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Application Of Altman's Z2 Model In The Characterization Of Financial Risk In Credit Unions In Ecuador During The Period 2019 – 2022

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Abstract

The COVID-19 pandemic constitutes an imminent danger to the life of human beings, besides being a silent enemy that becomes very dangerous for financiers: the risk of bankruptcy. The present quantitative approach study is applied to the balance sheet accounts contained in the monthly statistical reports delivered by the Ecuadorian Financial Institutions of the Popular and Solidarity Economy on their official website for three years. Its population consisted of 273 financial institutions from segments I, II, III and mutual institutions, and a sample of 7 institutions was taken to reflect losses based on a non-probabilistic purposive sample. For the analysis, Altman's Z2 model was applied, where the organizations' current solvency and possible risk of bankruptcy after the COVID-19 pandemic were identified. One of the most important findings is that the organizations have gone through a decline in their assets during this period leading some Cooperatives to change their level according to the Altman scale from stable to gray and from gray to bankruptcy.

Keywords: Financial risk; financial health; Altman's Z2 model; Financial solvency.

Resumen

La pandemia por la COVID-19 constituye un peligro inminente hacia la vida de los seres humanos además de ser un enemigo silencioso que para los financieros se torna muy peligroso: el riesgo de quiebra. El presente estudio de enfoque cuantitativo se aplica a las cuentas de balances que constan en los reportes estadísticos mensuales entregados por las Instituciones Financieras Ecuatorianas de la Economía Popular y Solidaria en su página oficial, en un periodo de tres años. Su población estuvo conformada por 273 entidades financieras de los segmentos I, II, III y mutualistas, se toma una muestra de 7 instituciones que reflejan pérdida basado en un muestro no probabilístico intencionado. Para el análisis se aplicó el modelo Z2 de Altman, en donde se identificó la solvencia actual y el posible riesgo de quiebra de las organizaciones tras la pandemia por la COVID-19. Uno de los hallazgos más importantes es que las organizaciones han pasado por una baja en sus activos durante este periodo llevando a algunas Cooperativas a cambiar su nivel según la escala de Altman de estable a gris y de gris a quiebra.

Palabras clave: Riesgo financiero; salud financiera; modelo Z2 de Altman; Solvencia financiera

Introduction

The social and solidarity financial system has an important share of the national financial market in Ecuador. Savings and credit cooperatives are the main players, and are grouped by segments according to their level of assets. The present study addresses an insolvency prediction analysis involving segments one, two, three and mutuals. The segment until April 2022 managed the following economic amounts: 20,037 million in assets, 14,117 million in gross portfolio, 16,273 million in deposits, and 2,481 million in equity, with 26.9% liquidity, 16.7% solvency, 5.4% profitability - ROE and 0.7% profitability - ROA (Asobanca, 2022).

Considering its level of importance and economic influence for its 7.4 million members, it becomes preponderant to perform such an insolvency prediction study to the sector, supported by Altman's Z2 model, which is based on its iterative statistical analysis of multiple discrimination of financial indicators, four measurement ratios are weighted and summed to classify solvent or insolvent organizations (Altman et al., 2013).

Solórsano (2022) argues that using Altman's Z2 model allows the establishment of a degree of business assertiveness for generating profitability in a scalable manner over time, making efficient decisions, and integrating economic results, liquidity, profitability and debt. In the same way (Báes, 2014) states that the Z2 model applies to all types of commercial or service companies, whether they are listed on the stock exchange or not, and is considered a model that can be used mainly in emerging markets.

Altman et al. (2013) state that Altman's Z2 model can adapt to companies, a group or a grouped section based on a criterion of 5 variables for the Z and Z1 model and 4 variables for the Z2 model that seek to capture the greatest amount of information on the subject to be investigated. When applying the model, whose variables are: X1 representing working capital over total assets; X2: retained earnings over total assets; X3: earnings before interest and taxes or operating income over total assets; and X4: market value or equity over total liabilities.

The Z2 model is born from a multivariate analysis that seeks the linear combination of the independent variables to differentiate (discriminate) the groups, taking full advantage of the interaction of the multiple variables that may be within the study groups and allowing increasing the ability to discriminate the variables (Díaz et al., 2016).

Therefore, when measuring the probability of financial instability in the cooperatives of segment 3 in Ecuador in 2019 (Freire, 2021) measuring the probability of financial instability in the cooperatives of segment 3 in Ecuador in 2019, resulted in healthy organizations representing 74.05%, making it an encouraging result; however, there is a 16.58% of entities that were found in the gray zone uncertainty zone, resulting in about 50 of these organizations cannot overcome economic shocks.

Caminos (2021) complements the information by verifying the financial risk variables and the profitability of the cooperatives under study and determining that the higher the financial risk, the lower the profitability, and the lower the risk, the higher the profitability, showing that the application of the various financial strategies of the sector contributed significantly to the reduction of said risk.

According to Luna et al. (2018), financial risk is the uncertainty associated with the return of a financial position, acting as a situation of ignorance of the future that is impossible to eliminate completely so strategies are made to try to control it trying to maximize the economic value of financial institutions, in turn (Díaz et al., 2017). They say that financial risks allow to measure solvency and know the environment in which the organization develops, giving flexibility when interpreting the financial information's data and opting to make good decisions within the organization.

For Vargas (2010), this risk increases in times of economic crisis, as it increases the possibility that the partners of the corporate sector decide to leave it for fear of an insolvent company and lack of capital, as was the case of covid 19 so that governments seeing these changes decided to modify the laws or regulations of the financial sector so that they remain stable in the market as was the case where:

The Monetary and Financial Board (2019) issued the reforming regulation to section IV of the regulation for comprehensive risk management in savings and credit cooperatives and central banks and mutual savings associations to manage financial risk and maintain equity coverage, which allows cooperatives of segment 1, 2, 3 and savings and credit associations to determine the rates of credit operations, considering the amount, terms, guarantees, types of products and financial destination: the amount, terms, guarantees, types of products and financial destination, and to the cooperatives of segment 4 and 5 have information tools that guarantee risk management and generate reliable reports of the credits provided by the organization and reduce the impact on financial indicators such as:

Liquidity, in cooperatives, where as a result of covid-19 they have been affected due to the lack of payments, delays and postponement of credits that members have, causing liquidity to contract and not allowing them to cover institutional obligations. (Brito & Vásconez, 2022)The Z2 model allows us to know if the organizations have liquidity and if they are able to respond with cash the assets of their company in the short term, and this value interacts with the others to check if the organization is solvent or not. (León & Murillo, 2021)

Profitability as the second variable of the Z2 model according to (Quintero & Sanchez, 2020) y (Chiluisa, 2022) allows to capture the reserves that an organization has and to know if

it has profits or losses in the year that has been analyzed, this can be both internal and external financing, accumulating to serve as a protection against the volatility of income or lack of liquidity that may occur due to the lack of cash, the higher the profitability, the better to invest in a project either with the profits of the organization or with the funds given by the partners.

(Quishpi, 2019)tells us that solvency as a financial indicator measures the degree of participation of the creditors of the cooperative, with which a level of indebtedness risk that the cooperative is willing to face is established, and (Fernandez, 2017) shares ideas saying that solvency affects the social capital and the organization's risk rating, since it decreases when the weight of social capital over liabilities is greater, which will allow avoiding long-term debts if they exist.

Materials And Methods

Methodology

The present study is based on a quantitative approach, since it is an analysis of balance sheet accounts data of the popular and solidarity financial sector. It consists of determining the risk of insolvency through the application of Altman's Z2 Model; the type of research used was descriptive, since it allows knowing the financial health of the sector and of the cases selected by c.

The study population is made up of 43 cooperatives in segment 1, 42 cooperatives in segment 2, 84 cooperatives in segment 3 and 4 mutuals. The technique and instrument used for the research collection were carried out through direct observation of the financial statements reported to the Superintendence of Popular and Solidarity Economy. The sample is made up of 7 institutions that reflect losses, for the respective analysis the Z2-Altman insolvency model was applied, where X1 represents working capital over total assets; X2: retained earnings over total assets; X3: earnings before interest and taxes or operating profit over total assets; and X4: market value or equity over total liabilities .

These indicators allow us to know the financial health of a company, (Reisdorfer, Koschewska, & Salla, 2017) they tell us that financial health allows a rapid development of companies, allowing companies to expand giving continuity to the business, as long as it exists under a control by the management (Guallpa & Urbina, 2021), they mention that financial health must be supported by strategies that make good use of the business fund to improve the concentration of the portfolio and reduce operating expenses.

Similarly, it tells us that in the corporate sector, financial health is reflected in the public sector that supports it (Alzate, 2019) tells us that in the corporate sector, financial health is reflected in the public sector that supports it, i.e. the consumption of financial services increases when the company shows to have a good financial health as it demonstrates the stability in the market that the organization has taking prominence in the popular and solidarity economy, likewise (Alegría & Henao , 2017) It also tells us that the financial health of the company allows us to establish possible errors and plans with which we seek to improve or highlight the correct administration of these.

Alman's Z-Score model

According to Altman, Danovi & Falini (2013) the Z2 model seeks to evaluate and predict the economic and financial situation of organizations, originating a multiple discriminant analysis by Edward Altman, who through a statistical analysis weights and sums

five measurement ratios to classify companies as solvent and insolvent, with which the following discriminant function emerges:

Z = V1X1 + V2X2 +...+ VnXn which transforms the values of the individual variables into a single discriminant score or Z-value, which is then used to classify the object, where:

Vn = are the discriminant coefficients y
Xn = are the independent variables
Thus, the equation expresses as follows:
Z=1.21X1+1.4X2+3.3X3+0.6X4+0.99X5

Where:

X1 = Working capital/Total assets: Measures the relative liquidity of the company.

X2 = Retained earnings/Total assets: Measures the reinvestment of a going concern and reflects its financing scheme.

X3 = Earnings before interest and taxes/Total assets: Measures the productivity of the company's assets.

X4 = Market value of shares/Total liabilities: Measures how far the value of the shares can fall in the market before the value of the liabilities exceeds the assets and the company enters a state of insolvency.

X5 = Sales/Total Assets: Measures a company's capacity to generate sales, also known as turnover indicator.

Due to criticism of the model by analysts, since its application was only for listed manufacturing companies, the Z1 and Z2 models were developed for manufacturing (non-listed) or closely held companies and for any type of company, respectively, and the Z2 model is applicable in emerging economies.

Model Z1

In this model the variable X4 is modified by the value of stockholders' equity instead of the market value of the shares, considering total assets and their turnover as important. Thus, the function is as follows:

Z1=0.717X1+0.847X2+3.10X3+4.20X4+0.998X5

Model Z2

In this model a modification is made to the previous model, the X5 ratio is eliminated so that it can be applied to all types of companies, considering the generation of profits with respect to assets and reinvestment, these being: working capital, total assets, profit, liabilities and equity. Thus, the model is described as follows: Z2=6.56X1+3.26X2+6.72X3+1.05X4

Where:

X1= Working Capital / Total Assets: Measures the relative liquidity of the company;

X2= Retained Earnings / Total Assets: Measures the profitability of an ongoing organization and reflects its financing scheme;

X3= Earnings before interest and taxes or operating income / Total assets: Measures the solvency of the organization;

X4= Market value of shares or equity / Total liabilities: measures the monetary activity

Table 1 *Z2 Value Scores*

RISK ZONE	MODEL Z	MODEL Z1	MODEL Z2
HEALTHY	≥2.9	≥2.9	≥2.6
GRAY	1.82≤Z≤2.89	1.24≤Z≤2.89	1.12≤Z≤2.59
BANKRUPTCY	≤1.81	≤1.23	≤1.11

Note: Z2 Value Score Table **(**Altman, Danovi & Falini, 2013). **Source:** (Bermeo & Armijos, 2021)

According to Table 1, if the organization obtains a Z equal to or above the limits established as healthy, there is no probability of bankruptcy and it is considered safe, whereas, if it is in the gray zone it should be cautious because it has a high probability of presenting insolvency problems; finally, if Z is less than or equal to the values indicated in Table 1, the company is sick and, therefore, is immersed in an imminent bankruptcy. To correctly execute Altman's Z2 model, a database must be obtained (minimum of the last 3 years) of a company or organization that offers the sale of products or services, in case there are several, they can be grouped as convenient, taking the data of X1= Working capital / Total assets; X2= Retained earnings / Total assets; X3= Earnings before interest and taxes or operating profit / Total assets; X4= Market value of shares or equity / Total liabilities.

With these results the formula of the model in question is applied: Z=6.56X1+3.26X2+6.72X3+1.05X4 in all the years with which we are working; finally, an average is made with the results of Z2 and an analysis of it is developed where if this result is ≥2.6 the company, organization, group or section is in a healthy state, if the value is between 1.12≤Z≤2.59 the organization is in a gray state, and finally if the organization obtains a result ≤1.11 it is in a state of bankruptcy (Kruchynenko, 2012).

Results

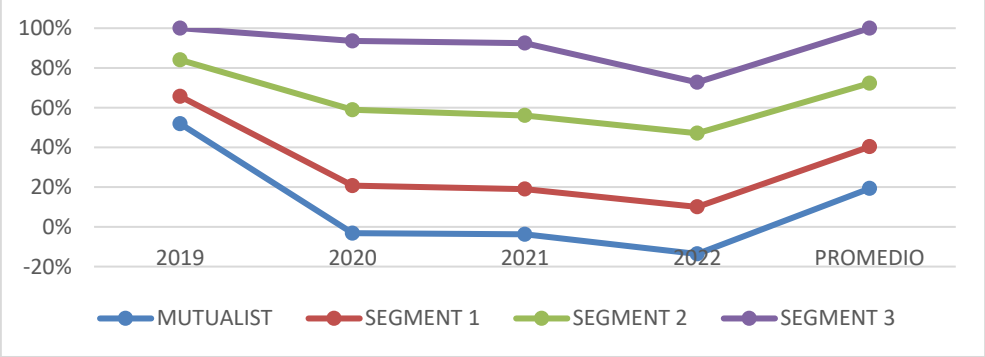
Table 2 *Results*

RISK ZONE	MODEL Z2
HEALTHY	≥2.6
GRAY	1.12≤Z≤2.5
BANKRUPTCY	≤1.11

ORGANIZATIONS	Z2 = 6.56*X1 + 3.26*X2 + 6.72*X3 +1.05*X4					STATUS
	2019	2020	2021	2022	AVERAGE	
MUTUALIST	5,34	-0,15	-0,19	-0,61	**1,10**	BANKRUPTCY
SEGMENT 1	1,42	1,15	1,13	1,07	**1,19**	GRAY
SEGMENT 2	1,89	1,84	1,84	1,67	**1,81**	GRAY
SEGMENT 3	1,65	1,67	1,81	1,16	**1,57**	GRAY
AVERAGE	2,57	1,13	1,15	0,82	1,42	GRAY

Note: *Table of Results*

Figure 1 *Altman's Z2 model analysis of the organizations analyzed.*



Note: *The graph represents the analysis of the Altman Z2 model of the organizations analyzed.*

As can be seen, the liquidity indicator in active entities has positive results, which indicates that the working capital managed in financial organizations with a total average of 1.42 in the results table, which means that it does cover immediate obligations and still has resources and generate peace of mind to develop productive activities. This indicator should be improved in order to avoid liquidity problems in the event of an unexpected event or a run on deposits in the organizations, especially in the mutual companies, which in the last three years have had negative results, especially Mutualista Ambato.

Table 3 *Organizations making a loss as of 2021*

BELONGS TO	ORGANIZATIONS	Z2 = 6.56*X1 + 3.26*X2 + 6.72*X3 +1.05*X4					STATUS
		Z2 2019	Z2 2020	Z2 2021	Z2 June 2022	Z2 (AVERAGE financial risk)	
MUTUALISTS	AMBATO	0,47	0,06	-0,07	0,12	0,14	BANKRUPTCY
SEGMENT 1	PABLO MUÑOZ VEGA LTDA.	1,69	1,24	0,50	0,51	0,99	BANKRUPTCY
SEGMENT 2	TEXTILE MARCH 14	2,47	2,36	2,00	1,98	2,20	GRAY
SEGMENT 3	OF THE FORTUNE MICROENTERPRISE	0,79	0,66	0,67	0,43	0,63	BANKRUPTCY
SEGMENT 3	MARCABELITA LTDA.	3,41	1,44	3,24	1,68	2,44	GRAY
SEGMENT 3	SALITRE LTDA.	2,49	0,83	3,24	0,65	1,80	GRAY
SEGMENT 3	SOL DE LOS ANDES LTDA.	-0,34	0,12	0,44	0,03	0,06	BANKRUPTCY

Note: *Table of Ecuadorian Financial Institutions of the SEPS that obtained a loss as of 2021*

According to the data shown, under the analysis of Altman's Z2 Model, it can be observed that of the seven financial institutions, four are classified according to the application

of Altman's Z2 model with negative results that will only be presented if they have consecutive losses of more than two years.

Discussion

The results of the Z2 model between the years 2019 to June 2022 are mostly positive, with an average total financial risk of 1.42 calculated vertically and are in a gray state except for the Mutualistas that are located in the bankruptcy zone, according to the parameters established in Altman's Z2 table with a value of 1.10. In turn, these results can be compared with those who investigated and applied Altman's Z2 model between the years 2016 to 2019 in segment II and III of the cooperatives, evidencing the following:

According to Freire (2021) in his study on credit risk and its impact on the financial stability of segment III cooperatives, conducted in the period from 2016 to 2019, these entities on average reflected a financial risk index of 1.65, this value was located in the gray representative scale, and until June 2022, this segment decreased to a value of 1.57; evidencing the economic recession of the world economy caused mainly by the Covid-19 pandemic. Likewise, it has only had a reduction of 0.08 points, which means that it continues to remain in a gray zone, representing a possible technical bankruptcy.

For its part, Roads (2021) maintains that segment II was in a gray zone during 2016, with an indicator of 2.25; while for 2019 it reflected an indicator of 1.89; thus, its impact was even greater. This indicator up to June 2022, reflects 1.87 with a decrease in relation to the previous one; therefore, this affectation is not only due to the effects caused by the Covid-19 pandemic; but other factors or variables are intervening that could be the object of investigation in a following study.

Finally, segment I in 2019 reflected a gray level with the Z2 indicator of 1.42; while, on average as of June 2022 it is positioned at a bankruptcy level with an index of 1.07; however, it is not at a bankruptcy level in its average which allows us to see that it will have a possible recovery, since it has been able to pay its debts and can remain solvent in the market.

Conclusions

The Ecuadorian cooperative organizations of the financial sector of segment 1, 2, 3 and mutual organizations have been affected by a reduction in their financial indicators, where COVID-19 was a crucial part in the decline, leading, according to the indicators of the Z2 model, a large number of organizations to drop from a healthy level to a gray level, or in some cases to enter a state of bankruptcy, such as the mutual organizations, where the low solvency of Mutualista Ambato, only 4 in the country, led this entire sector to be at this level with a 1.10.

The level of solvency when compared to previous years has been affected in the different segments presenting annual financial declines varying between each segment and affecting the financial health of the organizations who are taking strategic initiatives to increase and capture a greater amount of investments and partners in the popular and solidarity market.

Organizations that show losses in their financial statements may be forced to close, or in turn to be relocated in the segment according to their economic level if they do not generate solvency in the coming years, so their investors may need to intervene and choose to make decisions to change the administrative staff, limiting the return of money in the conditions

established at the beginning of a loan, and force their partners to liquidate the debts they have with the entity.

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