



Working Paper n. 05 - 2013

THE IMPACT OF FINANCIAL STRUCTURE ON FIRMS' PROBABILITY OF BANKRUPTCY: A COMPARISON ACROSS WESTERN EUROPE CONVERGENCE REGIONS

Lidia Mannarino

Dipartimento di Scienze Economiche,
Statistiche e Finanziarie
Università della Calabria
Ponte Pietro Bucci, Cubo 0/C
Tel.: +39 0984 492405
Fax: +39 0984 492421
e-mail: l.mannarino@unical.it

Marianna Succurro

Dipartimento di Scienze Economiche,
Statistiche e Finanziarie
Università della Calabria
Ponte Pietro Bucci, Cubo 1/C
Tel.: +39 0984 492445
Fax: +39 0984 492421
e-mail: m.succurro@unical.it

Aprile 2013



THE IMPACT OF FINANCIAL STRUCTURE ON FIRMS' PROBABILITY OF BANKRUPTCY: A COMPARISON ACROSS WESTERN EUROPE CONVERGENCE REGIONS

Marianna SUCCURRO

m.succurro@unical.it

Lidia MANNARINO

l.mannarino@unical.it

Department of Economics, Statistics and Financial Sciences
University of Calabria
Italy

Abstract

The aim of the paper is to investigate the impact of financial structure on firms' probability of bankruptcy in Western Europe convergence regions. The empirical evidence shows that the financial structure is a key factor explaining firms' bankruptcy, but while the debt, the cash flow and the profitability ratios are strongly significant in explaining firms' failure, structure and operational ratios are not relevant factors of bankruptcy. Additional differences arise when we consider the countries separately: while debt and cash flow ratios are significant for bank based economies, they are not significant for market oriented countries.

Keywords: Financial Structure, Probability of Bankruptcy, Convergence Regions

JEL classification: D92; E22; G33; L1.

Introduction

A large amount of research has focused on the relationship between finance and bankruptcy but, to the best of the authors' knowledge, there is no study that has verified if and to what extent the financial structure impacts the firms' probability of bankruptcy in Western Europe convergence regions. This is the aim of our paper.

As extension of previous empirical research on both developed and developing countries, our analysis focuses on developing areas of developed economies. The regions included in the analysis share some common characteristics, but they differ along several dimensions including differences in market imperfections (Cleary, 2006), different economic and institutional framework, the origins of the legal systems (La Porta *et al.*, 1998), industry concentration, and so on. World Bank rankings on the ease of doing business show great differences among the considered countries, ranging between rank 7 (United Kingdom) and rank 87 (Italy) (World Bank Doing Business Report, 2012). Additional features

differentiate convergence regions from the rest of the country. These differences would reinforce the generality of the results obtained and the conclusions reached. While large amount of evidence exists on the relation between financial development, firms' bankruptcy and growth both cross-countries and cross-industries (Levine, 2005; Demirguc-Kunt and Maksimovic, 1998; Beck et al., 2005a; Beck et al., 2005b; Aghion *et al.*, 2007; Jeon and Townsend, 2005), much less is known at the microeconomic level of the firm. In this context, the contribution of our research - which relies on accounting data collected from the Bureau van Dijk's Amadeus database - is twofold. First, we highlight the role of the financial structure in explaining firms' bankruptcy in Western Europe convergence regions. Second, following the most recent literature in this field, our research is based on an econometric analysis which takes into account several financial ratios instead of the commonly used one-dimensional definition of the financial status.

Empirical studies on developed economies identify several determinants of firms' failure, like size, age, industrial characteristics and geographical location but financial variables are not always significant in explaining firms' bankruptcy. We posit that, in Western Europe convergence regions, where the percentage of SMEs is relatively higher than in more developed regions, financial variables are equally if not more important than the other factors. Given the credit market imperfections, the access to financial market instruments is more limited for small and medium-sized enterprises than for large firms, which can benefit from reputation, privileged access to financial resources, economies of scale in their financing operations and access to stock markets. On one hand, these limitations for SMEs could seriously limit their expansion potential and, therefore, their future survival. On the other hand, firms operating in European convergence regions have also access to EU structural funds which would allow them to diversify their sources of financing and the associated risks. In this context, the final effect of diverse financial structures on firms' bankruptcy probabilities is worth analyzing.

We can summarize our main empirical results as follows. First, the financial strength is a key factor explaining bankruptcy in Western Europe convergence regions. This result is in line with other studies on developing economies. With reference to additional control variables, size, age and industry are always significant in explaining firms' probability of bankruptcy. This result, instead, is in line with other studies on developed economies. Second, some differences arise from a deeper analysis of the financial ratios. While the debt ratio, the cash flow ratio and profitability are strongly significant, structure and operational ratios are not important factors explaining firms' failure. Third, some differences arise when we consider the countries separately: while debt and cash flow ratios are significant for bank-based countries, they are not significant for United Kingdom, characterized by a developed financial market.

The paper is organized as follows. Section 1 presents a brief overview of the empirical literature on financial structure and bankruptcy. Section 2 illustrates our

data and descriptive statistics. Section 3 discusses the empirical strategy and Section 4 focuses on empirical results. The last section concludes the work.

1 Literature review

A large number of empirical studies have addressed the issue of financial status since it can significantly affect the firm's investment and its ability to grow and stay in the market. Several studies stem from the finance and growth literature and are based on cross-country comparison that takes financial variables as given for all firms located in the same country and/or industry (Levine, 2005; Demircuc-Kunt and Maksimovic, 1998; Beck et al., 2005a; Beck et al., 2005b; Aghion *et al.*, 2007; Jeon and Townsend, 2005).

For what concerns microeconomic studies, financial status has been found to play an increasingly important role on various aspects of firms' behavior¹ such as their investment capacity, their employment and their R&D activities. A lot of evidence seems to exist also about the significant role played by financial constraints in conditioning firms' growth and survival (Zingales, 1998; Fotopoulos and Louri, 2000; Geroski and Gregg, 1997; Bunn and Redwood, 2003; Vartia, 2004; Nkurunziza, 2005). A first group of empirical studies relies on a one-dimensional definition of financial constraint, assuming that a single variable can effectively identify the existence of a constraint. Specifically, several studies categorize firms according to an established characteristic (like dividend payout, size, age, location, group membership, debt rating) designed to measure the level of financial constraints faced by firms² (Fazzari *et al.*, 1988; Devereux and Schiantarelli, 1990; Gilchrist and Himmelberg, 1995; Kaplan and Zingales, 1997; Kadapakkam *et al.*, 1998; Greenaway *et al.*, 2005; Cleary, 2006). On the base of the chosen segmenting variable, these researches analyze the impact of financial status on various aspects of firm' behavior, often producing contradictory findings (Cleary, 2006, p.1561-1562). Departing from Altman (1968), a second group of empirical studies proposes a multivariate analysis for the financial status, often based on multiple discriminant analysis (MDA) or principal component analysis (PCA) which consider an entire profile of characteristics shared by a particular firm and transform them into a univariate statistic (Musso and Schiavo, 2007; Cleary 1999, 2006; Whited and Wu, 2006; Ginoglou *et al.*, 2002; Lamont *et al.*, 2001). Firms are classified into groups on the base of this beginning-of-period synthetic index which, however, can result from very different financial structures.

An additional weakness of the earlier approaches lies in the choice of a single variable or a synthetic index to classify firms *ex-ante* (a priori classification). Our study, on the contrary, applies an *ex-post* classification by distinguishing failed

¹ For comprehensive surveys see Hubbard (1998) and Bond and Van Reenen (2006).

² For a list of papers in chronological order and the segmenting variables used to distinguish among constrained and unconstrained firms see Musso and Schiavo (2007), Table 1 (p.15).

firms (in bankruptcy or in liquidation) and not failed firms (active firms) at time t and including several variables - each potentially important in affecting the probability of bankruptcy- that can give information on the firm's financial structure in the previous years. More specifically, in line with Lamont *et al.* (2001), Cleary (1999, 2006), Whited and Wu (2006), Musso and Schiavo (2007) we use several financial ratios to identify the financial structure which, however, is not used to categorize firms ex-ante, but to estimate the probability of bankruptcy in an econometric analysis.

Moreover, while most microeconomic works use market data for listed enterprises or survey data where firms give self-assessment of their financial status (Winker, 1999; Becchetti and Trovato, 2002; Holtz-Eakin *et al.*, 1994), we use public balance sheet data for both listed and not-listed firms.

2 Descriptive analysis across Western Europe Convergence Regions

This study uses two data sources. The first one is the EU regional policy online database which allows to identify Western Europe Convergence Regions (Structural and Cohesion funding 2007-13). The selected convergence regions, illustrated by the red areas on Graph 1A in the online Annex, include: Calabria, Campania, Puglia, Sicilia (Italy); Andalucia, Extremadura, Castilla-La Mancha, Galicia (Spain); Norte, Centro, Alentejo (Portugal); Western Wales & The Valleys; South Western (UK); Mecklenburg-Vorpommern, Sachsen-Anhalt, Sachsen, Thüringen (Germany).

The second data source is the Amadeus database, published by *Bureau van Dijk*. It is a European financial database which includes more than 4 million firms' accounting data in a standardized balance sheet format. The database includes both SME and large firms operating in all industries.

Our sample, which includes only manufacturing firms, is essentially made up of small and medium enterprises³, which constitute the 93% of the firms in Italy, the 97% in Spain, the 91% in Portugal, the 86% in Germany and the 72% in United Kingdom.

Table 1 shows the percentage of survived (S) and failed (F) firms in each country by size and technological cluster. On the base of the Pavitt's Taxonomy (Pavitt, 1984; Archibugi, 2001) and departing from NACE 2007 Classification, the main manufacturing sectors are grouped into four clusters with an increasing technological intensity (OECD, 2001; OECD, 2003): Low Technology (LT); Medium-Low Technology (MLT); Medium-High Technology (MHT) and High Technology (HT).

³ According to European Union Commission Recommendation 96/280/EC we classify the firms on the base of their relative size: micro and small firms (turnover<10mln); medium firms (10mln euros<turnover<50mln euros); large firms (turnover>50 mln euros).

By comparing the considered convergence regions, the percentage of failed firms is relatively higher in UK for SMEs and in Spain for large companies. In general, in Italy, Portugal and UK small and medium enterprises go bankrupt more frequently than large companies. When we focus on the technological clusters, data show a higher percentage of failed firms in high-tech and medium-high-tech sectors in UK and in Italy than in the other countries.

Table 1A in the online Annex illustrates the composition by size – in each industrial cluster - of the two groups of active and failed firms. Data indicate a high firms' size homogeneity in Italy, Spain and Portugal, where the presence of small firms is very high, independently from the technological intensity of the sector. In Germany and UK, on the contrary, large firms are relatively more numerous than in other countries.

Table 1 Survived (S) and Failed (F) firms by size and technological cluster (% values)

	ITALY		SPAIN		PORTUGAL		GERMANY		UK	
	S	F	S	F	S	F	S	F	S	F
Large	97.4	2.6	68.8	31.1	96.0	4.0	95.5	4.5	91.2	8.8
SMEs	95.8	4.2	93.6	6.4	93.8	6.2	98.6	1.4	80.5	19.5
HT	91.1	8.9	98.0	2.0	96.7	3.3	98.7	1.3	83.8	16.2
MHT	87.1	12.9	95.4	4.5	96.9	3.1	97.3	2.7	93.1	6.9
MLT	88.0	12.0	92.9	7.1	97.1	2.9	98.1	1.9	79.3	20.7
LT	97.4	2.6	92.9	7.1	95.2	4.8	97.4	2.6	81.1	18.9

Source: own elaborations on Amadeus data

3 Empirical strategy and Econometric specification

Our study distinguishes survived firms and failed firms (in bankruptcy or in liquidation) at time t and includes several variables that can give information on their financial structure at time $t-\tau$. Specifically, we consider all the active firms at time $t-\tau$. The dependent variable takes value 1 if the firm, active at time $t-\tau$, is in bankruptcy or in liquidation at time t , 0 otherwise. Failed firms are removed from the Amadeus database after 2 years, hence in our empirical analysis $\tau=2$ years. The financial health is investigated at the start of the recent global financial crisis (2008), and firms' probability of bankruptcy is evaluated during the next two years. Following a consolidated methodology (Pederzoli and Torricelli, 2010; Zeitun *et al.*, 2007; Ginoglou *et al.*, 2002; Westgaard and Wijst, 2001, among others), we use a logit analysis to compute the probability of bankruptcy based on several financial ratios used to measure the financial structure of the firms. The aim of the research is to verify if and to what extent the selected financial ratios affect the probability to go bankrupt.

The logistic regression technique allows us to specify the probability of bankruptcy as a function of a set of explanatory variables. In formal terms:

$$p_i = \Pr(Y_i = 1) = F(x_i\beta)$$

where p_i is the probability that the dependent variable equals 1 ($Y=1$), $F(\cdot)$ is the logistic cumulative distribution function, x_i is the set of explanatory variables thought to affect p_i , and β are the regression coefficients.

The logit model is expressed as follows:

$$p_i = \text{BANKRUPTCY}_i = F(\beta_0 + \beta_1 \text{Current}_i + \beta_2 \text{Debt}_i + \beta_3 \text{Cash}_i + \beta_4 \text{ROE}_i + \beta_5 \text{IntCov}_i + \beta_6 X_i)$$

where the dependent variable is dichotomous and takes value 1 if the firm, active in year $t-2$, is in bankruptcy or liquidation in year t , 0 otherwise.

A clear definition of failure is required since different researchers have used different criteria to define bankruptcy (Bridges and Guariglia, 2008; Zeitun *et al.*, 2007; Castagna and Matolcsy, 1981; Deakin, 1972; Beaver, 1968). We classify a firm as failed if it is in bankruptcy, liquidation or dissolved for liquidation or bankruptcy⁴. We do not define a firm as failed if its company status is in receivership. In this case, indeed, the firm remains active though it is in administration or receivership or under a reorganization procedure. During the rehabilitation period, the company is usually placed under protection and continues operating in order to reorganize and repay creditors. At the end, the company will either return to normal operating (thus the default of payment was temporary) or will be reorganized (parts of its activity can be restructured or sold) or will be liquidated. This last option is the less frequent one. Indeed, the principal focus of modern insolvency legislation and business debt restructuring practices in European countries no longer rests on the liquidation and elimination of insolvent entities but on the remodeling of the financial and organizational structure of debtors experiencing financial distress so as to permit the rehabilitation and continuation of their business (Succurro, 2012, p.108). For this reason we do not consider a firm in receivership or reorganization as failed.

In line with other studies, our analysis is confined to the sub-sample of firms which report the required accounting data⁵.

Financial literature identifies a number of financial ratios as significant indicators of bankruptcy (Pederzoli and Torricelli, 2010). The choice of our explanatory variables, motivated by both theoretical and empirical considerations, include the following beginning of period financial variables:

Current_i is a structure ratio, that is the ratio between current assets and current liabilities; it indicates the balance between assets and liabilities;

Debt_i indicates the debt ratio of the firm, that is total debt to total assets;

Cash_i indicates the ratio between cash flow and Total Assets and it is a proxy of firm liquidity. Firms holding a large cash flow ratio are more likely to be able to

⁴ Firms dissolved for reasons different from liquidation or bankruptcy (for example, due to a merger) are excluded from the analysis.

⁵ This limit shrinks the analyzed samples in particular in those countries, like Germany and United Kingdom, where some balance sheet information are not compulsory for firms.

finance internally their investments; at the same time, in presence of imperfect capital markets, a high cash flow ratio might also function as a “screening device” to gain a better access to external financing;

ROE_i is the return on equity, that is (Profit before tax/Shareholders Funds) and it is included as profitability ratio;

$IntCov_i$, the interest coverage of the firm, is an operational ratio measured as EBIT (Earnings before Interest and Taxes) over interest paid.

The selected financial ratios allow us to measure the financial strength of the firms (Cleary 1999; 2006). In order to capture the fact that the financial health influences firms’ survival in the next two-years period, all the explanatory variables are considered at the beginning of the period.

The matrix X includes additional control variables. Specifically:

Sales over Total Assets is a measure of performance linked to several factors including management efficiency, firm’s marketing strategies, external market conditions and macroeconomic context.

The variable *Size* indicates the beginning of period size of the firm, measured as the log of total revenues (turnover)⁶. It is argued that large companies are less prone to fail because of easier access to the credit market.

The variable *Age* is measured as the log of the number of years since firm’s foundation. Age is computed as the difference between the last available year and the company foundation year. Though the relationship between age and the probability of bankruptcy is explained in several ways in the empirical literature, generally empirical studies on developed economies find negative correlation between bankruptcy and age while research on developing economies finds contradictory results.

Finally, since the financial ratios can vary significantly from one industrial sector to another, we include 23 dummy variables to control for the effect of the industrial sector. Although Audretsch (1995) finds that the observed differences in default rates across industries are due to varying innovative environments, it is difficult to find stylized facts about the sector determinants of firms’ bankruptcy because of different, sometimes contradictory, results obtained in previous empirical studies.

In order to correct for significant outliers, we eliminate all observations in the lowest 1% and in the highest 99% percentile.

Table 2A in the Appendix illustrates some descriptive statistics. Table 3A and Table 4A in the online Annex illustrate the median values of the financial variables used in the empirical analysis, distinguishing between active and failed firms. Data show that failed firms are generally younger, characterized by lower levels of cash flow and profitability and a higher debt ratio compared to survived firms.

The next paragraph illustrates the econometric estimates.

⁶ We have also used the logarithm of total number of employees but, because of data availability, the logarithm of total revenues (turnover) appears the most satisfactory size measure in this study.

4 Empirical Results

Table 2 illustrates the econometric estimates for Western Europe convergence regions as a whole while Table 3 illustrates the results separately for each country. Table 2 shows the estimation results of the logistic regression parameters, the standard errors, the odds ratio of the logistic regression and the marginal effects. Given the non-linearity of the first-order conditions with respect to parameters, a solution of numerical approximation is adopted that reaches the convergence after several reiterations. For the sample as a whole, convergence is reached after 4 reiterations and the maximized value of the log-likelihood function is -4533.89.

Given that the parameters of the logistic regression are not directly interpretable as marginal effects, these have been explicitly calculated. $Debt_i$, $Cash_i$ and ROE_i are significant at the 1% level with the expected sign. *Current* ratio and *interest coverage*, on the contrary, are not significant in explaining firms' probability of bankruptcy though they have the expected negative sign.

With reference to the control variables, they are all significant at 1% level and enter the function with a negative sign. In line with other studies on developed economies, empirical evidence on Western Europe convergence regions shows that bigger and older firms, with a good sales performance, are less likely to go bankruptcy, holding the other variables constant.

The positive (negative) marginal effects indicate that a rise in each explanatory variable increases (decreases) the probability of bankruptcy. A one percent increase in $Debt_i$ rises the probability of bankruptcy by approximately 0.013%; a one percent increase in $Cash_i$ decreases the probability of bankruptcy by approximately 0.06%.

With reference to the odds ratio, which coincides with the exponential value of estimated parameters, the highest value is registered by the *Debt* ratio. Specifically, increasing the debt ratio impacts the odds of bankruptcy by $[(1.399-1)*100]=39.9\%$, hence firms characterized by high debt over total assets are $(e^{0.336})=1.4$ times more likely to fail. The lowest value is registered by the *Cash flow* ratio. For a unit (100%) increase in the Cash flow ratio, the Odds - $(p_i/1-p_i)$ - of bankruptcy, that is $[(e^{\beta}-1)*100]$, decreases by 80.2%, holding the other variables constant. Cash flow over total assets is an important financial variable affecting firms' survival since firms with a high Cash flow ratio - that is firms characterized by weak internal financial constraints - are less likely to fail than firms with low cash flow. Analogously, for a unit increase in ROE, the odds of firms' bankruptcy decreases by 20% holding the other variables constant.

The overall empirical results indicate that the financial structure is a relevant factor explaining firms' probability of bankruptcy. With reference to the other control variables, which are all strongly significant, *Age* shows the lowest odds ratio, equal to 0.721. Therefore, a unit increase in $\log(\text{Age})$ decreases the odds of firm failure by 28%. At the same time, a unit increase in $\log(\text{size})$ or sales decreases the odds of

bankruptcy by 13%⁷. Sector dummy variables are included in the regression and most of them are significant at 1% or 5% level.

Table 2 Estimates - Logistic regression, Western EU Convergence Regions

Dependent Variable: $p_i = \text{BANKRUPTCY}_i$	β	SE	p-value	Odds ratio e^β	Marginal Effects
Current	-0.014	0.014	0.294	0.986	-0.000
Debt	0.336	0.081	0.000	1.399	0.013
Cash Flow	-1.619	0.298	0.000	0.198	-0.063
Return on equity	-0.224	0.044	0.000	0.799	-0.008
Interest coverage	-0.029	0.058	0.620	0.971	-0.001
Sales	-0.129	0.023	0.000	0.879	-0.005
Size	-0.134	0.013	0.000	0.874	-0.005
Age	-0.327	0.027	0.000	0.721	-0.013
constant	0.581	0.118	0.000		
Prob>chi2=0.000					
Log-likelihood: -4533.89					
N = 32974					

Robust Standard Errors. Sector dummy variables included.

Table 3 illustrates estimation results for each country separately. Since the regions examined share some common characteristics, but they differ along several aspects, these differences could reinforce or not the generality of the results obtained.

Some differences arise from a compared analysis of financial ratios and countries.

The ratio between current assets and current liabilities, which is not significant for Western Europe convergence regions as a whole, results to be strongly significant for Italian and English convergence regions.

The Debt ratio is significant with positive sign for Italy, Spain and Germany which are all bank based economies, but it is not significant for the UK, characterized by a more developed financial market.

Analogously, the ratio between cash flow and total assets is an extremely important financial factor influencing firms' bankruptcy in bank based countries. In Southern Italy, in particular, for a unit (100%) increase in the *Cash* flow ratio, the odds of bankruptcy decreases by 93%. The empirical evidence on Italian convergence regions, mainly characterized by strong financial market imperfections, would signal lower creditworthiness and higher difficulties to access external financial resources. In this context, internal resources may be an extremely important source to finance investments and growth. Analogously, Italian firms with a higher *Debt*

⁷ Age and size are still significant at 1% level also when we consider the quadratic forms age^2 and size^2 , but while age^2 enters with a negative sign, the positive sign associated to size^2 would indicate increasing returns to scale (in affecting default probability).

ratio are more likely to fail. For a debt ratio increase of one, the odds ($p_i/1-p_i$) of bankruptcy increases by 35.6%, holding the other variables constant.

With respect to profitability and operational ratios, return on equity is strongly significant with the expected negative sign for all countries, while interest coverage enters significantly only for Italy, Spain and Portugal.

In line with other studies on developed economies, and differently from empirical results on developing countries, age and size are both significant in explaining firms' probability of bankruptcy in all Western Europe convergence regions.

Table 3 Econometric estimates – Logistic regression (β), Western EU regions

Dependent Variable: $p_i = \text{BANKRUPTCY}_i$	Italy	Spain	Portugal	UK	Germany
Current	-0.202*** (0.043)	-0.043 (0.026)	-0.017 (0.024)	-1.142*** (0.229)	-0.232 (0.262)
Debt	0.305** (0.124)	0.536*** (0.194)	0.045 (0.202)	0.203 (0.579)	2.090* (1.003)
Cash Flow	-2.670*** (0.626)	-0.698** (0.305)	-0.525 (0.525)	-0.764 (1.112)	1.053 (1.89)
Return on equity	-0.289*** (0.108)	-0.364** (0.161)	-0.183** (0.087)	-1.367** (0.575)	-0.482*** (0.165)
Interest coverage	-0.104* (0.059)	-0.478*** (0.177)	-0.220* (0.117)	-0.078 (0.119)	-0.047 (0.826)
Sales	0.007 (0.029)	0.320*** (0.051)	0.031 (0.082)	-0.435 (0.342)	1.290** (0.378)
Size	-0.198*** (0.020)	-0.250*** (0.026)	-0.744*** (0.038)	-0.436*** (0.074)	0.295* (0.175)
Age	-0.420*** (0.035)	-0.362*** (0.060)	-0.191*** (0.063)	-0.284*** (0.104)	-0.707** (0.339)
constant	-0.099*** (0.129)	-0.897*** (0.308)	0.922*** (0.265)	1.023*** (0.923)	-2.14** (1.890)
Log-likelihood:	-5443.94	-3090.94	-2352.54	-292.73	-66.70
	N=16911	N=6588	N=7916	N=750	N=809

Notes: Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Sector dummy variables included.

Moreover, in order to evaluate the model, we computed the percent of correct classifications which gives us the percent of correct predictions of our model. Table 4 shows that positive responses were predicted for 32715 observations, of which 31082 were correctly classified because the observed response was positive ($y=1$), while the other 1633 were incorrectly classified because the observed response was negative. Likewise, of the 259 observations for which a negative response was predicted, 192 were correctly classified and 67 were incorrectly classified. In total, 94.84% of predicted probability is correctly classified.

Table 4 Prediction of the model

Classified	D	*D	Total
+	31082	1633	32715
-	67	192	259
Total	31149	1825	32974
Correctly Classified			94.84%

We have further assessed the model's ability to accurately classify observations using a receiver operating characteristic (ROC) curve (Graph 2A in the online Annex). A ROC curve is constructed by generating several classification tables for cutoff values ranging from 0 to 1 and calculating the sensitivity and specificity for each value. Sensitivity is plotted against 1, to make a ROC curve. The area under the ROC curve (AUC) is a measure of discrimination; a model with a high area under the ROC curve suggests that the model can accurately predict the value of an observation's response. In our analysis, the area under the ROC curve equals 0.7486, compared to 0.64-0.67 of correct classification obtained in previous studies (see Cleary, 2006, p.1567).

Finally, we have checked the presence of any specification error using the linktest (Table 5). The idea behind linktest is that if the model is properly specified, one should not be able to find any statistically significant additional predictors, except by chance. The linktest uses the linear predicted value (\hat{y}) and linear predicted value squared (\hat{y}^2) as the predictors to rebuild the model. Since the variable \hat{y} is a statistically significant predictor, the model is not misspecified. On the other hand, if our model is properly specified, variable \hat{y}^2 should not have much predictive power except by chance. Since, \hat{y}^2 is not significant, we have not omitted relevant variables and our equation is correctly specified.

Table 5 Specification error test

SURV	Coef.	Std. Err.	z	$p > z$
\hat{y}	1.823	0.157	11.59	0.000
\hat{y}^2	0.038	0.143	0.27	0.789
_cons	1.087	0.220	1.22	0.224

Conclusions

The aim of this study is to investigate the impact of financial structure on firms' probability of bankruptcy in Western Europe convergence regions, which are developing regions of developed countries. We concentrate on a particular area in order to develop a model able to capture the specific features of the firms in these regions. The research indicates that the analyzed regions share some characteristics with the developed countries and others with the developing ones.

We can summarize our empirical results as follows. First, the financial structure is significant in explaining firms' probability of bankruptcy in Western Europe convergence regions. This result is in line with studies on developing economies. Empirical studies on developed economies, in fact, show that the financial variables are not always significant in explaining firms' bankruptcy. With reference to additional control variables, size, age and industry are always significant in explaining firms' probability of bankruptcy. This result, instead, is in line with studies on developed economies.

Second, some differences arise from a deeper analysis of the financial ratios. While the debt, the cash flow and the profitability ratios are strongly significant, operational and structure ratios are not relevant in explaining firms' bankruptcy.

Third, further differences arise when we consider the countries separately. While the debt and the cash flow ratios are significant for Italy and Spain, which are bank based economies, they are not significant for UK, characterized by a more developed financial market. In Southern Italy, in particular, for a unit increase in the cash flow ratio, the odds of bankruptcy decreases by 93%. This result would signal lower creditworthiness, higher difficulties to access external finance, and the reason for which internal resources are often the most important source to finance investments and growth.

This research would offer a relevant support to market analysis, given the potential impact of the financial structure on firms' failure and, therefore, on market selection mechanisms. Moreover, this study could offer interesting applications since the estimated probability of bankruptcy is used as input in the Basel II minimum capital requirement formula. Finally, while most microeconomic works use market or survey data, we use public and accessible balance sheet data, so that the model lends itself to be used by any economic agent interested in the firm's financial health and its probability of bankruptcy.

REFERENCES

- Aghion, P., Fally, T. and Scarpetta, S. (2007), "Credit constraints as a barrier to the entry and post-entry growth of firms", *Economic Policy*, vol.22(52), pp.731-79.
- Altman, E.I. (1968), "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy", *Journal of Finance*, vol.23, pp.589-609.
- Archibugi, D. (2001), "Pavitt's Taxonomy Sixteen Years On: A Review Article", *Economics of Innovation and New Technology*, vol.10, pp. 415-425.
- Beaver, W. (1968), "Alternative Financial Ratios as Predictors of Failure", *Accounting Review*, XLIII, pp.113-122.
- Becchetti, L. and Trovato, G. (2002), "The determinants of growth of small and medium sized firms. The role of the availability of external finance", *Small Business Economics*, vol.19(4), pp.291-306.
- Beck, T., Demirguc-Kunt, A. and Maksimovic, V. (2005a), "Financial and legal constraints to firm growth: Does firm size matter?", *Journal of Finance*, LX(1), pp.137-77.

Beck, T., Demirguc-Kunt, A., Laeven, L. and Levine, R. (2005b), "Finance, firm size and growth", Policy Research Working Paper Series 3485, The World Bank.

Bond, S. and J. Van Reenen (2006), "Microeconomic Models of Investment and Employment" in J. Heckman and E. Leamer (eds) *Handbook of Econometrics*, Volume 6, Elsevier, North Holland.

Bridges, S. and Guariglia, A. (2008), "Financial Constraints, Global Engagement, and Firm Survival In The United Kingdom: Evidence From Micro Data", *Scottish Journal of Political Economy*, vol.55, pp.444-464.

Bunn, P. and V. Redwood (2003), "Company Accounts Based Modelling of Business Failures and the Implications for Financial Stability" Bank of England Discussion Paper No. 210.

Castagna, A.D. and Matolcsy, Z.P. (1981), "The Prediction of Corporate Failure: Testing the Australian Experience", *Australian Journal of Management*, vol.6, pp.23-50.

Cleary, S. (1999), "The relationship between firm investment and financial status", *Journal of Finance*, vol.54(2), pp.673-92.

Cleary, S. (2006), "International corporate investment and the relationships between financial constraint measures", *Journal of Banking & Finance*, vol.30(5), pp.1559-1580.

Deakin, E.B. (1972), "A Discriminant Analysis of Predictors of Business Failure", *Journal of Accounting Research*, vol.10, pp.167-179.

Demirguc-Kunt, A. and Maksimovic, V. (1998), "Law, finance, and firm growth", *Journal of Finance*, LIII(6), pp.2107-137.

Devereux, M. and Schiantarelli, F. (1990), "Investment, financial factors and cash flow: Evidence from U.K. panel data", in G. Hubbard, ed., *Information, Capital Markets and Investment*, University of Chicago Press, pp. 279-306.

Fazzari, S., Hubbard, G. and Petersen, B. (1988), "Financing constraints and corporate investment", *Brookings Papers on Economic Activity*, vol.1, pp.141-95.

Fotopoulos, G. and H. Louri (2000), "Determinants of Hazard Confronting New Entry: Does Financial Structure Matter?", *Review of Industrial Organization*, vol.17, pp. 285-300.

Geroski, P. and P. Gregg (1997), *Coping with Recession: UK Company Performance in Adversity*, Cambridge University Press, Cambridge.

Gilchrist, S. and Himmelberg, C. (1995), "Evidence on the role of cash flow for investment", *Journal of Monetary Economics*, vol.36(3), pp.541-572.

Ginoglou, D., Agorastos, K., Hatzigagios, T. (2002), "Predicting Corporate Failure of Problematic Firms in Greece with LPM Logit, Probit, and Discriminant Analysis Models", *Journal of Financial Management and Analysis*, vol.15, pp.1-15.

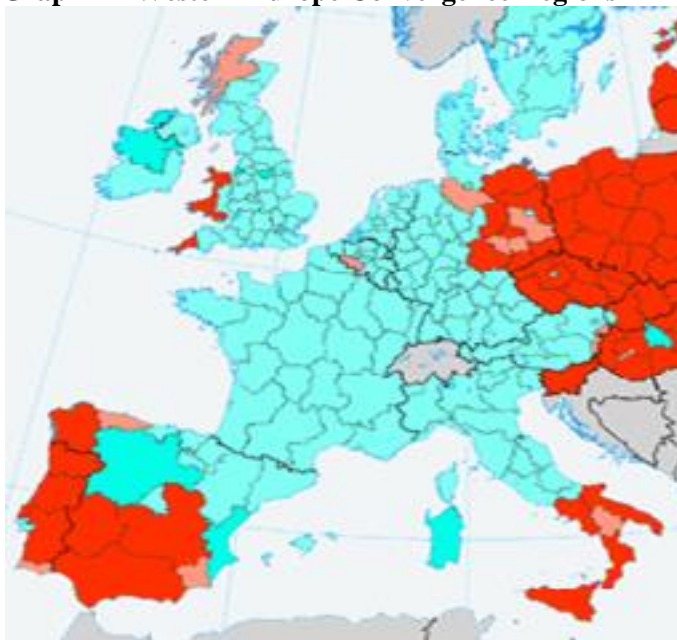
Greenaway, D., Guariglia, A. and Kneller, R. (2005), "Do financial factors affect exporting decisions?", GEP Research Paper 05/28, Leverhulme Center.

Holtz-Eakin, D., Joulfaian, D. and Rosen, H. (1994), "Sticking it out: Entrepreneurial survival and liquidity constraints", *Journal of Political Economy*, vol.102, pp.53-75.

- Hubbard, G. (1998), "Capital Market Imperfections and Investment" *Journal of Economic Literature*, vol.35, pp.193-225.
- Kadapakkam, P.R., Kumar, P. and Riddick, L. (1998), "The impact of cash flows and firm size on investment: The international evidence", *Journal of Banking & Finance*, vol.22(3), pp.293-320.
- Kaplan, S. and Zingales, L. (1997), "Do investment-cash flow sensitivities provide useful measures of financing constraints?", *The Quarterly Journal of Economics*, vol.112(1), pp.169-215.
- Lamont, O., Polk, C. and Saa-Requejo, J. (2001), "Financial constraints and stock returns", *Review of Financial Studies*, vol.14(2), pp.529-54.
- Levine, R. (2005), "Finance and growth: Theory and evidence", in P. Aghion and S. Durlauf, eds, *Handbook of Economic Growth*, vol.1, chapter 12, pp.865-934.
- La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R.W. (1998), "Law and finance", *Journal of Political Economy*, pp.1113-1155.
- Nkurunziza, J. (2005), "Credit Can Precipitate Firm Failure: Evidence from Kenyan Manufacturing in the 1990s", Center for the Studies of African Economies Working Paper No. 2005-04.
- OECD (2003), *OECD Science, Technology and Industry Scoreboard 2003*, OECD Publishing, Paris. doi: 10.1787/sti_scoreboard-2003-en.
- OECD, (2001), *Innovative Clusters: Drivers of National Innovation Systems*, OECD, Paris.
- Pavitt, K. (1984), "Sectoral Patterns of Technical Change: Towards a Taxonomy and a Theory", *Research Policy*, vol.13, pp.343-73.
- Pederzoli, C., Torricelli, C. (2010), "A parsimonious default prediction model for Italian SMEs", *Banks and Bank Systems*, vol.5(4), pp.5-9.
- Succurro M. (2012), "Bankruptcy Systems and Economic Performance across Countries: some empirical evidence", *European Journal of Law and Economics*, vol.33, pp.101-126.
- Westgaard, S., Wijst, N.V.D. (2001), "Default Probability in A Corporate Bank Portfolio: A Logistic Model Approach", *European Journal of Operational Research*, vol.135, pp.338-349.
- Whited, T. and Wu, G. (2006), "Financial constraints risk", *Review of Financial Studies*, vol.19(2), pp.531-59.
- Winker, P. (1999), "Causes and effects of financing constraints at the firm level", *Small Business Economics*, vol.12(2), pp.169-81.
- World Bank *Doing Business Report*, 2012.
- Vartia, L. (2004). "Assessing Plant Entry and Exit Dynamics and Survival – Does Firms' Financial Status Matter?" *Mimeograph*, European University Institute.
- Zeitun, R., Tian, G., Keen, K. (2007), "Default probability for the Jordanian companies: a test of cash flow theory", *International Research Journal of Finance and Economics*, vol.8, pp.147-162.
- Zingales, L. (1998). "Survival of the Fittest or the Fattest? Exit and Financing in Trucking Industry", *Journal of Finance*, vol.53, pp.905-938.

CONTENTS TO BE INCLUDED IN THE ONLINE ANNEX

Graph 1A Western Europe Convergence Regions



Source: http://ec.europa.eu/regional_policy/atlas2007/index_en.htm

The figure shows the selected convergence regions (RED AREAS): Calabria, Campania, Puglia, Sicilia (Italy); Andalucia, Extremadura, Castilla-La Mancha, Galicia (Spain); Norte, Centro, Alentejo (Portugal); Western Wales & The Valleys; South Western (UK); Mecklenburg-Vorpommern, Sachsen-Anhalt, Sachsen, Thüringen (Germany).

Table 1A Survived/Failed firms, distribution by size and sector (% values)

	ITALY	SPAIN	PORTUGAL	GERMANY	UK
HT-SURVIVED:					
TURNOVER<=10 MLN	96.4	95.9	99.9	83.4	62.8
10<TURNOVER<=50	3.1	3.4	0.1	12.4	26.9
TURNOVER>50 MLN	0.5	0.8	0.0	4.2	10.4
HT-FAILED:					
TURNOVER<=10 MLN	97.7	97.9	96.9	82.5	83.6
10<TURNOVER<=50	1.8	0.0	3.1	10	13.6
TURNOVER>50 MLN	0.5	2.1	0.0	7.5	2.7
MHT-SURVIVED:					
TURNOVER<=10 MLN	96.7	97.1	94.7	82.6	71.8
10<TURNOVER<=50	2.9	2.0	3.4	12.1	20.0
TURNOVER>50 MLN	0.5	1.0	1.9	5.4	8.2
MHT-FAILED:					

TURNOVER<=10 MLN	98.9	91.7	94.0	75.0	83.3
10<TURNOVER<=50	1.1	5.3	5.2	6.3	12.5
TURNOVER>50 MLN	0.0	3.0	0.7	18.8	4.2
MLT-SURVIVED:					
TURNOVER<=10 MLN	96.5	97.7	97.4	88.9	67.0
10<TURNOVER<=50	3.1	2.0	2.2	8.1	26.6
TURNOVER>50 MLN	0.3	0.4	0.3	2.9	6.3
MLT-FAILED:					
TURNOVER<=10 MLN	97.6	95.1	98.8	77.8	91.1
10<TURNOVER<=50	2.1	4.4	0.9	19.0	6.3
TURNOVER>50 MLN	0.3	0.5	0.3	3.2	2.6
LT-SURVIVED:					
TURNOVER<=10 MLN	92.3	97.1	97.7	86.8	65.8
10<TURNOVER<=50	6.3	2.2	2.0	8.7	25.8
TURNOVER>50 MLN	1.4	0.6	0.3	4.5	8.3
LT-FAILED:					
TURNOVER<=10 MLN	98.2	94.0	99.2	75.0	88.7
10<TURNOVER<=50	1.5	4.6	0.7	13.5	10.6
TURNOVER>50 MLN	0.2	1.3	0.1	11.5	0.8

Source: own elaborations on Amadeus data

Table 2A Variables and Main Summary Statistics

	OBS	MEAN	STD DEV.	MIN	MAX
DEFAULT		0.054	0.207	0	1
<i>Current</i>		1.687	1.582	0.12	18.37
<i>Debt</i>		0.481	0.247	0.011	1.707
<i>Cash flow</i>		0.056	0.075	-0.869	0.421
<i>ROE</i>		-0.005	0.411	-3.384	0.896
<i>Interest cover</i>		0.112	0.380	-0.454	3.813
<i>Sales</i>		1.154	2.443	-0.004	350.4
<i>Size</i>		3099.122	7273.383	18	72136
<i>(Log)Size</i>		6.722	1.602	2.890	11.186
<i>(Log)Age</i>		2.523	0.769	0.693	4.143

Source: own elaborations on Amadeus data

Table 3A Financial Variables - Median Values for Survived Firms

ITALY SPAIN PORTUGAL GERMANY UK
HT:

<i>Current ratio</i>	1.18	1.16	1.39	2.00	1.45
<i>Debt ratio</i>	38.44	75.89	44.56	48.49	45.08
<i>Cash flow</i>	3.70	4.41	4.22	9.64	8.97
<i>ROE</i>	2.82	5.44	5.88	9.95	13.99
<i>Interest cover</i>	2.57	1.54	1.95	3.16	4.58
<i>Age</i>	12	10	14	11	11
MHT:					
<i>Current ratio</i>	1.14	1.20	1.35	2.02	1.17
<i>Debt ratio</i>	39.17	76.27	45.46	48.19	55.42
<i>Cash flow</i>	3.70	4.01	6.05	8.75	9.73
<i>ROE</i>	3.52	6.09	7.93	8.93	22.79
<i>Interest cover</i>	2.77	1.79	2.66	3.16	3.17
<i>Age</i>	5	10	9	12	7
MLT:					
<i>Current ratio</i>	1.12	1.06	1.27	1.94	1.26
<i>Debt ratio</i>	37.37	82.28	49.89	51.32	48.65
<i>Cash flow</i>	3.65	3.91	5.55	11.14	8.41
<i>ROE</i>	2.52	4.47	5.21	11.00	10.83
<i>Interest cover</i>	1.99	1.30	1.66	3.23	4.78
<i>Age</i>	9	10	11	13	10
LT:					
<i>Current ratio</i>	1.18	1.06	1.18	1.86	1.07
<i>Debt ratio</i>	40.50	79.11	54.33	54.29	50.50
<i>Cash flow</i>	3.31	4.28	5.54	11.63	9.41
<i>ROE</i>	2.18	3.99	4.85	10.48	13.04
<i>Interest cover</i>	1.71	1.31	1.49	3.48	4.68
<i>Age</i>	12	11	10,5	14	10

Source: own elaborations on Amadeus data

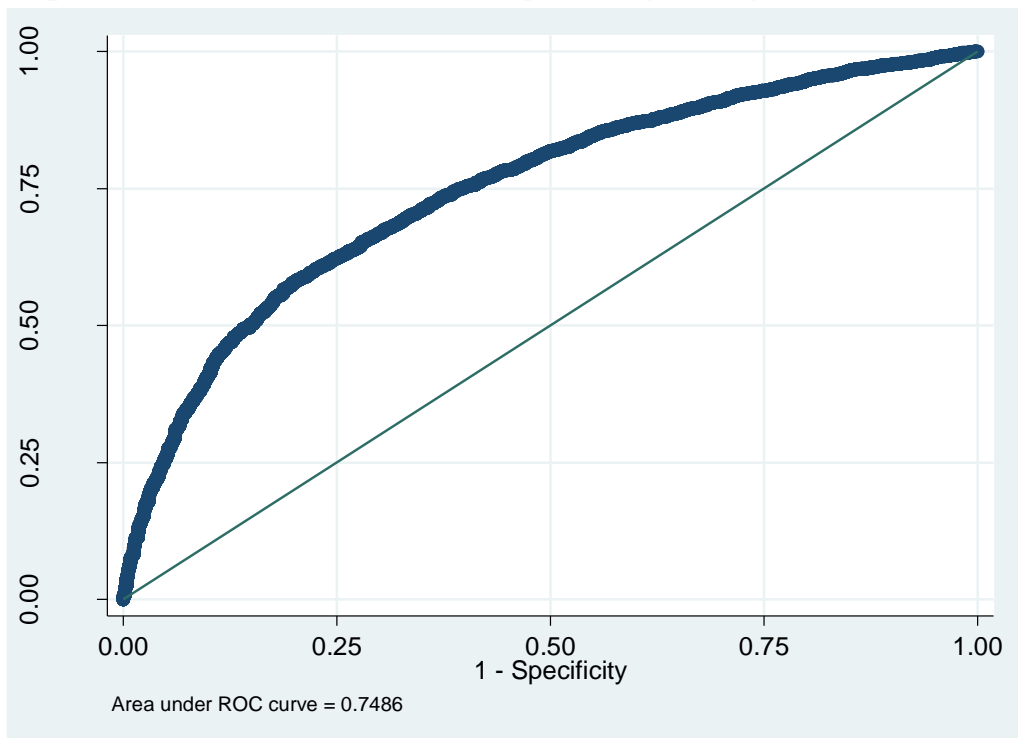
Table 4A Financial Variables - Median Values for Failed Firms

	ITALY	SPAIN	PORTUGAL	GERMANY	UK
HT:					
<i>Current</i>	0.99	1.06	1.20	2.17	1.03
<i>Debt</i>	51.82	78.60	41.23	54.57	70.36
<i>Cash flow</i>	0.84	1.91	0.68	4.79	0.53
<i>ROE</i>	-0.99	0.02	-0.30	6.05	4.77

<i>Interest cover</i>	0.14	0.08	-0.24	6.17	0.98
<i>Age</i>	10	5	10	8	6
MHT:					
<i>Current</i>	1.03	1.05	1.16	1.15	0.94
<i>Debt</i>	50.52	72.11	48.24	67.00	66.67
<i>Cash flow</i>	1.64	2.90	1.31	10.05	4.76
<i>ROE</i>	0.15	3.29	2.42	1.01	14.94
<i>Interest cover</i>	0.87	1.26	0.95	3.87	0.99
<i>Age</i>	7	8	8	6	7
MLT:					
<i>Current</i>	0.99	0.99	1.09	1.28	0.95
<i>Debt</i>	50.36	77.71	58.15	63.59	68.68
<i>Cash flow</i>	1.14	2.81	1.61	12.22	4.76
<i>ROE</i>	-0.25	1.76	0.70	12.49	11.66
<i>Interest cover</i>	0.09	0.72	-0.09	2.69	1.03
<i>Age</i>	9	9	9	12	5
LT:					
<i>Current</i>	0.99	0.98	0.99	1.14	0.84
<i>Debt</i>	50.60	75.75	70.80	61.00	69.07
<i>Cash flow</i>	0.73	2.27	0.45	10.57	6.49
<i>ROE</i>	-0.56	0.88	0.95	7.62	12.26
<i>Interest cover</i>	-0.25	-0.08	-0.55	1.65	0.91
<i>Age</i>	9	11	8	11	3

Source: own elaborations on Amadeus data

Graph 2A The ROC curve, Western Europe convergence regions



Source: own elaborations on Amadeus data