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

SUCCURRO, Marianna*
MANNARINO, Lidia

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.
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1. 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 form 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 at al., 2005a; Beck at 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

*Marianna Succurro, m.succurro@unical.it; Lidia Mannarino, l.mannarino@unical.it;
Department of Economics, Statistics and Financial Sciences, University of Calabria, Italy

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 indentify 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.

2. 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; Demirguc-Kunt and Maksimovic, 1998; Beck at al., 2005a; Beck at al., 2005b; Aghion *et al*., 2007; Jeon and Townsend, 2005).

For what concerns microeconometric studies, financial status has been found to play an increasingly important role on various aspects of firms' behavior[1] 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

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

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 firms[2] (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 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 microeconometric 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.

3. Descriptive analysis across Western Europe Convergence Regions

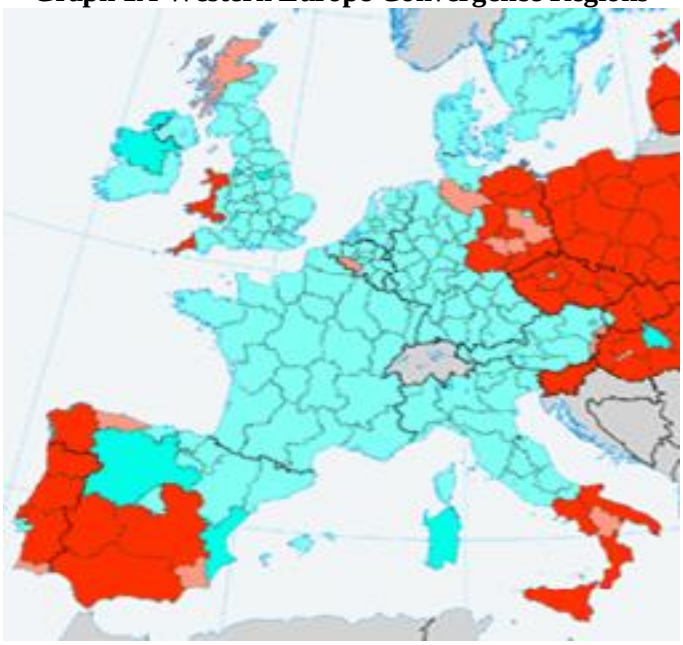
This study uses two data sources. The first one is the EU regional policy online database which allows to indentify Western Europe Convergence Regions (Structural and Cohesion funding 2007-13). The selected convergence regions, illustrated by the red areas on Graph 1, include: Calabria, Campania, Puglia, 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).

[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).

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 enterprises[3], 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.

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 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).

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,

[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).

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

4. 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-τ. Specifically, we consider all the active firms at time t-τ. The dependent variable takes value 1 if the firm, active at time t-τ, 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(.) 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:

$$p_i = BANKRUPTCY_i = F(\beta_0+\beta_1 Current_i+\beta_2 Debt_i+\beta_3 Cash_i+\beta_4 ROE_i+\beta_5 IntCov_i+\beta_6 X_i)$$

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 bankruptcy[4]. 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 data[5].

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 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'

[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.

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.

5. 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.

[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.

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.

Table 2 Estimates - Logistic regression, Western EU Convergence Regions

Dependent Variable: p_i = 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.

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^{β}-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(Age) decreases the odds of firm failure by 28%. At the same time, a unit increase in log(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 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.

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

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

[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).

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* 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.

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.

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).

Table 4 Prediction of the model

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

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) and linear predicted value squared (_hatsq) as the predictors to rebuild the model. Since the variable _hat is a statistically significant predictor, the model is not misspecified. On the other hand, if our model is properly specified, variable _hatsq should not have much predictive power except by chance. Since, _hatsq 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	1.823	0.157	11.59	0.000
_hatsq	0.038	0.143	0.27	0.789
_cons	1.087	0.220	1.22	0.224

6. 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 microeconometric 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.

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ONLINE ANNEX

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

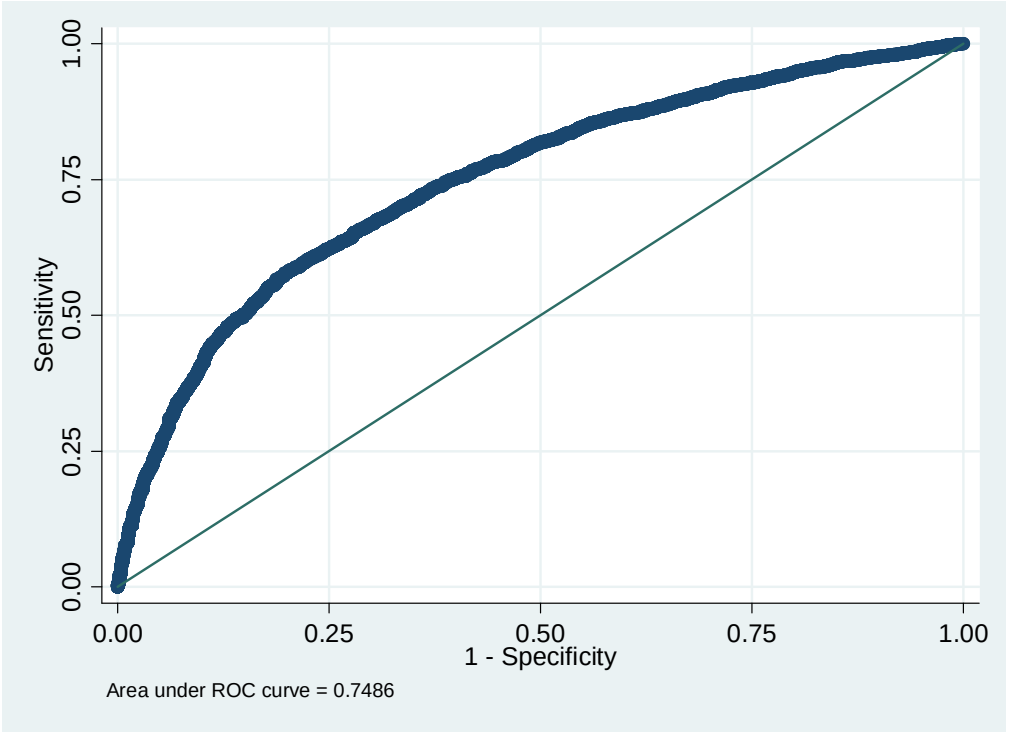
Source: own elaborations on Amadeus data

Table 2A Variables and Main Summary Statistics

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

Source: own elaborations on Amadeus data

Graph 2A The ROC curve, Western Europe convergence regions



Source: own elaborations on Amadeus data

Table 3A Financial Variables - Median Values for Survived Firms

	ITALY	SPAIN	PORTUGAL	GERMANY	UK
HT:					
Current ratio	1.18	1.16	1.39	2.00	1.45
Debt ratio	38.44	75.89	44.56	48.49	45.08
Cash flow	3.70	4.41	4.22	9.64	8.97
ROE	2.82	5.44	5.88	9.95	13.99
Interest cover	2.57	1.54	1.95	3.16	4.58
Age	12	10	14	11	11
MHT:					
Current ratio	1.14	1.20	1.35	2.02	1.17
Debt ratio	39.17	76.27	45.46	48.19	55.42
Cash flow	3.70	4.01	6.05	8.75	9.73
ROE	3.52	6.09	7.93	8.93	22.79
Interest cover	2.77	1.79	2.66	3.16	3.17
Age	5	10	9	12	7
MLT:					
Current ratio	1.12	1.06	1.27	1.94	1.26
Debt ratio	37.37	82.28	49.89	51.32	48.65
Cash flow	3.65	3.91	5.55	11.14	8.41
ROE	2.52	4.47	5.21	11.00	10.83
Interest cover	1.99	1.30	1.66	3.23	4.78
Age	9	10	11	13	10
LT:					
Current ratio	1.18	1.06	1.18	1.86	1.07
Debt ratio	40.50	79.11	54.33	54.29	50.50
Cash flow	3.31	4.28	5.54	11.63	9.41
ROE	2.18	3.99	4.85	10.48	13.04
Interest cover	1.71	1.31	1.49	3.48	4.68
Age	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:					
Current	0.99	1.06	1.20	2.17	1.03
Debt	51.82	78.60	41.23	54.57	70.36
Cash flow	0.84	1.91	0.68	4.79	0.53
ROE	-0.99	0.02	-0.30	6.05	4.77
Interest cover	0.14	0.08	-0.24	6.17	0.98
Age	10	5	10	8	6
MHT:					
Current	1.03	1.05	1.16	1.15	0.94
Debt	50.52	72.11	48.24	67.00	66.67
Cash flow	1.64	2.90	1.31	10.05	4.76
ROE	0.15	3.29	2.42	1.01	14.94
Interest cover	0.87	1.26	0.95	3.87	0.99
Age	7	8	8	6	7
MLT:					
Current	0.99	0.99	1.09	1.28	0.95
Debt	50.36	77.71	58.15	63.59	68.68
Cash flow	1.14	2.81	1.61	12.22	4.76
ROE	-0.25	1.76	0.70	12.49	11.66
Interest cover	0.09	0.72	-0.09	2.69	1.03
Age	9	9	9	12	5
LT:					
Current	0.99	0.98	0.99	1.14	0.84
Debt	50.60	75.75	70.80	61.00	69.07
Cash flow	0.73	2.27	0.45	10.57	6.49
ROE	-0.56	0.88	0.95	7.62	12.26
Interest cover	-0.25	-0.08	-0.55	1.65	0.91
Age	9	11	8	11	3

Source: own elaborations on Amadeus data