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Costant	-1.633*	-1.448	-1.579*	-1.443	-1.449	-3.021***	-3.058***	-3.214***	-3.103***	-3.075***
	(0.94)	(0.94)	(0.94)	(0.94)	(0.94)	(0.65)	(0.65)	(0.65)	(0.65)	(0.65)
Obs	4746	4746	4746	4746	4746	4746	4746	4746	4746	4746
LogL	-1361.263	-1355.37	-1346.21	-1351.864	-1350.891	-1361.263	-1355.37	-1346.21	-1351.864	-1350.891
Chi2	148.204***	159.991***	178.311***	167.004***	168.948***	148.204***	159.991***	178.311***	167.004***	168.948***

Legend: *=sig. 10%; **=sig. 5%; ***=sig. 1%

Table 6 – Results of the multinomial logit estimates on the probability of exit early vs. late: 95% threshold

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Early: firms exit before 2010; excluded category firms alive					**Late: firms exit between 2010-2014; excluded category: alive**				
SIZE	-0.017	0.098	0.101	0.098	0.099	0.039	0.023	0.026	0.025	0.023
	(0.11)	(0.12)	(0.12)	(0.12)	(0.12)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
AGE	-0.336	-0.367	-0.340	-0.372*	-0.370*	-0.081	-0.076	-0.048	-0.094	-0.084
	(0.22)	(0.22)	(0.22)	(0.22)	(0.22)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
VERT_INT	0.130	-0.073	0.008	-0.055	-0.085	0.782**	0.813**	0.855**	0.851**	0.763*
	(0.71)	(0.72)	(0.71)	(0.72)	(0.72)	(0.40)	(0.40)	(0.39)	(0.39)	(0.40)
D_GROUP	0.133	0.153	0.183	0.150	0.154	-0.087	-0.089	-0.064	-0.099	-0.087
	(0.25)	(0.26)	(0.26)	(0.26)	(0.26)	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)
LAB_PRDTY	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TCI	-0.775	-0.767	-0.841	-0.769	-0.790	-1.001**	-1.001**	-1.057**	-1.025**	-1.023**
	(0.69)	(0.69)	(0.69)	(0.69)	(0.69)	(0.43)	(0.43)	(0.43)	(0.43)	(0.43)
EXPORT	-0.011*	-0.010	-0.011*	-0.010	-0.010	0.005	0.005	0.004	0.005	0.005
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
D_EU (d)	0.662	0.701	0.720	0.696	0.717	-0.239	-0.244	-0.216	-0.256	-0.222
	(0.65)	(0.65)	(0.65)	(0.65)	(0.66)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)
D_EXTRAEU (d)	1.802***	1.790***	1.809***	1.779***	1.804***	-0.005	0.000	0.020	-0.024	0.017
	(0.65)	(0.65)	(0.66)	(0.65)	(0.66)	(0.43)	(0.43)	(0.43)	(0.43)	(0.43)
FINEXP (index)	0.054***	0.052***	0.041**	0.050***	0.051***	0.058***	0.059***	0.049***	0.057***	0.059***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
LIQUID (index)	0.091	0.072	0.085	0.072	0.095	-0.163**	-0.159**	-0.141**	-0.155**	-0.071
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)
ROA (index)	-0.402***	-0.410***	-0.389***	-0.383***	-0.408***	-0.438***	-0.440***	-0.418***	-0.366***	-0.434***
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.07)	(0.07)	(0.07)	(0.08)	(0.07)
D_ICI (d)		-0.763***	-0.434*	-0.694***	-0.619**		0.124	0.322*	0.273	0.335*
		(0.23)	(0.25)	(0.26)	(0.28)		(0.16)	(0.17)	(0.17)	(0.18)
D_ICI*D_FINEXP (d)			-1.043***					-0.564***		
			(0.37)					(0.18)		
D_ICI*D_ROA (d)				-0.185					-0.446**	
				(0.34)					(0.20)	
D_ICI*D_LIQUID (d)					-0.293					-0.500***
					(0.32)					(0.19)
Regional dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Industry dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Costant	-1.634*	-1.467	-1.632*	-1.488*	-1.471*	-3.083***	-3.133***	-3.272***	-3.174***	-3.148***
	(0.89)	(0.89)	(0.90)	(0.89)	(0.89)	(0.66)	(0.66)	(0.66)	(0.66)	(0.66)
Obs	4746	4746	4746	4746	4746	4746	4746	4746	4746	4746
LogL	-1372.933	-1367.109	-1357.418	-1364.339	-1363.292	-1372.933	-1367.109	-1357.418	-1364.339	-1363.292
Chi2	152.462***	164.110***	183.493***	169.650***	171.744***	152.462***	164.110***	183.493***	169.650***	171.744***

Legend: *=sig. 10%; **=sig. 5%; ***=sig. 1%

Table 7 – Results of the probit estimates with control dummies for firm size

	(1)	(2)	(3)	(4)	(5)
	Dep. Var.: dummy = 1 if the firm exits by 2014, 0 otherwise				
D_LARGE	-0.153	-0.143	-0.134	-0.151	-0.159
	(0.13)	(0.14)	(0.14)	(0.14)	(0.14)
D_SMALL	-0.078	-0.087	-0.088	-0.091	-0.093
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
AGE	-0.080	-0.080	-0.067	-0.089	-0.084
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
VERT_INT	0.317*	0.308	0.345*	0.334*	0.293
	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)
D_GROUP	-0.016	-0.009	0.004	-0.014	-0.009
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
LAB_PRDTY	0.000	0.000	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TCI	-0.501***	-0.499***	-0.533***	-0.506***	-0.519***
	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)
EXPORT	0.001	0.001	0.001	0.001	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
D_EU (d)	-0.051	-0.054	-0.043	-0.06	-0.045
	(0.15)	(0.15)	(0.16)	(0.16)	(0.16)
D_EXTRAEU (d)	0.243	0.238	0.239	0.227	0.248
	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)
FINEXP (index)	0.033***	0.033***	0.027***	0.032***	0.032***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LIQUID (index)	-0.032	-0.035	-0.028	-0.035	-0.002
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
ROA (index)	-0.219***	-0.220***	-0.210***	-0.188***	-0.218***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
D_ICI (d)		-0.073	0.046	0.003	0.042
		(0.06)	(0.07)	(0.07)	(0.07)
D_ICI*D_FINEXP (d)			-0.322***		
			(0.08)		
D_ICI*D_ROA (d)				-0.193**	
				(0.08)	
D_ICI*D_LIQUID (d)					-0.253***
					(0.08)
Regional dummies	*yes*	*yes*	*yes*	*yes*	*yes*
Industry dummies	*yes*	*yes*	*yes*	*yes*	*yes*
Costant	-1.064***	-1.010***	-1.081***	-1.026***	-1.011***
	(0.26)	(0.27)	(0.27)	(0.27)	(0.27)
Obs	4746	4746	4746	4746	4746
LogL	-1177.125	-1176.446	-1167.337	-1173.716	-1171.408
Chi2	134.133***	135.490***	153.709***	140.951***	145.567***

Legend: *=sig. 10%; **=sig. 5%; ***=sig. 1%

Table 8 – Results of the multinomial logit estimates on the probability of exit early vs. late: dummies for size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Early: firms exit before 2010; excluded category firms alive					**Late: firms exit between 2010-2014; excluded category: alive**				
D_LARGE	0.767*	0.910**	0.933**	0.903**	0.893**	-0.908**	-0.922**	-0.898**	-0.933**	-0.956**
	(0.41)	(0.42)	(0.42)	(0.42)	(0.42)	(0.40)	(0.40)	(0.40)	(0.40)	(0.40)
D_SMALL	0.090	0.014	0.003	0.013	0.011	-0.264*	-0.254*	-0.256*	-0.258*	-0.266*
	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
AGE	-0.403*	-0.401*	-0.366	-0.405*	-0.403*	-0.050	-0.051	-0.024	-0.068	-0.058
	(0.22)	(0.22)	(0.22)	(0.22)	(0.22)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
VERT_INT	0.274	0.167	0.242	0.182	0.159	0.748*	0.766*	0.810**	0.805**	0.717*
	(0.69)	(0.68)	(0.67)	(0.68)	(0.68)	(0.40)	(0.40)	(0.40)	(0.40)	(0.40)
D_GROUP	0.027	0.110	0.134	0.108	0.110	-0.068	-0.077	-0.051	-0.087	-0.076
	(0.25)	(0.26)	(0.26)	(0.26)	(0.26)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
LAB_PRDTY	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TCI	-0.780	-0.776	-0.847	-0.777	-0.796	-1.023**	-1.026**	-1.083**	-1.054**	-1.053**
	(0.71)	(0.70)	(0.70)	(0.70)	(0.70)	(0.43)	(0.43)	(0.43)	(0.43)	(0.43)
EXPORT	-0.012*	-0.011*	-0.011*	-0.011*	-0.011*	0.005	0.005	0.004	0.005	0.005
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
D_EU (d)	0.777	0.797	0.807	0.793	0.809	-0.281	-0.283	-0.248	-0.297	-0.263
	(0.66)	(0.66)	(0.66)	(0.66)	(0.66)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)
D_EXTRAEU (d)	1.892***	1.874***	1.897***	1.865***	1.881***	-0.003	0.002	0.021	-0.023	0.025
	(0.66)	(0.66)	(0.66)	(0.66)	(0.66)	(0.43)	(0.43)	(0.43)	(0.43)	(0.43)
FINEXP (index)	0.054***	0.051***	0.041**	0.050***	0.051***	0.057***	0.057***	0.047***	0.056***	0.057***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
LIQUID (index)	0.115*	0.088	0.102	0.088	0.108	-0.177***	-0.173***	-0.155**	-0.169***	-0.081
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)
ROA (index)	-0.422***	-0.431***	-0.408***	-0.408***	-0.430***	-0.436***	-0.438***	-0.417***	-0.363***	-0.433***
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.07)	(0.07)	(0.07)	(0.08)	(0.07)
D_ICI (d)		-0.713***	-0.384	-0.659**	-0.589**		0.099	0.296*	0.251	0.315*
		(0.23)	(0.25)	(0.26)	(0.28)		(0.15)	(0.16)	(0.16)	(0.17)
D_ICI*D_FINEXP (d)			-1.032***					-0.562***		
			(0.37)					(0.18)		
D_ICI*D_ROA (d)				-0.136					-0.457**	
				(0.35)					(0.20)	
D_ICI*D_LIQUID (d)					-0.247					-0.523***
					(0.32)					(0.19)
Regional dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Industry dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Costant	-1.681*	-1.23	-1.397	-1.247	-1.227	-2.799***	-2.873***	-2.996***	-2.907***	-2.884***
	(0.90)	(0.90)	(0.91)	(0.90)	(0.91)	(0.65)	(0.66)	(0.66)	(0.66)	(0.66)
Obs	4746	4746	4746	4746	4746	4746	4746	4746	4746	4746
LogL	-1362.751	-1357.694	-1348.188	-1354.814	-1353.665	-1362.751	-1357.694	-1348.188	-1354.814	-1353.665
Chi2	164.873***	174.986***	193.999***	180.747***	183.046***	164.873***	174.986***	193.999***	180.747***	183.046***

Legend: *=sig. 10%; **=sig. 5%; ***=sig. 1%

7. Conclusion

The recent crisis in the Euro area has caused several business closures, especially in the EMU periphery. In this paper we use an original firm-level dataset on Italy to study whether intangible assets reduce the probability of firm exit during the crisis. We argue that intangible assets strengthen the firm's resilience capacity via both a variety and dynamic capabilities effect, and this in turn makes firms better equipped to develop adequate responses in the face of adverse and unexpected shocks.

On the basis of our analysis we obtain two main results: first we show that intangible assets significantly reduce the probability of firm exit, especially during the initial phase of the crisis; second, we show that financial weaknesses becomes more relevant than intangibles in explaining firm exit at later stages of the crisis. If taken together these two findings point toward the existence of a different model of firm selection that has operated during the first (i.e. 2008-2010) and second crisis (i.e. 2011-2014), with financial constraints becoming much more salient during the latter.

In addition, some of our findings confirm the results obtained by the previous literature. First of all, in line with Claessens et al. (2012), we find that trade operated as an important transmission channel through which the subprime crisis spread to Europe. Secondly, we find that, at time of crisis, firm age has no effect on firm exit. Finally, we confirm that firm size has a relatively ambiguous effect on firm survival. The latter result reinforces the general scepticism on the role of firm size as a good predictor of survival (e.g., Santarelli and Vivarelli, 2007).

Based on these results, some interesting policy implications can be drawn. As an extensive literature nowadays shows intangible assets are usually associated with positive measures of firm performance, in terms of both productivity and innovativeness. In light of this literature our results suggest that the prolonged economic recession is likely to produce a distortion in the process of firm selection. If at the beginning of the crisis intangible assets could still ensure a survival premium in favour of best performing firms, at later stages this effect has weakened. As the negative economic outlook continuous firm selection is increasingly driven by financial and budgetary weaknesses only, irrespective of the capabilities accumulated by firms. If this result is confirmed in other EU countries as well, policy makers should be worried about the significant economic losses that this overall process entails. In addition to the cost due to unemployment, the selection of firms with valuable skills may produce a long-term capability gap with respect to international competitors and this may indeed delay the full recovery of EU economies. In this sense policy interventions aimed softening the pressure caused by financial constraints (e.g. through easier access to credit) could potentially reduce the impact of the selective distortion and should thus be welcomed.

Acknowledgement

We thank participants to the C.Met 05 workshop held at the University of Venice for the useful comments.

Appendix.

A.1 "Alive" vs. "exited" firms

The identification of the firms that are part of the 2008 MET survey and exited the market before 2015 is based on the information contained in the AIDA-BVD database. For each firm such database makes it possible to establish the "firm status" following different types of legal action. The available classification distinguishes between firms that are "active" and those that are "inactive" or "in liquidation".

Then, independently of the available "firm status", we checked whether the AIDA-BVD database contains information on the specific legal actions a firm may be subjected to. Although an ending date for the pending legal actions is not always available in the database, it is plausible to assume that the opening of such actions (for instance the company's liquidation or failure) is a signal of a significant downsizing of the firm's operations, which may be even associated with the firm's actual exit. On this basis we identified a series of criteria that helped us to categorize firms as either "alive" or "exited". In particular, we define a firm as "alive" if in 2014:

a) Her status in the AIDA-BVD database is "active" with no pending legal actions;

b) Her status in the AIDA-BVD database is "active" and there are pending legal actions that refer only to a transfer to another province.

A firm is instead categorized as "exited" if in 2014:

a) Her status in the AIDA-BVD database is "in liquidation"

b) Her status in the AIDA-BVD database is "inactive" and there are not pending legal actions related to merges and/or acquisitions

c) Her status in the AIDA-BVD database is "active" and there are pending legal actions related to debt restructuring, failure, liquidation, insolvency, creditor agreement.

Moreover, a third category of firms was created with the label "in transformation". A firm is categorized as "in transformation" if in 2014:

a) Her status in the AIDA-BVD database is "active" and there are pending legal procedures related to merges and/or acquisitions;

b) Her status in the AIDA-BVD database is "inactive" and there are pending legal procedures related to merges and/or acquisitions;

In the present paper we consider only firms that are categorized as "alive" or "exited". Firms categorized as "in transformation" are removed from the sample.

A.2 List of the variables

- *ICI*: intangible assets / tot. assets in 2007.
- *TCI:* tangible assets / tot. assets in 2007.
- *SIZE*: logarithm of the number of employees in 2007.
- *AGE*: logarithm of 2007 less the year of foundation.
- *LAB_PRDTY*: added value / number of employees in 2007.
- *EXPORT*: sales occurred through export / total sales in 2007.
- *D_EU*: = 1 if % of sales in EU countries > 50%, 0 otherwise
- *D_EXTRAEU*: = 1 if % of sales in extra EU countries > 50%, 0 otherwise
- *FINEXP*: (liabilities – net assets – credits) / net assets in 2007.
- *LIQUID*: liquid assets / net assets in 2007
- *ROA*: net income / average total assets in 2007
- *D_GROUP*: = 1 if firm belong to a group, 0 otherwise
- *VERT_INT*: added value / total sales in 2007

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