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### MSMSEs Corporate Bankruptcy Prediction Models

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#### ABSTRACT

In Mexico, processes for assessing credit risk of MiPyMEs (MSMSEs) requesting to have access to governmental financial support as well as commercial banks or any other kind of funding, are based on traditional methodologies which results use to lead to a substantial rejection of applicant enterprises. In this study, through an interpretative analysis with cross-cutting approach it is analyzed and determined the usefulness of methods for predicting corporate bankruptcy in MSMSEs and start-ups, regardless of their business activity. Likewise, besides highlighting and recommending the importance of their use, it is shown how such as prediction models contribute to reduce costs due to information asymmetry and financing costs by themselves and, help to prevent rejection of financing and ensure the permanence and competitiveness of enterprises.

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#### Introduction

##### Summary

In Mexico, banks and financial organs, be it a commercial bank, government agency or any other type providing financial support to micro, small and medium enterprises (MSMEs) in their risk rating processes, are aided with traditional methodologies whose results lead to a substantial rejection of requests for financial resources which avoids the creation or enhancement of opportunities for productive sources of employment.

In this study, using a model of hermeneutical research with a transversal approach, it is analyzed and determined the usefulness of prediction systems related to corporate bankruptcy in MSMEs, regardless of their business activity, and specially in those new companies that have a strong technological component, related to the Internet world, which have great growth potential, known as start- ups . Here it is justified and recommended the use of these models, highlighting how they contribute to lower the costs of information's asymmetry and financing costs; It emphasizes that these models help to prevent the rejection of funding applications, and ensures the permanence and competitiveness of the enterprises using them. A case is presented.

In the business world, the business solvency is concerning as it ensures the permanence and competitiveness of enterprises in an increasingly globalized environment.

A company is technically insolvent when it is unable to address its immediate debts with cash on hand, and in Mexico as in other countries, solvency is one of the factors that is preventing business development, mainly because of the lack of affordable financing (Lozano, 2013).

The lack of available funding is derived from the risks, implied mainly for commercial banks, which may occur the moment they decide to authorize a credit, reflected as high interest rates and as a high cost of financing for entrepreneurs,

holding back business development of MSMEs (Micro, small and medium enterprises) primarily.

In order to reduce the insolvency risk, which would affect the bankruptcy risk, it is necessary to monitor the solvency of the organizations through established and proven methodologies (Mosqueda, 2010).

It is impossible to stop speaking about the MSMEs in Mexico, because as it is well known, 98 % of the companies are MSMEs, and from these, 99 % are micro, contributing to GDP by 52 %, with a source of employment of 70 % (The Economist, 2012); which constantly seek to survive by implementing strategies that contribute to their permanence. Therefore, the objective of this research is to present and analyze some existing models that predict corporate bankruptcy, selecting those considered the most suitable for Mexican MSMEs, to finally achieve the investor confidence. Prediction models for insolvency and corporate bankruptcy arose in order to measure and predict the bankruptcy of businesses listed on the stock market Módica - Milo, A. , Baixauli , JS, & Alvarez , S. ( 2012) , nevertheless, this investigation makes a research about the application of several of the most prominent models to apply MSMEs that are seeking for funding, permanence and competitiveness. The research will revise the increasement on the investor confidence and the reduction on the bankruptcy risk. Once applied these tools, you can implement strategies to avoid insolvency and even business bankruptcy.

#### Referential framework

The concern about predicting the risk of financial insolvency has led financial institutions to use the analysis of financial ratios to predict the risk of financial default, developing financial mathematical models to diagnose and predict corporate financial insolvency. Espinosa (2013).

Although the financial reform has sought to increase the economic support for enterprises, it has not shown encouraging results, since according to the survey Conjuncture

Evaluation of Credit Market that took place during the October- December trimester of 2015, the companies that received new bank loans represented a 30% (Banxico , 2016 ), plus the results from the financial reform show that the financing from commercial banks to the private sector to June 2015 represents the 30.6 % of GDP ( the Economist, 2015).

Rodríguez and Aguilar (2013), say that due to the economic importance of MSMEs, especially job creation, one of the big questions and subject of matter keeps being the effectiveness of the loans, it is, that the loan wasn't just liquidated and recovered, but if it actually helped reducing poverty, if it actually improved life quality, if it created a self-sustaining productive source, or if it contributed to job creation.

The National Institute of Statistics and Geography (INEGI) through the National Survey of Microbusinesses, ENAMIN 2010 (INEGI, 2012) , estimated that there are 8'353,649 microbusinesses in Mexico, of which 85 % required an initial funding to start. In this survey it shows that the monthly income and expenses are 83.993 and 86.352 billion pesos, respectively. On the other hand, the National Survey of Occupation and Employment (ENOE) (INEGI, 2011) shows that there are 18.5 million people working in microenterprises , representing 42% of the economically active population in Mexico .

For its part, the Bank of Mexico (2016) conducted a study about the supply of financing faced by SMEs that have access to credit from financial intermediaries:

It is known that Mexican companies generally have limited access to bank financing; This problem becomes larger in the case of SMEs. There are multiple causes that keep the SMEs from the access, from the lack of reliable information provided by the same SMEs faced by bidders and the high death rates thereof, to the low productivity these companies may show. Low productivity is associated with conditions of informality, poverty and size (CIDAC, 2011). The credit granting to companies with very low productivity can have the effect of worsening their credit ratings and financial condition. Financial Conduct Authority (FCA acronym) in the UK warns that situation in credits with high cost and low durability.

Therefore, it is considered necessary to ensure commercial banks and development banks that the companies are solvent, mainly small businesses and start ups , which particularly require sustainable development.

According to the Dictionary of the Royal Spanish Academy (RAE, 2009), bankruptcy is defined as "Trial by which it patrimonially incapacitates someone for their insolvency and proceeds to run all of its assets in favor of all of its creditors ". Here are analyzed some of the main models for predicting insolvency – corporate bankruptcy, considered the best known and trusted, and that have shown between 85% and 98 % of accuracy.

#### Z score de Altman

Edward Altman (1968) was the first to use financial ratios based on a statistical analysis of multiple discrimination, determining the likelihood of bankruptcy (financial risk) among firms ( Altman , and Hotchkiss , 2010).

The model Z score of Altman begins with determining the risk of insolvency considering manufacturing companies, trying to measure up to two years the viability of the company, helping capital investors to avoid panicking about the probability of default by a company, avoiding insolvency, funding and information asymmetry costs (Giner and De Albornoz , 2013 ) .

Discriminant analysis means that the belonging to different groups from a sample of firms is discriminated, whether or not bankruptcy cases are involved; importance weights are being set to each independent variable that is being analyzed, in order to enhance the qualitative relationship with dependent variables.

Then the discriminant analysis allows studying the differences between two or more groups defined a priori, referring to several variables simultaneously. Statistically we can identify two types of errors:

Error type I: A bankrupt company is considered as a non-insolvent one.

Error type II: A non bankrupt company is considered as an insolvent one.

With these detected errors, what is sought is to minimize them through internal company policies, such as a bank, with its authorization policies of conservative credit aims to reduce risk, but also affects the cost of not having granted credits for companies with an acceptable financial situation that were rated as insolvent, losing the interest rate of the loan that wasn't granted.

The Altman Z -score, ranks companies in solvent and insolvent, assigning a score through financial ratios. If the score exceeds a cutoff value, the company is considered solvent, otherwise, it indicates significant risk of bankruptcy in the near future, showing an accuracy between 80% and 90 % (Bernal, 2011) .

The original formula is:

Z = Breakpoint

$V_n$  = Discriminant Coefficient

$X_n$  = Financial Ratios

From where:

Z = Global Indicator (overall index)

$X_1$  = Working Capital/ total assets

$X_2$  = Total retained / active utilities

$X_3$  = EBIT / total assets)

$X_4$  = share's market value / book value of total liabilities

$X_5$  = sales / total assets (Altman, 1968)

By tracking the original model, Altman develops other models for closely held companies engaged in manufacturing and for closed capital generic companies, i.e.; business activities other than those in manufacturing.

$Z_2 = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$

Below the cutoff points for different types of companies in the Altman model,  $Z_1$  and  $Z_2$ , both are presented. , Clarifying that  $Z_2$  is implemented in 2006, being applicable to all business sectors and making some interesting changes.

**Table 1. Types of companies in Altman Z score.**

Z score above 3.0	The company is considered as "safe"
Z score between 2.7 and 2.99	"On alert". This area is where you should exercise caution.
Z score between 1.8 and 2.7	There's a possibility that the company goes bankrupt within the following 2 years of operations from the given financial figures.
Z score below 1.8	High probability of financial failure

Source: self made.

### Springate Model

Gordon Springate in 1978 developed another model with an accuracy of 92.5 %, following procedures developed by Altman. He selected four from 19 financial reasons helping to detect between good businesses and those that tend to end with insolvency issues (Springate , 1978). The Springate model is expressed as it follows:

$$Z = 1.03A + 3.07B + 0.66C + 0.40D$$

Where A = Working Capital / Total Assets,

B = Net income before interest and taxes / Total Assets,

C = Net income before taxes / Current liabilities,

D = Sales / Total assets, and when

$Z < 0.862$ , the company can be considered insolvent.

### Fulmer Model

Later in 1984, Fulmer develops its own model considering nine financial reasons with 98 % of accuracy, evaluating 40 financial ratios applied to a sample of 60 companies, where 50% were insolvent.

The model considers nine weighted financial reasons, presenting the following equation:

$$H = 5.528 X_1 + 0.212 X_2 + 0.073 X_3 + 1.270 X_4 + 0.120 X_5 + 2.335 X_6 + 0.575 X_7 + 1.083 X_8 + 0.894 X_9 - 6.075$$

Donde:

$X_1$  = Retained utilities / Total assets,

$X_2$  = Sales / Total assets,

$X_3$  = Utilities before tax / Stockholder's equity

$X_4$  = Cash flow / Total liabilities,

$X_5$  = Total liabilities / Total assets,

$X_6$  = Current liabilities / Total assets,

$X_7$  = Total tangible assets,

$X_8$  = Work capital / Total liabilities,

$X_9$  = log operating income / financial expenses.

When  $H < 0$ , the company can be described as " insolvent " .

Fulmer won a 98 % of accuracy by applying the model one year prior to the insolvency and 81 % with more than a year of insolvency.

### Jean Legault Model

Jean Legault , (1987 ) , from Quebec University, develops the CA -Score Valdes model (2010 ) being one of the most recommended by financial analysts in Canada, although the author mentions that it has an average level of confidence of 83% and it is only applicable to evaluate manufacturing firms ( Jiménez , 2013 ) .

Thirty financial ratios from a sample of 173 manufacturing companies with annual sales between 1 to 20 Canadian dollars were analyzed.

The model has the following formula:

$$CA\text{-SCORE} = 4.5913 X_1 + 4.5080 X_2 + 0.3936 X_3 - 2.7616$$

Where:

$X_1$  = Stockholder's equity / Total assets,

$X_2$  = (Profit before taxes and extraordinary items + financial expenses) / Total assets,

$X_3$  = Sales / Total assets.

When  $CA\text{-SCORE} < -0.3$ , the company can be considered insolvent.

Performing a comparison of the models, the percentages of accuracy, applicability, and some observations from each one of them, could be revised.

Therefore, the model that would not be advisable to SMEs, is the CA -Score, as it is only applicable to manufacturing companies, unless the SME's activity was manufacturing.

**Table 2. Comparison of the prediction models for financial insolvency.**

Model	Accuracy	Directed to:	Observations
Altman Z score	80 and 90%	Manufacturing business Various business activities	Applicable to manufacturing and any type of business , either with open or closed capital.
Gordon Springate	92.5%	Various business activities	Applicable to any type of business.
Fulmer	81% and 98%	Various business activities	Applicable to any type of business.
CA-Score	83%	Manufacturing business	Only applicable to manufacturing businesses

Source: self made.

Also, for the applicability of the model to be efficient in SMEs, it is necessary and advisable to consider companies that are at least two years old, due to the characteristic features of MSMEs, such as the disappearance of firms before two years of operation, where 80 % of them close due to the lack of financial and mainly administrative forecast ( the Economist, 2011; Forbes , 2013 ). The recommended is applying the model from the third year of operation, determining that the company is in fact positioned in the market, with a solid administration and with the initial investment probably already recovered.

### Methodology

This research is based mainly on a literature review and analysis of predictive models for financial insolvency, under a deductive method with a transversal approach, where prediction models are applied to a case of study, demonstrating its applicability in SMEs and its restrictions.

Here is presented the financial information of an SME, where prediction models for financial insolvency are analyzed and the obtained results are shown to consider their possible applicability.

### Application of models, development and results

Following, it is performed an application exercise for the company "ALECSA" de C.V., that for confidential reasons, has been captured under another name, showing information for the fourth and fifth year of operation.

#### a) The Application of Altman's Z-Score Model

The  $Z_2$  Score Model is the formula applied for generic companies and those with closed capital.

$$Z_2 = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$$

$X_1$  = Working capital / Total assets

$X_2$  = URetained earnings / Total assets

$X_3$  = EBIT/ Total assets

$X_4$  = Stockholder's equity / Book value of total debt

Altman Z-Score calculation 2014

$$\begin{aligned} Z &= 6.56(\$15,196.5/\$34,793.8) + 3.26(\$8,238/\$34,793.8) \\ &+ 6.72(\$41,328.34/\$34,793.8) + 1.05(\$11,680/\$10,431.7) \\ &= 2.86513806 + 0.7718582 + 7.98206707 + 1.1756473 = \\ &12.7950106 \end{aligned}$$

Altman Z-score calculation 2015

$$\begin{aligned} Z &= 6.56(\$16,615.4/\$36,098.5) + 3.26(\$11,148/\$36,098.5) \\ &+ 6.72(\$48,820.00/\$36,098.5) + 1.05(\$11,680/\$9,080.00) \\ &= 14.465054 \end{aligned}$$

Concept	2015	2014
Assets	\$ 21,793.40	\$ 20,852.00
Total Assets	36,098.50	34,793.80
Liabilities	5,178.00	5,655.50
Total Liabilities	9,080.00	10,431.70
Working capital	16,615.40	15,196.50
Retained earnings	11,148.00	8,238.00
EBIT Earnings before interests and taxes	48,820.00	41,328.34
Pretax profit	30,640.00	23,148.34
Sales	114,060.00	96,434.00
Stockholder's equity	25,695.50	24,362.10
EBITDA	58,680.00	53,181.34
Total tangible assets	16,345.00	16,524.30
Financial expenses	18,180.00	18,180.00
Heritage	11,680.00	11,680.00

The results obtained from the model application indicate that the company is in a financially strong area as  $Z > 2.6$  in both years of operation, demonstrating that it is a reliable company that will not present problems of insolvency at least in the next two years.

It is said that this SME has been denied funding because they cannot prove their credit history; or in its absence, that they would have the fundind authorized at a high interest rate to cover the loan's risk. This affects the solvency of the company, forcing it to seek for other informal sources of funding. This negative not only affects the development of this company, at a regional level, it influences the lack of job creation, holding back the regional and national competitiveness.

#### a) The application of the Gordon Springgate Model

$$Z = 1.03A + 3.07B + 0.66C + 0.40D$$

Gordon Springgate 2014

$$Z = 1.03(\$15,196.5/\$34,793.8) + 3.07(\$41,328.34/\$34,793.8) + 0.66(\$23,148.34/5,655.50) + 0.40(96,434/\$34,793.8) = 9.7305$$

Gordon Springgate 2015

$$Z = 1.03 (\$16,615.4/\$36,098.5) + 3.07(\$48,820.00/\$36,098.5) + 0.66(\$30,640.00/5,178.00) + 0.40(114,060.00/\$36,098.50) = 9.7953$$

Confirming the obtained result by Altman, according to the Springgate model, the company gets a higher score than  $Z > 0.862$  for both years, so it is considered as a solvent and financially strong one, which means confidence, a reduced credit risk, a reduced information asymmetry and a reduction in the interest rate. In the figure No. 1, the behavior of the 2014 and 2015 models is observed, where a similar behavior in each year is detected, also, in 2015 the strenght of the company shows an improvement according to Altman and Springate.

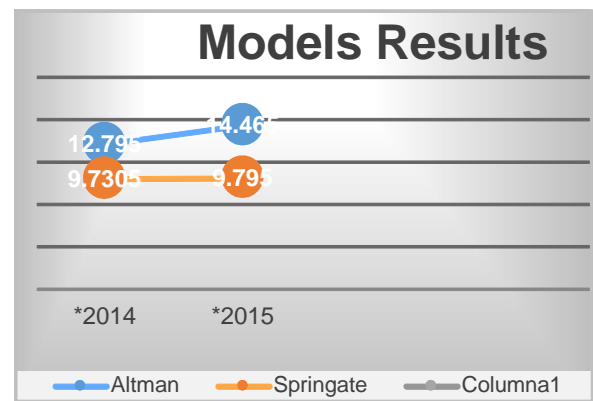


Figure 1. Comparative results from the models application.

Source: self made.

#### c) The application of the Fulmer model

$$H = 5.528 X_1 + 0.212 X_2 + 0.073 X_3 + 1.270 X_4 + 0.120 X_5 + 2.335 X_6 + 0.575 X_7 + 1.083 X_8 + 0.894 X_9 - 6.075$$

Fulmer Model 2014

$$H = 5.528(\$8,238/\$34,793.80) + 0.212(\$96,434/\$34,793.8) + 0.073(\$23,148.34/\$24,362.10) + 1.270(\$14,848.6/10,431.70) - 0.120(\$10,431.70/\$34,793.80) + 2.335(\$5,655.5/\$34,793.8) + 0.575(\$16,524.3) + 1.083(\$15,196.5/10,431.7) + 0.894(4,616/18,180) - 6.075 = 1.3088 + 0.5875 + 0.06936 + 1.8077.0359 + 0.379538 + 9501.47 + 1.5776 + 0.2269 - 6.075 = 9500.042$$

Fulmer model 2015

$$H = 5.528 X_1 + 0.212 X_2 + 0.073 X_3 + 1.270 X_4 + 0.120 X_5 + 2.335 X_6 + 0.575 X_7 + 1.083 X_8 + 0.894 X_9 - 6.075$$

$$H = 5.528(\$11,148/\$36,098.5) + 0.212(\$114,060.0/\$36,098.5) + 0.073(\$30,640./\$25,695.5) + 1.270(\$15,778.3/9,080.0) - 0.120(\$9,080.0/\$36,098.50) + 2.335(\$5,178.0/\$36,098.5) + 0.575(\$16,345.0) + 1.083(\$16,615.40/9,080.0) + 0.894(4,688/18,180) - 6.075 = 1.7071 + 0.6698 + 0.0870 + 2.2068 + 0.03018 + 0.3349 + 9,398.3 + 1.9866 + 0.23053 - 6.075 = 9,399.4498$$

Applying the Fulmer model, it is observed that  $H > 0$ , which is considered as "solvent", realizing that the variable that causes a radical change in the formula is " $X_7$ ", being it the tangible assets and causing a very high and positive result.

In the Figure No. 2, it is shown that the result from 2014 to 2015 suffers an ebb, which wasn't observed in any of the past models, pointing a contradiction among them.

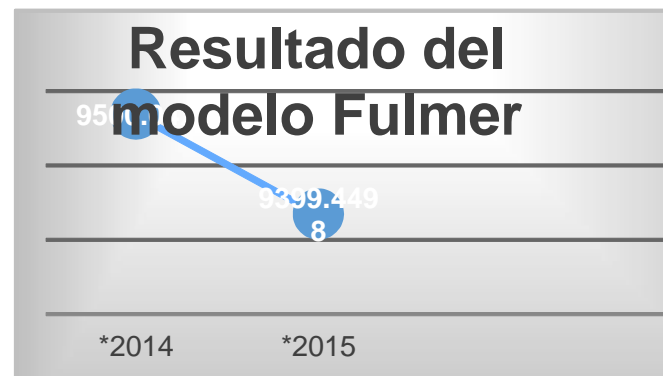


Figure 2. Result from the Fulmer model application

Source: Self made

It should be clarified that the CA -Score model won't be applied, because the company is not engaged with manufacturing processes.

Broadly speaking, it is inferred that this analysis would be useful for financial institutions engaged in providing credit,

because together with the application of other assessment tools, accurate funding decisions would be taken, reducing risk and interest rates.

Also, to SMEs that generate an accounting and have reliable financial statements, this analysis would be useful too to know their areas of opportunity and to implement strategies that contribute to their improvement, their economic growth and insolvency prevention.

### Discussion and recommendations

Prediction models of financial failure are heavily used in developed countries like the United States, whether by auditors, by governmental institutions or financial institutions. However, in Mexico they are unknown, so it's time to publicize the advantages offered by these models and their use as a complementary tool for the pursue of correct financial decisions in the companies management, mainly among the Mexican SMEs.

These models do not predict when a company will go bankrupt, what they do is that they measure the financial performance and predict the occurrence of insolvency and possible bankruptcy. However, they are relevant tools for helping a company creditworthiness assessment, that if are applied on time, they will help to prevent bankruptcy by establishing improvement solutions; as well as the financial assessment for a company that requires a credit, and even start ups and venture companies guaranteeing their permanence in the market.

Also, by applying these models you can identify which part of insolvency is due to internal company problems, be it the current assets or the tangible generating resources, and how much is due to external problems, as can be debt, being in the possibility of establishing specific strategies for each area of opportunity.

The difference among the financial insolvency predicting models lies in the use of financial ratios and the weights assigned to each of them; even in some cases the results are opposites; this is why several models arise, because in the quest of predicting insolvency, qualitative variables need to be considered in the study and they need to work together with the quantitative variables; everything will depend on the intended use of the study.

The information that the MSMEs has is essential to know the situation of the company, so that if quantitative variables with qualitative ones are combined, the accuracy of prediction of insolvency is higher and the costs of information asymmetry are lower.

These models drive the development of future research methods for corporate bankruptcy prediction with greater certainty and where qualitative and non-financial variables could be considered.

### Conclusions

The bankruptcy prediction models should be chosen with the caution they deserve and applied by economic sector and company size, ensuring the efficiency of the results.

It is recommended that these models are applied in companies that require funding, in order to develop strategies to help them overcome the requested indicators, ensuring that the credit application won't be denied.

These tools not only involve the finance costs, but also the business management and administration costs, mainly because detecting the insolvency and possible bankruptcy of a company requires the firm to implement strategies of various disciplines which contribute to improving the business situation.

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