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Earnings management indicators as predictors of bankruptcy in Spanish companies

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Abstract

This study examines whether earnings management indicators, which highlight unjustified variations in accounting items, can predict business bankruptcy. Using data from 179,559 Spanish firms, from 2009 to 2014, both traditional financial ratios and earnings management indicators were analyzed. Significant differences between failed and non-failed firms were observed years before bankruptcy. To ensure robustness, a test sample from a future period validated the findings. Logistic regression revealed that certain earnings management indicators, particularly a synthetic index combining multiple indicators, can predict bankruptcy. Such indexes could enhance bankruptcy prediction models, offering valuable insights for assessing financial health and potential risks in businesses.

Keywords: Bankruptcy, financial ratios, earnings management, creative accounting.

JEL codes: G33, G53

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1. Introduction

Large firms' bankruptcy is often associated with fraudulent accounting, earnings management or creative accounting (Akerlof et al 1993). Some of the most known examples are the Enron case (Healy and Palepu, 2003) and the Worldcom case (Rezaee, 2005). Pioneer bankruptcy studies (Beaver, 1966 and Altman, 1968) proved the discriminatory power of financial ratios. The most recent bankruptcy models propose the inclusion of new indicators, for example from corporate governance (Liang et al, 2016) or macroeconomic variables (Tinoco and Wilson, 2013). But the inclusion of indicators capturing financial statement distortions is uncommon. A recent paper by Dutzi and Rausch (2016) reviews empirical studies on bankruptcy and earnings management, finding that the results about the accounting practices in distressed firms in the periods before failing are ambiguous. They claim that there is still a need for more research in other countries concerning non-US firms and non-listed firms. Besides, the predictive power of earnings management indicators and its inclusion in bankruptcy prediction models has not been sufficiently studied, which motivates this paper.

Earnings management is a hot topic for research. Healy and Wahlen (1999) and Xu et al (2007) perform a thorough literature review. Among the papers relating bankruptcy and earnings management, Sweeney (1994) finds that managers of defaulted firms make a greater number of accounting changes in the years surrounding technical defaults. Rosner (2003) studies earnings manipulation in failed companies with assets over USD 50 million, finding that firms that bankrupted hid their financial stress through earnings manipulation. García-Lara et al (2009) analyse earnings quality in ex-post UK failed firms finding that failed firms manipulate earnings upwards four years prior to failure. DeAngelo et al (1994) study US listed companies in trouble, finding that managers' accounting choices primarily reflect their firms' financial difficulties, rather than their attempts to inflate income. Leach and Newsom (2007) also study bankruptcy of US publicly traded firms, finding that firms try to manage their earnings to make their financial statements more favourable over the years prior to bankruptcy. But findings from large and listed firms not always apply to small and medium sized firms (SMEs) as Altman and Sabato (2007) demonstrate. Hence, Campa and Camacho-Miñano (2014) focus on SMEs, finding statistically significant differences between bankrupt and healthy firms, concluding that bankrupt firms' managers manipulate earnings upwards through both accruals and sales manipulation during the years preceding bankruptcy. These previous papers study the relationship between bankruptcy and earnings management, but none of them develop a bankruptcy prediction model. García-Lara et al (2009) wonder whether bankruptcy prediction models could be improved by explicitly considering accounting manipulation. To the best of our knowledge no studies are specifically dealing with this issue. This paper contributes to the existing literature by including earnings management indicators to predict firms' failures.

The main research question of this paper is to study whether the indicators frequently used to detect the presence of earnings management can predict bankruptcy. The indicators in this paper adapt those used by Beneish (1999) and Beneish et al (2013), who propose an accounting-based earnings manipulation detection model, demonstrating that they have strong out-of-sample power to predict cross-sectional stock returns. Our paper performs an empirical study using a sample of failed and non-failed firms (2009-2013). The sample contains data from 179,559 Spanish firms. Indicators five years prior to failure were analysed. Firstly, several tests were performed to detect the presence of statistically significant differences on earnings management indicators between failed and non-failed firms. Most indicators show statistically significant differences several years before bankruptcy.

It is not only interesting to know whether these indicators exhibit discriminatory power, but also to know if they can predict bankruptcy, and whether the inclusion of these indicators improves the predictive power of classical bankruptcy models, such as Beaver (1966), Altman (1968), Ohlson (1980) or Zmijewski (1984). A test sample from a future period (2014), distinct from the primary sample, is used to ensure intertemporal validation. Logistic regression is used in the study, finding that indicators such as Beneish ratios (1999) and sales and profit variation coefficients can be useful for prediction. Results show that an earnings management index, created from the above indicators, presents a notable discriminatory power among the data analysed. Its inclusion in the classical bankruptcy prediction models improves their predictive capability, which is the main contribution of this paper. In fact, among the data analysed, the earnings management index predictive power can be close to profitability or solvency ratios. The paper concludes by proposing that analysts should look beyond classical financial ratios by including indicators that capture financial statement distortions to predict business failure.

The remainder of the paper is organized as follows. Section 2 presents the literature review and hypothesis development. Section 3 presents the empirical study. Finally, conclusions are presented.

2. Literature review

Beaver (1966) and Altman (1968) pioneer works show that financial ratios can predict bankruptcy. State of the art revisions by Zavgren (1983), Ravi Kumar and Ravi (2007), Demyanyk and Hasan (2010), Beaver et al (2010), and Sun et al (2014) detail methodological aspects and describe the evolution of statistical techniques, from the univariate analysis of ratios to the widely used logistic regression or techniques such as neural networks, hazard models or ensemble methods. Financial ratios are, by far, the most widely used independent variables in bankruptcy prediction models. However, they are not the only one; Altman et al (2010) explore the value added by non-financial information, finding that this information is likely to significantly improve the prediction accuracy of the model.

Although the relationship between earnings management and bankruptcy seems clear, most bankruptcy studies do not include indicators specifically designed to measure earnings management practices. Dutzi and Rausch (2016) perform a comprehensive literature review on bankruptcy and earnings management. Among the studies that do include the behaviour of such variables before bankruptcy, papers by Sweeney (1994), DeAngelo et al (1994), Kalunki and Martikainen (1999), Rosner (2003), Leach and Newsom (2007), Charitou et al (2007), García-Lara et al (2009), Etemadi et al (2012), and Campa and Camacho-Miñano (2014) can be highlighted. These studies establish the existence of earnings management before bankruptcy, but they provide heterogeneous results with regard to the direction of earnings management during the periods analysed. Dutzi and Rausch (2016) conclude that more research into earnings management in the periods prior to bankruptcy is needed, since better insolvency prediction models can be developed.

Earnings management and fraudulent financial reporting are both subsets of earnings manipulation, but while earnings management may not technically violate generally accepted accounting principles, fraud does (Rosner, 2003). Earnings management occurs when managers use judgment in financial reporting to alter financial reports to mislead some stakeholders about the underlying financial situation of the company (Healy and Wahlen, 1999). Stolowy and Breton (2004) review the literature on accounts manipulation and their explanative theories. Among them, the Positive Accounting Theory by Watts and Zimmerman (1978) stands out. This Positive Accounting Theory, based on the Agency Theory, is concerned with explaining accounting practice. Earnings management can be seen as an accounting choice case, when managers exercise their discretion on one accounting method over another to influence the output of the accounting system. For example, the existence of a bonus plan might give managers an incentive to choose accounting procedures that increase reported earnings (Watts and Zimmerman, 1978).

Fundamental to the Positive Accounting Theory is a belief in rational choice theory. Another theory proposed to explain earnings management is the Prospect Theory, by Kahneman and Tversky (1979). This theory describes how real human behaviour makes decisions, arguing that there is a range of options that are clearly not rational. The Prospect Theory states that a company realizes the largest value increase when it avoids losses and achieves gains. Similarly, for Akerlof and Shiller (2010), people do not only have rational motivations and hence, the temptations for creative accounting can be great, since corruption is one of the five human emotions that influence economic decisions. Nevertheless, sometimes managers disclose yearly lower profits than real profits, and the Pecking Order Theory offers a theoretical framework supporting this idea: managers do it to prudently finance the company, thus avoiding debt (Myers, 1984).

Thus, there can be many motivations behind earnings management. In the case analysed, as the empirical study will show, they are companies experiencing difficulties close to bankruptcy, whose most frequent motivation is to present accounts better than reality, for example to renew credit from banks in a context of economic crisis where credit is rationed. Taking into account the previous literature, the following hypothesis is posed: a positive relationship is expected between earnings management and the probability of default. It is expected that the presence of earnings management will be a symptom of bankruptcy, and that the models including earnings management indicators will improve the accuracy of classical bankruptcy models.

There is an issue that deserves attention: earnings management is not directly measurable, not even as ex-post. This has motivated substantial research proposing ways to detect and measure earnings management. Beneish (2001) identifies three ways: to aggregate accruals using regression models to calculate expected and unexpected accruals, to focus on specific accruals such as the provision for bad debt, and to investigate discontinuities in the distribution of earnings. Kighir et al (2014) enlarge the earnings management detection methods, by including graphical modelling and mathematical modelling of specific accruals, total discretionary accruals modelling with time series and cross sectional data, the use of financial and proxy statements modelling, distribution of reported earnings and accruals modelling, and real activity management. Most studies set out to calculate a measure of discretionary accruals relative to a benchmark model of expected accruals, following the Jones model (1991). Although widely used, this approach is not free from criticism, for example, according to Ball (2013) the great majority of findings of earnings management are often the result of an omitted variable. The approach followed in this paper is based on Beneish (1999), who uses accounting ratios and indexes to detect financial statements manipulation.

3. Empirical study

The SABI database from Bureau van Dijk was used for the empirical study. It contains accounting information from Spanish companies. It is compulsory that all Spanish companies disclose their annual accounts in the Mercantile Register. This is a public register: any person can search for annual statements from any Spanish company. The SABI database takes and organizes the information from the Mercantile Register. A key issue differentiating this database from other databases is that SABI discloses information of all companies, not only listed or large companies.

A limitation of some bankruptcy prediction models is that the test samples are drawn from the same time period as the primary samples, and thus cannot provide an adequate test of a model's predictive ability intertemporal validation (Joy and Tollefson, 1975). This fact is relevant; according to the empirical study by Grice and Dugan (2001), applying the models to time periods other than those used to develop the models may result in a significant decline in the accuracy of the models. In other words, bankruptcy prediction models are not stationary across time periods. Grice and Dugan (2001) replicate Zmijewski (1984) and Ohlson (1980) studies, that reported, respectively, 98.2 percent and 96.4 percent overall accuracies for their models using samples from 1970–1978. The overall accuracies for the sample used in Grice and Dugan (2001) study ranged from 34.8 percent to 81.3 percent when the same models were applied using further years' data.

Our paper uses intertemporal validation and tries to approach a real world case. Failed companies in 2012 were identified and data from 2011 were taken to build the model. A company was considered as failed if it had entered statutory bankruptcy proceedings. A given company can be solvent in 2012, but can go bankrupt in the following years. For this very reason, to consider a company as non-failed, it has to be active in the following years. The models, developed using data from the primary sample, were tested using data from the test sample. The test sample includes firms which failed in 2014. The test sample considered a company as non-failed if in 2016 it was still active. The models were built by using data one year before bankruptcy, but indicators five years before bankruptcy were also analysed to know whether earnings management indicators exhibit failure tendencies several years prior to bankruptcy. It has to be noticed that the analysed period matches a profound economic crisis that hit the Spanish economy especially hard, with banks being rescued and credit rationed.

SABI currently contains information from 821,372 companies, although not all of them present full or valid information. In the case of failed companies, they must have presented full accounting information from 2005 to 2011. In the case of non-failed companies, they must have presented full accounting information from 2005 to 2015. These facts lowered the number of companies to 179,559. The primary sample contains 597 failed and 597 non-failed firms, following the common paired samples strategy, in which each distressed company was matched with a healthy one from the same sector (Sun et al 2014). The test sample contains 879 failed firms and 178,680 non-failed firms.

Two kind of independent variables were considered: those widely used in bankruptcy prediction models (Beaver, 1966, and Altman 1968), updated by Altman and Sabato (2007), and Beaver et al (2012), and those used in earnings management models by Beneish (1999) and Beneish et al (2013). Table 1 displays the variables used and their definitions.

Variable	*Definition*
ROA	Return on assets: Earnings Before Interest and Taxes/Total Assets
RE/TA	Retained earnings ratio: Retained Earnings/Total Assets
EQ/TL	Equity strength : Equity/Total Liabilities
WC/TA	Working capital ratio: (Current assets - Current liabilities)/Total Assets
ROTA	Asset turnover: Sales/Total Assets
CASH	Cash ratio: Cash/Total assets
PROFIT	Dummy variable equal to 1 if the return on assets (ROA) is positive
INT/S	Financial expenses coverage: Interest Expenses/Sales
ΔSALES	Increase in sales ratio: $\frac{\text{Sales}_t - \text{Sales}_{t-1}}{\text{Sales}_{t-1}}$
DSRI	Days' sales in receivable index: $\frac{\text{Receivables}_t}{\text{Sales}_t} / \frac{\text{Receivables}_{t-1}}{\text{Sales}_{t-1}}$
LEVI	Leverage index: $\frac{\text{Total Debt}_t}{\text{Total Assets}_t} / \frac{\text{Total Debt}_{t-1}}{\text{Total Assets}_{t-1}}$
AQI	Assets quality index: $\frac{1 - \text{Current Assets}_t + \text{Property, Plant and Equipment}_t}{\text{Total Assets}_t} / \frac{1 - \text{Current Assets}_{t-1} + \text{Property, Plant and Equipment}_{t-1}}{\text{Total Assets}_{t-1}}$
SGAI	Sales, general, and administrative expenses index: $\frac{\text{Sales,general,and administrative expenses}_t}{\text{Sales}_t} / \frac{\text{Sales,general,and administrative expenses}_{t-1}}{\text{Sales}_{t-1}}$
DEPI	Depreciation index: $\frac{\text{Depreciation rate}_{t-1}}{\text{Depreciation rate}_t}$
DDI	Depreciation decay index: $\frac{\text{Depreciation}_{t-1}}{\text{Depreciation}_t}$
TATA	Total accruals to total assets ratio: $\frac{\text{Total accruals}_t}{\text{Total assets}_t}$
SGI	Sales growth index: $\frac{\text{Sales}_t}{\text{Sales}_{t-1}}$
C_VSAL	Coefficient of variation of sales: $\frac{\sigma(\text{Sales}_t,\text{Sales}_{t-1})}{\lvert\mu(\text{Sales}_t,\text{Sales}_{t-1})\rvert}$
GMI	Gross margin index: $\frac{\text{Sales}_{t-1} - \text{Cost of goods sold}_{t-1}}{\text{Sales}_{t-1}} / \frac{\text{Sales}_t - \text{Cost of goods sold}_t}{\text{Sales}_t}$
C_VPRO	Coefficient of variation of profits: $\frac{\sigma(\text{Net Profit}_t,\text{Net Profit}_{t-1})}{\lvert\mu(\text{Net Profit}_t,\text{Net Profit}_{t-1})\rvert}$
EM-index	Earnings management index: $\sum(z(\text{DSRI}), z(\text{LEVI}), z(\text{AQI}), z(\text{SGAI}), z(\text{CVSAL}), z(\text{CVPRO}))$, being z the standardized variable

Table 1. Variables employed and their definition.

The first five variables are the financial ratios from the classical study by Altman (1968). A typical bankruptcy pattern is associated to a lack of profits and retained earnings. The profitability ratio (ROA) measures the first fact, whereas the retained earnings to total assets ratio (RE/TA) and the equity ratio (EQ/TL) measure the distance to bankruptcy (Akerlof and Shiller, 2010). The solvency ratio expresses the working capital of a company as a percentage of its total assets. The asset turnover (ROTA) is sometimes questioned as a bankruptcy predictor, because there are firms with low turnover but with high margins which are profitable; however that, empirical researches have shown its predictive capability.

Four other common ratios in bankruptcy studies were added, following Rose and Giroux (1984) who analysed 134 financial ratios. Some profitable companies go bankrupt due to a lack of liquidity, thus, a relevant financial ratio is CASH, which measures short term liquidity related to assets. Other studies, such as Beaver et al (2012) include a dummy variable taking the 0 value if the company is making losses and 1 value if the company is making profits (PROFIT). Banks often check if the amount of interest expense related to sales is high (INT/S). Finally, ΔSALES measures the increase in sales; it is justified because sales reduction can be a cause of bankruptcy.

Beneish (1999) and Beneish et al (2013) earnings management indicators were selected and adapted. Creative accounting distorts the analysis of financial ratios. An example is the working capital to total assets ratio. This ratio measures solvency, and in a true and fair accounting situation, the higher its value, the better it is. But when fraudulent accounting arises, the receivables figure includes doubtful debts or even bad debts, thus paradoxically the higher its value becomes, the closest to bankruptcy the firm is. Hence, the first earnings management indicator, DSRI, compares the ratio of receivables to sales in two consecutive years. A DSRI value over 1 indicates a distortion that could raise suspicion of earnings management. It has to be remarked that earnings management is not directly measurable and any indicator is just a proxy: the distortion may simply come from a change in the receivable recovery policy, trying to favour clients to gain market share.

The second indicator is the Leverage index or LEVI, the ratio of total debt to total assets in year t relative to the corresponding ratio in year t-1. A LEVI greater than 1 indicates an increase in leverage, what can be considered as a sign of earnings management. The third indicator, AQI or Assets quality index, is an aggregate measure of the change in asset realization risk. An increase in AQI indicates an increased propensity to capitalizing and deferring costs, which can be associated with earnings management. SGAI is the Sales, general, and administrative expenses index. A value greater than 1 can be considered as an earnings management sign. Depreciation is judgmentally-based and it is vulnerable to manipulation. The DEPI ratio captures declining depreciation rates as a possible earnings manipulation symptom; a DEPI greater than 1 indicates that the depreciation has slowed. A different indicator, DDI or Depreciation decay index, has been calculated by dividing the depreciation in year t-1 into the depreciation in year t.

TATA is defined as total accruals to total assets. TATA tries to capture whether accounting profits are not supported by cash profits. SMEs do not disclose the statement of cash flows, and for this reason, the Sloan (1996) approach to deriving accruals has been used, taking information from the balance sheet and income statement. Then, Total accruals = (ΔCA - ΔCash) - (ΔCL - ΔSTD - ΔTP) - Dep, where ΔCA = Change in current assets; ΔCash = Change in cash/cash equivalents; ΔCL = Change in current liabilities; ΔSTD = Change in debt included in current liabilities; ΔTP = Change in income taxes payable; and Dep = Depreciation and amortization expense.

Ooghe and De Prijcker (2008) observed four types of failure processes; one of them is the failure process of ambitious growth companies, where the Sales growth index (SGI) can be a good indicator to detect distortions. Beneish (1999) includes this indicator, because he looks for firms growing extremely fast, aiming at increasing their share prices and adopting aggressive accounting practices. However, our study focuses on firms experiencing difficulties, most of them SMEs, which in a context of economic crisis try to hide their financial stress through accounting manipulation. In a situation of economic crisis, a growth in sales is not expected to be a bankruptcy symptom, but the opposite, reflected in a drop in the ΔSALES ratio. Another way of detecting distortions in sales is by calculating the coefficient of variation of sales, as Imhoff (1981) does. Hence, the coefficient has been calculated by taking two consecutive years (C_VSAL). A positive relationship is expected between C_VSAL and the probability of bankruptcy. Like the rest of indicators, a variation of sales can have justifiable causes, even a disproportionate variation does not necessary imply earnings manipulation owing to the fact that it can be simply caused by a declining market. GMI or Gross margin index presents a similar behaviour: if its value is greater than 1, gross margins have deteriorated, which can be considered as an earnings management symptom. The final indicator is the coefficient of variation of profits (C_VPRO), which is used to measure the variability of earnings.

Table 2 shows the results of an exploratory analysis of the financial ratios. The Table shows the evolution from 2009 a 2013. There are 879 failed firms and 178,680 non-failed firms. Some firms show extreme values in their financial ratios, and statistical measures such as the mean are very sensitive to atypical values. Outliers' removal is a common strategy to solve it. However, many of these outliers are firms close to bankruptcy, and a financial analyst willing to predict failure will not renounce analysing these firms just due to an abnormal value in a ratio. For this reason, no company has been removed from the test sample. Other widely used approaches are data transformation, winsorisation or truncation. We opted to keep the original data, given the possible problems warned about by Leone et al (2014), such as biases and increased probability of a Type I error. Leone et al (2014) recommend the use of robust techniques not affected by outliers and the use of the median to describe financial ratios. Table 2 shows the mean and median values, and two tests' results to detect statistically significant differences between failed and non-failed firms: a non-parametric Wilcoxon test and a median test, both robust against outliers.

		2013		2012		2011		2010		2009	
		Non-failed	Failed	Non-failed	Failed	Non-failed	Failed	Non-failed	Failed	Non-failed	Failed
	N	178,680	879	178,680	879	178,680	879	178,680	879	178,680	879
ROA	Mean	-0.01	-0.28	-0.01	-0.15	0.00	-0.06	0.01	-0.07	0.02	-0.76
	Median	0.02	-0.04	0.01	-0.01	0.02	0.01	0.02	0.02	0.03	0.02
	Wilcoxon Z		(-21.97)***		(-11.93)***		(-8.95)***		(-5.26)***		(-4.67)***
	Median X^2		(283.53)***		(97.48)***		(44.82)***		(13.33)***		(5.29)**
RE/TA	Mean	0.19	-2.84	0.20	-3.61	0.22	-8.16	0.23	-8.03	0.24	-225.56
	Median	0,27	-0.06	0.27	0.02	0.26	0.07	0.26	0.09	0.25	0.08
	Wilcoxon Z		(-28.13)***		(-22.29)***		(-18.73)***		(-16.63)***		(-16.16)***
	Median X^2		(462.43)***		(348.35)***		(256.86)***		(221.33)***		(203.59)***
EQ/TL	Mean	131.82	6.30	131.25	6.00	147,06	1,63	49,10	1,48	160,31	1,99
	Median	0.73	0.05	0.71	0.15	0.67	0.21	0.64	0.23	0.61	0.23
	Wilcoxon Z		(-28,28)***		(-22.89)***		(-19.37)***		(-17.33)***		(-16.69)***
	Median X^2		(496,11)***		(381.91)***		(315.47)***		(271.45)***		(248.04)***
WC/TA	Mean	0.11	-2.24	0.12	-3.17	0.14	-7.78	0.14	-7.77	0.14	-222.89
	Median	0.18	-0.02	0.18	0.06	0.18	0.09	0.17	0.12	0.16	0.12
	Wilcoxon Z		(-16.46)***		(-9.52)***		(-5.99)***		(-3.36)***		(-2.45)**
	Median X^2		(184.75)***		(66.95)***		(48.51)***		(22.41)***		(18.73)***
ROTA	Mean	1.25	0.86	1.29	0.93	1.36	1.00	1.39	1.12	1.42	1,21
	Median	0.90	0.40	0.94	0.58	1.01	0.69	1.05	0.79	1.08	0.84
	Wilcoxon Z		(-16.77)***		(-13.98)***		(-11.7)***		(-9.9)***		(-9.87)***
	Median X^2		(126.01)***		(96.14)***		(58.39)***		(33.82)***		(27.11)***
CASH	Mean	0.12	0.03	0.11	0.04	0.12	0.04	0.12	0.05	0.13	0.06
	Median	0.05	0.00	0.05	0.01	0.05	0.01	0.06	0.01	0.06	0.02
	Wilcoxon Z		(-27.11)***		(-22.42)***		(-19.73)***		(-17.9)***		(-17.13)***
	Median X^2		(459.53)***		(333.37)***		(288.1)***		(231.5)***		(231.5)***
PROFIT	Mean	0.63	.21	0.60	0.32	0.64	0.42	0.69	0.55	0.70	0.58
	Median	1,00	0.00	1.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00
	Wilcoxon Z		(-25.45)***		(-16.94)***		(-13.24)***		(-8.73)***		(-7.45)***
	Pearson X^2		(1,042.01)***		(366.32)***		(227.88)***		(87.73)***		(15.18)***
INT/S	Mean	0.22	77.91	0.34	75117.67	0.15	45.98	0.12	12.25	0.19	21,06
	Median	0.01	0.05	0.01	0.04	0.01	0.03	0.01	0.03	0.01	0.03
	Wilcoxon Z		(-7.26)***		(-4.4)***		(-0.44)		(-0.27)		(-1.25)
	Median X^2		(23.01)***		(8.12)***		(0.07)		(0.17)		(0.29)
ΔSALES	Mean	0.12	795.8	0.12	1.22	31	9.71	0.49	2.08	0.17	2362.0
	Median	-0.04	-0.23	-0.07	-0.17	-0.03	-0.09	-0.01	-0.03	-0.11	-0.14
	Wilcoxon Z		(-18.36)***		(-11.69)***		(-7.01)***		(-2.46)**		(-0.84)
	Median X^2		(166.92)***		(98.65)***		(36.52)***		(5.47)**		(4.15)**

Table 2. Exploratory analysis of financial ratios, showing the mean and median for Non-failed and Failed firms. It also shows the results from a non-parametric Wilcoxon test for means, and a non-parametric test for medians, and significance levels (Pearson X^2 for PROFIT, a dummy variable). * significant at 10% level; ** significant at 5% level; *** significant at 1% level.

Table 2, as expected, shows statistically significant differences in all the 9 financial ratios associated to bankruptcy. Several years prior to bankruptcy the deterioration of these ratios can be appreciated. Figure 1, following Beaver (1968), shows the median time evolution for the 9 ratios in failed and non-failed firms. Ratios such as profitability (ROA) or growth in sales (ΔSALES) are good bankruptcy predictors up to three years before bankruptcy, whereas ratios such as RE/TA present very sharp differences up to five years before bankruptcy.

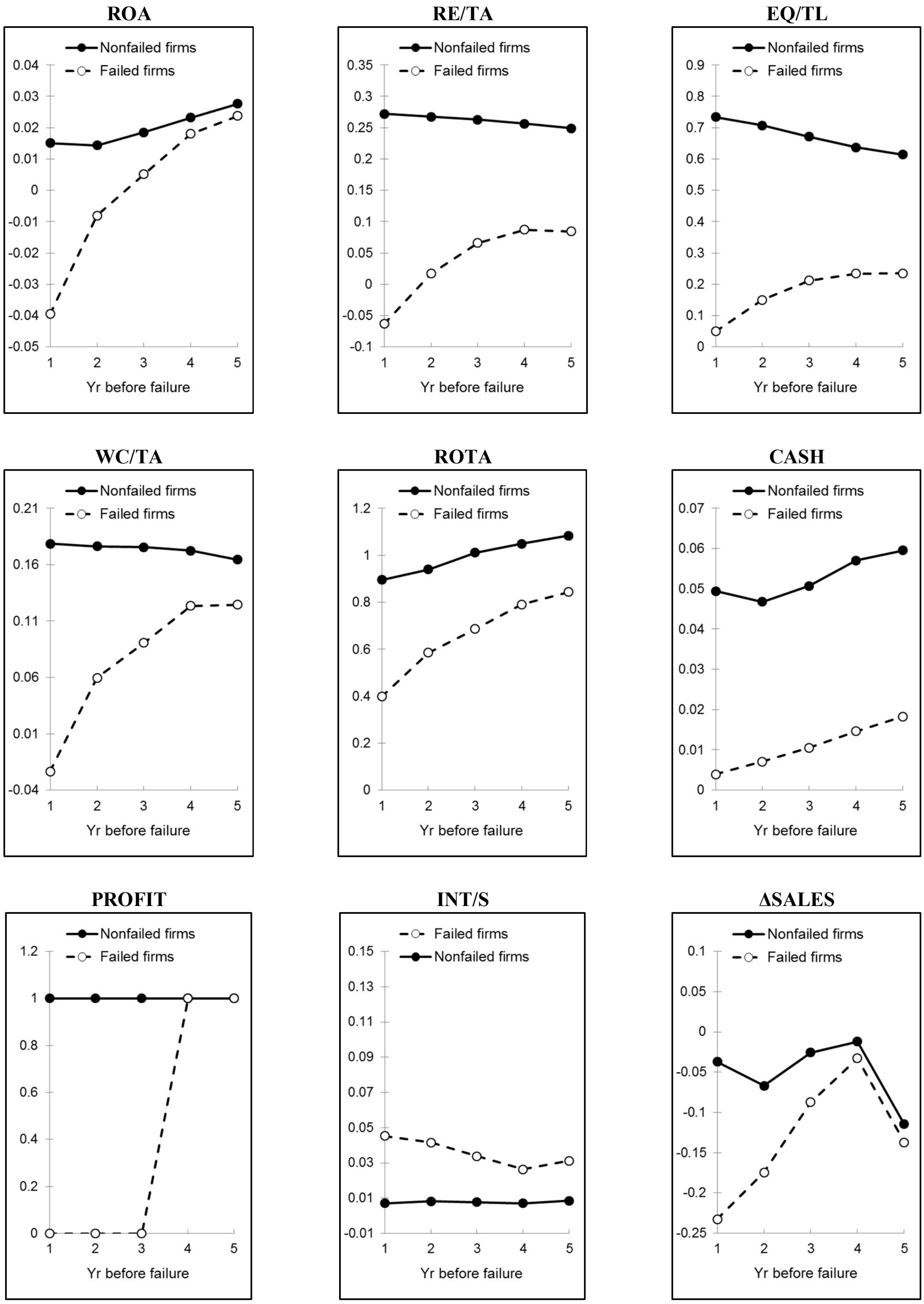

Figure 1. Comparison of median values for Failed and Non-failed firms using 9 traditional financial ratios.

Table 3 displays the exploratory study of the earnings management indicators, while Figure 2 graphically displays their temporal evolution. One year before bankruptcy, there are differences between failed and non-failed firms, and all of them are statistically significant, except for the depreciation indicators. Different patterns arise. LEVI, AQI, C_VSAL, and C_VPRO present acute differences even five years before bankruptcy. DSRI and SGAI present differences two or three years before bankruptcy. DEPI, DDI and GMI exhibit a low or null discriminatory power. As expected, failed firms have low sales figures, as the SGI indicator shows. As for the TATA indicator, five years before bankruptcy accounting profits were not supported by cash profits, but as bankruptcy approaches, the firms cannot sustain their return and accounting losses arise. Within the data analysed, TATA could be a good bankruptcy predictor five years before it happens, in coherence with other empirical studies finding that low accrual firms have high bankruptcy risk (Khan, 2008, and Dechow and Ge, 2006). Nevertheless, more studies will be necessary to confirm whether the behaviour found in this study is common in firms experiencing financial distress.

		2013		2012		2011		2010		2009	
		Non-failed	**Failed**	**Non-failed**	**Failed**	**Non-failed**	**Failed**	**Non-failed**	**Failed**	**Non-failed**	**Failed**
	N	178,680	879	178,680	879	178,680	879	178,680	879	178,680	879
DSRI	Mean	649.12	5900.16	641.13	271.17	685.56	208.28	827.42	58.22	408.38	6.82
	Median	1.00	1.11	1.04	1.06	0.99	1.00	1.01	1.03	1.09	1.08
	Wilcoxon Z	(-4.9)***		(-1.29)		(-0.75)		(-0.9)		(-0.22)	
	Median X^2	(12.99)***		(1.75)		(0.08)		(0.66)		(0.02)	
LEVI	Mean	1.23	1.41	1.21	1.24	1.14	1.08	1.52	1.25	1.28	2,88
	Median	0.99	1.06	0.99	1.03	0.99	1.01	0.99	1.00	0.98	1.00
	Wilcoxon Z	(-18.96)***		(-13.14)***		(-9.15)***		(-5.42)***		(-6.99)***	
	Median X^2	(9.18)***		(6.73)***		(5.27)***		(4.02)***		(4.32)***	
AQI	Mean	495.62	-156.15	821.29	-339.63	892.36	-673.12	883.84	254.48	204.83	-408,21
	Median	1.01	1.05	1.02	1.06	1.01	1.04	1.00	1.03	1.01	1.04
	Wilcoxon Z	(-6.59)***		(-5.11)***		(-4.66)***		(-5.21)***		(-3.03)***	
	Median X^2	(34.21)***		(19.44)***		(14.86)***		(16.25)***		(9.91)***	
SGAI	Mean	-376.45	6.37	-109.98	3557.33	-199.73	-1.80	545.46	12.35	-360.12	11,09
	Median	0,99	1.13	1.02	1.07	1.00	1.01	0.99	0.98	1.04	1.01
	Wilcoxon Z	(-7.7)***		(-3.13)***		(-0.77)		(-1.31)		(-2.24)**	
	Median X^2	(31.5)***		(5.8)**		(0.9)		(0.15)		(5.15)**	
DEPI	Mean	1.86	2.16	32.13	2.07	36.75	1.53	2.71	1.27	7.96	5.24
	Median	0.97	0.95	0.97	0.96	0.96	0.96	0.96	0.97	0.94	0.93
	Wilcoxon Z	(-3.1)***		(-0.92)		(-0.81)		(-0.39)		(-2.17)**	
	Median X^2	(2.25)		(0.24)		(0)		(1.97)		(0.35)	
DDI	Mean	5.96	2.23	29.48	1.53	53.73	1.53	4.52	1.24	8.58	1,18
	Median	1.03	1.04	1.03	1.04	1.02	1.02	1.01	1.02	1.00	1.00
	Wilcoxon Z	(-2.18)**		(-0.83)		(-0.33)		(-0.67)		(-3.46)***	
	Median X^2	(3.6)		(0.2)		(0.02)		(3.25)*		(9.14)***	
TATA	Mean	-0.04	-0.20	-0.03	-0.33	-0.03	-0.44	-0.03	-0.45	-0.02	-833.9
	Median	-0.03	-0.08	-0.03	-0.05	-0.03	-0.05	-0.03	-0.02	-0.02	0.00
	Wilcoxon Z	(-9.84)***		(-4.81)***		(-4.4)***		(-0.17)		(-3.77)***	
	Median X^2	(33.04)***		(12.36)***		(13.33)***		(0.37)		(17.58)***	
SGI	Mean	1.12	796.81	1.12	2.22	1.31	10.71	1.49	3.08	1.17	236.03
	Median	0.96	0.77	0.93	0.83	0.97	0.91	0.99	0.97	0.89	0.86
	Wilcoxon Z	(-18.36)***		(-11.69)***		(-7.01)***		(-2.46)**		(-0.84)	
	Median X^2	(166.92)***		(98.65)***		(36.52)***		(5.47)**		(4.15)**	
CvSAL	Mean	0.16	0,36	0.17	0.30	0.15	0.28	0.15	0.26	0.19	0.29
	Median	0.09	0.23	0.10	0.19	0.09	0.15	0.09	0.14	0.13	0.18
	Wilcoxon Z	(-17.54)***		(-14.54)***		(-11.85)***		(-9.53)***		(-8.77)***	
	Median X^2	(178.52)***		(150.81)***		(70.5)***		(51.99)***		(50.29)***	
GMI	Mean	36.84	1.38	0.73	16.74	1.03	-176.63	.32	6.51	1.19	373.79
	Median	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	0.99	0.99
	Wilcoxon Z	(-3.89)***		(-3.45)***		(-1.01)		(-2.39)**		(-0.45)	
	Median X^2	(6.82)***		(3.3)*		(0)		(2.7)		(0.02)	
CvPRO	Mean	4.58	1.53	3.81	13.53	4.10	4.14	4.23	2.25	4.36	2.47
	Median	0.58	0.93	0.58	0.82	0.57	0.72	0.56	0.69	0.59	0.79
	Wilcoxon Z	(-7.54)***		(-5.73)***		(-3.61)***		(-4.16)***		(-5.03)***	
	Median X^2	(58.61)***		(47.49)***		(18.01)***		(16.1)***		(27.81)***	
EM-index	Mean	-0.01	1.74	-0.01	1.09	-0.01	1.05	-0.01	0.73	0.00	0.21
	Median	-0.09	1.62	-0.21	0.90	-0.20	0.85	-0.15	0.63	-0.21	0.00
	Wilcoxon Z	(-22.83)***		(-13.32)***		(-13.37)***		(-9.78)***		(-2.85)***	
	Median X^2	(363.03)***		(103.37)***		(138.95)***		(65.23)***		(5.17)**	

Table 3. Exploratory analysis of earning management ratios showing the mean and median for Non-failed and Failed firms. It also shows the results from a non-parametric Wilcoxon test for means, and a non-parametric test for medians, and significance levels. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.

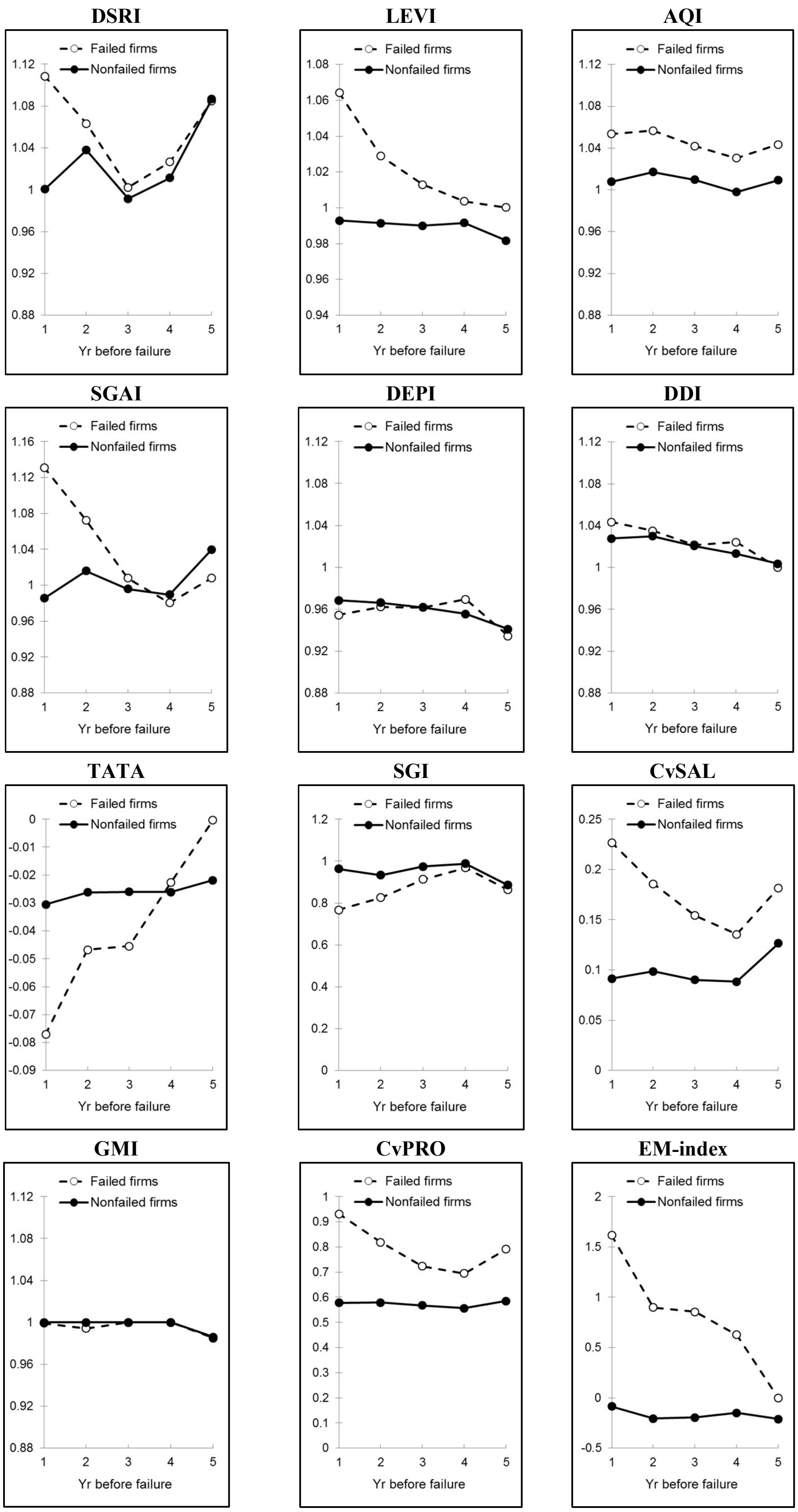

Figure 2. Comparison of median values for Failed and Non-failed firms using 12 earnings management indicators.

Some earnings management indicators exhibit certain discriminatory power. But the data analysed and the figures show that the differences are not as clear as in the classical financial ratios case. For example, one year prior to bankruptcy, the DSRI median for failed firms is 1.11 and for non-failed firms is 1.00. By contrast, the EQ/TL median for failed firms is 0.05 and for non-failed firms is 0.73, much more pronounced. A new index was defined, the Earnings-Management Index (EM-index), as the sum of the previous earnings management indications with the highest discriminatory power, that is: DSRI, LEVI, AQI, SGAI, C_VSAL and C_VPRO. An issue is that the variables are measured in different scales: the first four range around 1, but the coefficient of variation is usually lower than 1. For this reason, they have been standardized to mean 0 and variance 1. One year before bankruptcy, the EM-index median for failed firms is 1.62 and for non-failed firms is -0.09. Differences are statistically significant. Figure 2 allows appreciating that five years before failure these differences are not very important, but they gradually increase as bankruptcy approaches. A possible explanation is that the firm starts experiencing difficulties five years before bankruptcy and managers try to hide them through earnings management practices, but bankruptcy is unavoidable. There are also earnings management indicators that are always slightly bad in firms borne to bankruptcy: indebted firms, with diminishing sales and returns. More research is needed, using different databases, to confirm these results.

We are interested in not only showing that there is a significant association between a dichotomous variable (failed and non-failed) and one indicator, but also in being able to predict the likelihood of bankruptcy of a firm in any sector. If one wants to explicitly make predictions, a logistic regression is appropriate, even in a simple univariate model. Besides, logistic regression can be extended to the multivariate case of predicting the bankruptcy from a set of independent variables, for the purpose of controlling for covariates.

Table 4 shows the results of 21 univariate logistic regressions, performing as many models as independent variables. Intertemporal validation was chosen to test predictive results over time. Failed firms in 2012 were identified and for them, accounting data from 2011 was taken to build the models. Failed firms in 2014 were identified and accounting data from 2013 was taken to obtain the test sample and to test the previously obtained models. Table 4 displays the confusion matrices, allowing visualizing True positives, True negatives, Type I errors and Type II errors. As performance measures accuracy (correct prediction rate), true positive rate (sensitivity or 1-Type II error rate) and true negative rate (specificity or 1-Type I error rate) were also calculated. Type II error has the form of an opportunity cost for a provider of funds, for example a bank granting loans. Type I error rate is important, because the misclassification of a failed firm is considered more costly than the opposite. Hence, a good performance measure in bankruptcy studies is the true negative rate. It should be noticed that in the case analysed, the number of non-failed firms in the test sample is larger than that of the failed firms, and for this reason, accuracy and true positive rate are very close. The three performance measures were calculated for the primary sample and the test sample. Having a high accuracy in the primary sample but a low one in the test sample should imply a lack of generalization of findings. Results show that most of the financial ratios present a clear predictive power. RE/TA is one of the ratios with high performance, having in the test sample an accuracy of 76.0%, a true negative rate of 65.6%, and a true positive rate of 76.1%. The presence of profits, measured with the PROFIT variable, shows an accuracy of 62.6% and a true negative rate of 79.2% in the test sample. Obviously, firms with losses and without retained earnings have the highest probability of bankruptcy. Earnings management indicators have lower predictive power than traditional financial ratios. Although earnings management indicators show high accuracies, their negative prediction rate is low. Moreover, the performance measures are different in the primary and the test sample, what implies a lack of generalization of results. However, there is a variable, the EM-index, which presents a remarkable predictive power. Its accuracy is 65.5% and its true negative rate is 65.9% in the test sample, close to the values found in the classical financial ratios.

	Beta and significance	Primary sample					Test sample				
		Confusion matrix		Accuracy (%)	True negative rate (%)	True positive rate (%)	Confusion matrix		Accuracy (%)	True negative rate (%)	True positive rate (%)
ROA	2.115***	247	350	62.2	41.4	83.1	402	477	80.7	45.7	80.9
		101	496				34,117	144,563			
RE/TA	1.050***	337	260	64.1	56.4	71.7	577	302	76.0	65.6	76.1
		169	428				42,779	135,901			
EQ/TL	0.496***	510	87	64.1	85.4	42.7	760	117	51.2	86.7	51.0
		342	255				87,385	91,121			
WC/TA	0.277***	274	323	54.9	45.9	64.0	499	380	68.7	56.8	68.8
		215	382				55,831	122,849			
ROTA	0.103**	436	161	60.0	73.0	46.9	627	252	45.7	71.3	45.5
		317	280				97,299	81,381			
CASH	8.793***	521	76	66.5	87.3	45.7	765	114	49.2	87.0	49.0
		324	273				91,056	87,624			
PROFIT	1.781***	461	136	70.4	77.2	63.7	696	183	62.6	79.2	62.5
		217	380				66,970	110,710			
INT/S	-0.006	10	544	52.1	1.8	99.8	20	753	99.5	2.6	99.9
		1	583				231	178,429			
ΔSALES	-0.037	36	535	52.0	6.3	96.4	30	785	97.0	3.7	97.4
		21	566				4,676	173,981			
DSRI	-0.000	6	532	51.6	1.1	99.6	14	744	99.3	1.8	99.7
		2	563				549	172,785			
LEVI	-0.276**	188	409	56.6	31.5	81.7	313	563	83.3	35.7	83.5
		109	488				29,379	149,158			
AQI	-0.000	540	0	51.3	100	0	798	2	0.7	99.8	0.7
		512	0				154,399	327			
SGAI	-0.000	1	542	51.8	0.2	100	1	765	99.6	0.1	100
		0	582				20	178,590			
DEPI	-0.026	9	464	52.8	1.9	98.5	16	664	98.2	2.4	98.6
		8	520				2,231	155,034			
DDI	-0.059	20	439	54.4	4.4	98.5	28	625	96.4	4.3	96.8
		8	513				4,939	148,758			
TATA	0.390***	265	332	56.7	44.0	69.0	447	432	66.3	50.9	66.3
		185	412				60,157	118,523			
SGI	-0.037	36	535	52.0	6.3	96.4	30	785	97.0	3.7	97.4
		21	566				4,676	173,981			
CvSAL	-1.968***	221	324	61.2	40.6	80.6	334	432	83.0	43.6	83.2
		113	469				30,062	148,587			
GMI	0.008	9	536	52.4	1.7	100	5	761	99.4	0.7	99.8
		0	581				298	178,344			
CvPRO	-0.020	72	517	50.7	12.2	88.7	79	789	86.0	9.1	86.4
		67	528				24,240	154,287			
EM-index	-0.620***	371	226	65.0	62.1	67.8	579	300	65,5	65,9	65,5
		192	405				61,627	117,053			

Confusion matrix	
True negative	*Type I error*
Type II error	*True positive*

Primary sample comprises 1,194 firms, where 597 are Failed firms and 597 are Non-failed firms, using data from 2012. Test sample comprises 179,559 firms, where 879 are Failed firms and 178,680 Non-failed firms, using data from 2014. True negative rate = 1 - Type 1 error rate. True positive rate = 1 - Type II error rate.

Table 4. Univariate logistic regressions analysis for predicting bankruptcy, showing B coefficients and significance levels. * significant at 10% level ** significant at 5% level; *** significant at 1% level

Table 5 shows five multivariate logistic regression models. For each model, the Nagelkerke R^2, confusion matrix, accuracy, true negative rate, and true positive rate, both for primary and test samples, are shown. Model 1 has been built using the five financial ratios from the classical model by Altman (1968). Its test accuracy is 72.4% and its true negative rate is 74.7%, displaying a predictive power much better than any of the 21 univariate models, as expected. Model 2 was built using the earnings management variables, excluding the EM-index. Its test accuracy is 79.5%, while its true negative rate is 51.2%. Model 3 adds the EM-index, with a test accuracy of 68.8% and a true negative rate is 65.1%. It can be argued that the inclusion of the EM-index improves the model performance, but the predictive power of earnings management indicators is still lower than classical financial ratios models. Model 4 includes all the variables, and its test accuracy is 73.8% and its true negative rate 78.7%, which can be considered as the best performance. Model 5 is a parsimonious model including just four variables (EQ/TL, CASH, NROI and EM-index) and its predictive power is very similar to the full model, with a test accuracy of 73.9% and a true negative rate of 76.3%. Within the data analysed, a financial analyst willing to predict bankruptcy in a Spanish firm should look into four variables: the presence or absence of profits (NROI), the strength of its balance sheet (EQ/TL), the cash stress (CASH), and signs of earnings management (EM-index).

	Model 1	Model 2	Model 3	Model 4	Model 5
ROA	-0.705***			0.155	
RE/TA	0.862***			0.869***	
EQ/TL	1.705***			0.172***	0.274***
WC/TA	0.318***			-0.632***	
ROTA	0.470***			0.102	
CASH				8.548***	6.287***
PROFIT				0.877***	1.215***
INT/S				0.000	
ΔSALES				-0.040	
DSRI		0.000	0.000	0.000	
LEVI		-0.824***	0.010	0.183	
AQI		0.000	0.000	0.000	
SGAI		-0.002	0.000	0.000	
DEPI		-0.043	-0.032	-0.030	
DDI		-0.059	-0.043	-0.040	
TATA		0.796**	0.407**	0.566**	
SGI		0.014	-0.049	0.012	
CvSAL		-1.625***	-0.899***	-0.272	
GMI		0.003	0.004	0.004	
CvPRO		-0.025	-0.020	-0.015	
EM-index			-0.500***	-0.226**	-0.326***
Constant	-0.589***	1.447***	0.429**	-1.076***	-0.964***
R^2 Nagelkerke	0.261	0.128	0.162	0.403	0.365
Primary sample (N obs = 1,194)					
Confusion matrix	432 / 165	192 / 232	308 / 189	386 / 111	448 / 149
	183 / 414	100 / 348	149 / 338	128 / 359	164 / 433
Accuracy (%)	70.9	61.9	65.7	75.7	73.8
True negative rate (%)	72.4	45.3	62.0	77.7	75.0
True positive rate (%)	69.3	77.7	69.4	73.7	72.5
Test sample (N obs = 179,559)					
Confusion matrix	655 / 222	312 / 297	464 / 249	561 / 152	669 / 208
	49,301 / 129,205	27,631 / 107,820	46,888 / 103,647	39,513 / 110,951	46,578 / 131,928
Accuracy (%)	72.4	79.5	68.8	73.8	73.9
True negative rate (%)	74.7	51.2	65.1	78.7	76.3
True positive rate (%)	72.4	79.6	68.9	73.7	73.9

Confusion matrix	
True negative	*Type I error*
Type II error	*True positive*

Primary sample comprises 1,194 firms, where 597 are Failed firms and 597 are Non-failed firms, using data from 2012. Test sample comprises 179,559 firms, where 879 are Failed firms and 178,680 Non-failed firms, using data from 2014. True negative rate = 1 - Type 1 error rate. True positive rate = 1 - Type II error rate.

Table 5. Logistic regression analysis for predicting bankruptcy, showing B coefficients and significance levels. * significant at 10% level; ** significant at 5% level; *** significant at 1% level

In face of the results, it can be concluded that some earnings management indicators have certain bankruptcy predictive power. But this power is lower than traditional financial ratios. It seems sensible that the profitability ratio would be a better bankruptcy predictor than an indicator measuring distortions in depreciation. Or that the ratio measuring retained earnings to assets would better allow predicting bankruptcy than an indicator measuring growth in receivables to sales. However, within the data analysed, an indicator aggregating all the earnings management symptoms has turned out to be an efficient bankruptcy predictor. It seems reasonable that high values of an index developed from indicators especially designed to capture financial statement distortions are a symptom preceding bankruptcy. Indicators like this one should be included in bankruptcy prediction models, although more research is needed using different data and in further contexts to ensure results robustness.

4. Conclusions

Earnings management distorts the traditional financial statement analysis; however, bankruptcy prediction models do not usually include indicators that capture financial statement distortions. Profits can be affected, as well as depreciation and recognition of income and expenses. Ratios such as the working capital to assets can be misleading. An empirical study has been performed to test whether earnings management is a symptom preceding bankruptcy. With this aim, a set of earnings management indicators has been analysed; they are indicators that capture distortions in receivables, deterioration of margins, declining depreciation rates, or variations of sales and profits, among others. An earnings management index has been developed from these indicators.

The empirical study uses data from 179,559 failed and non-failed firms. Indicators up to five years before bankruptcy were analysed. Earnings management indicators present statistically significant differences between failed and non-failed firms. Some indicators even present sharp differences five years prior to bankruptcy.

Logistic regression was used to test the predictive power of the earnings management indicators. Intertemporal validation has been ensured by means of a test sample from a later period than the primary sample. None of the earnings management indicators has a predictive power in itself, as good as the classical financial ratios have, such as the profitability ratio, working capital ratio or cash ratio. Notwithstanding that, the earnings management index constructed presents a predictive power close to the classical financial ratios. This study is limited to Spanish firms, primarily SMEs, which may affect the generalizability of the results to other countries or larger companies. The findings are also shaped by the specific economic context of Spain during the post-crisis period, which may have affected firm behavior and bankruptcy patterns.

Within the data analysed on Spanish firms, a parsimonious model to predict bankruptcy could include as predictors: lack of profits, cash stress, lack of equity capital to face financial problems, and earnings management practices. Future studies could extend this analysis to firms in different countries or economic environments to validate the robustness of the findings. Exploring sector-specific behavior and refining the synthetic EM-index could enhance its predictive power. Additionally, incorporating advanced analytical techniques such as machine learning may improve bankruptcy prediction accuracy. Further research could also examine the role of governance or audit quality in moderating earnings management practices.

The study demonstrates that earnings management indicators can serve as effective early warning tools for bankruptcy, complementing traditional financial ratios. The development of a synthetic EM-index contributes a novel perspective to financial distress prediction models. These findings have practical implications for analysts, regulators, and auditors seeking to detect financial risk earlier and more accurately. Bankruptcy researchers and analysts should look beyond classical financial ratios and should increasingly use indicators that capture financial statement distortions to predict firm bankruptcy.

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