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MERGERS AND ACQUISITIONS. A CREDIT RISK EVALUATION IN THE GREEK BANKING INDUSTRY SHORT- AND LONG-TERM TIME PERIOD AFTER THE EVENT

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Abstract:
The Greek banking system was greatly affected by the financial crisis that began to plague Greece in 2010. Therefore, in order to have competitive Greek banks, a rally of acquisitions and mergers of Greek banks began in 2010 and ended mainly in 2015. So, in essence, the Greek economy was left with only four large Greek systemic banks, which took over the other large and small distressed Greek banks under the specter of bankruptcy. This wave of acquisitions and mergers in the Greek banking system created strength in Greek banks mainly in terms of assets and at the same time protected the interests of Greek depositors. This paper deals with the assessment and calculation of the credit risk that led to the bankruptcy of the four Greek systemically important banks with Z-Score models. These banks are Piraeus Bank, National Bank, Eurobank, and Alpha Bank. The time period for conducting our study is limited from 2015 to 2020. The year 2015 is essentially the last year in which all the important and large mergers and acquisitions of Greek systemic banks that occurred immediately after the onset of the financial crisis in Greece in the year 2010, were completed. The last year of our study is the year 2020 when the pandemic started in Greece. In our paper, extensive reference is made to the credit risk models that we apply in our study, namely the Z-Score, the Z-Score for banks, and the Zeta model. The analysis of our findings is accompanied by tables, diagrams, and comments on them. The final comparative results obtained are forecasts for imminent possible or non-bankruptcy of the Greek systemic banks we

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examined. At the end of our paper, we present some conclusions about the Greek banking system and its future.

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Keywords: banks, mergers & acquisitions, credit risk, bankruptcy

1. Introduction

The global financial crisis that began in 2008 with the collapse of the investment bank Lehman Brothers brought the term systemic risk to the fore. The fact that banking systemic risk can lead to a huge financial crisis with devastating consequences for the financial environment created the need for the financial industry and policymakers to clarify this term so that the relevant regulatory authorities can manage to control it to make the banking system less vulnerable to economic shocks. The global financial crisis invaded Greece essentially in 2010 and then the financial problems of Greek banks began to appear in the economic foreground with a direct impact on the Greek economy. The Greek banking system suffered a serious freeze after 2010 with the influx of the global financial crisis into the Greek economy. The effect of the financial crisis on Greek banks resulted in the appearance of problems such as liquidity and capital insufficiency. The reaction of the Greek banks, in the face of the emerging financial problems, was their attempt to create strong banking groups, in order to be able to deal with issues of liquidity, insolvency, credit, and operational risk, as well as aggressive acquisitions by foreign financial institutions. For this purpose, they proceeded with acquisitions and mergers within the Greek area. This effort started shortly after the year 2010 and somehow ended in the year 2015. Thus, in Greece four large banking groups were created, which became systemic domestic banks, avoiding at the same time a future bankruptcy, which would cause significant problems to the Greek economy with a direct impact on Greek households and in the business world and probably a financial distress would appear.

As it is known a pervasive financial distress can cause systemic risk. Systemic risk refers to "*the risk that many market participants are simultaneously affected by severe losses, which then spread through the system*" (Benoit, Colliard, Hurlin, & Perignon, 2016).

The main purpose of carrying out this study is to investigate and analyze with numerical results, the probability of insolvency and distress of the four systemically important banks vis-à-vis the creditors, as well as the possibility of their direct or indirect bankruptcy. This work is a comprehensive and thorough research and analysis of the four systemically important banks of Greece, Piraeus Bank, National Bank, Eurobank, and Alpha Bank, with indicators and bankruptcy models in the years 2015-2020.

In the year 2014, all the important acquisitions in the Greek banking system mainly were completed and thus the year 2015 is considered as a short time period after the acquisitions. The time period from 2016-2020 is considered as a long time period in our

analysis of all Z-Score models as well as the findings according to the Standard & Poor's ratings.

This choice of time period was not accidental. First let us mention that the year 2015 was a milestone year for the Greek financial system because:

1) The intense political uncertainty at the beginning of the year led savers to successive outflows of deposits from credit institutions.
2) The third support program (memorandum) was signed.
3) Capital controls were imposed on cash withdrawals and the transfer of funds abroad from bank accounts.
4) The four systemically important banks were recapitalized for the third time.

At the same time, banking institutions have been managing the problem of non-performing exposures for all these years, which has a direct impact on their balance sheets. The most important consequences they face are:

- The shrinking of their assets.
- The formation of increased provisions for credit risk.
- The reduction of their equity.
- The decrease in interest income.

In 2018, the third memorandum ended definitively, while in 2019, capital controls were completely abolished. Finally, in the last year of the time period we have chosen, the COVID-19 pandemic broke out, an event that affected the operation of banks, resulting in the initial motivation that was chosen to carry out this work, which is the recording and analysis of the effects of the above events, over time on the finances sizes of the systemically important Greek banks.

2. Literature Review

A systemically important financial institution (SIFI) is a bank, insurance company, or other financial institution whose failure could trigger a financial crisis. Systemically important financial institutions, as far as banking institutions are concerned, are distinguished in global systemically important banks (G-SIBs) and in domestic systemically important banks (D-SIBs).[ii]

The four Greek systemic banks that we dealt with in this study are considered domestic systemic banks. The assessment of the effects of the bankruptcy of a bank at the domestic level should in principle be based on the following parameters: (i) size, (ii) interconnectivity, (iii) possibility of substitution with evaluation, (iv) degree of concentration of the country's banking system and (vi) complexity of activity, including issues arising from any cross-border activity of the bank.[iii]

Systemic risk is a default by one financial institution that may possibly create a "ripple effect" that leads to defaults by other financial institutions and threatens the

[ii] https://www.investopedhttps://www.investopedia.com/terms/s/systemically-important-financial-institution-sifi.asp ia.com/terms/s/systemically-important-financial-institution-sifi.asp
[iii] https://www.bis.org/basel_framework/chapter/RBC/40.htm?inforce=20191215&published=20191215

stability of the financial system. In order to predict and avoid bank failure situations and their subsequent economic disaster a regulatory framework for the banking sector was necessary to be established Hull (2015) pointed out the importance of regulations in order to avoid bank failure. (Hull, 2015, p.326). He justified this necessity and explained it with the phrase "*…main purpose of bank regulation is to ensure that a bank keeps enough capital for the risks it takes. It is not possible to eliminate altogether the possibility of a bank failing, but governments want to make the probability of default for any given bank very small. By doing this, they want to create a stable economic environment where private individuals and businesses have confidence in the banking system*" (Hull, 2015, p. 325).

Credit risk is the possibility that a bank borrower or counterparty will fail to meet its payment obligations regarding the terms agreed with the bank (GARP, 2014, p. 14). In this study we demonstrate the credit risk of Greek systemic banks using linear bankruptcy models and more specifically we use Altman's Z-Score model, the Z-Score for banks, and the Zeta model.

The early prediction of financial distress is essential for investors or lending institutions who wish to protect their financial investments. As a consequence, modeling, prediction, and classification of firms to determine whether these are potential candidates for financial distress have become key topics of debate and detailed research. Financial distress is defined as "*… a condition where a company cannot meet, or has difficulty paying off its official obligations to its creditors. The chance of financial distress increases when a firm has high fixed costs, illiquid assets, or revenues sensitive to economic downturns*" (Sofat and Hiro, 2015, p. 406).

Despite all the arguments and criticism from the scientific community, nowadays financial analysts and scientists are still considering Altman's Z-Score model as one of the most effective and suitable models of a firm's / bank's ability to avoid credit risk that leads to bankruptcy. All over the scientific world, professors, and financial and credit professionals are constantly using Altman's Z-Score models in order to mitigate credit risk and predict bankruptcy. It is quite popular because it is easy to use and also uses multiple ratio variables to measure the financial distress and credit risk of any firm or bank. Since Z-Score is an open system, the ratio variables employed in the formula can easily be understood by its users. So, Z''-Score models help to measure credit risk and predict the financial distress of banks so they would be able to avoid bankruptcy in the future. Altman (1968) expanded on the work of Beaver by using multiple discriminant analysis for various bankrupt and non-bankrupt groups and used a variety of different ratio groups to predict business failures. After almost forty years, Altman's Z-Score is still widely regarded by researchers as an indicator of a company's financial well-being. In 1993, Altman revised his model to incorporate a "*four variable Z-Score*" prediction model (Altman, 1993). Altman felt this revised model significantly improved the predictive ability of his model and made it simpler to incorporate (Meeampol S., et al., 2014).

The Z-Score is a linear combination of four or five common business ratios, weighted by coefficients. The coefficients were estimated by identifying a set of firms that had declared bankruptcy and then collecting a matched sample of firms which had

survived, with matching by industry and approximate size (assets). The formula may be used to predict the probability that a firm/bank will go into bankruptcy within two years. Z-Scores are used to predict corporate defaults and an easy-to-calculate control measure for the financial distress status of companies/banks in academic studies. The Z-Score uses multiple corporate income and balance sheet values to measure the financial health of a company.[iv]

The new improved bankruptcy model was:

$$Z' = 6.56 * X_1 + 3.26 * X_2 + 6.72 * X_3 + 1.05 * X_4 \quad (1)$$

In order to standardise the Z''-Score results Altman, Hartzell and Peck (1995) added a constant (+3.25) so that the scores that equal or less than zero would be *"equivalent to the default situation"* (Altman, Danovi, and Falini, 2013:4). The revised equation of Altman's Z''-Score model for credit risk measurement transformed into:

$$Z'' = 3{,}25 + 6.56 * X_1 + 3.26 * X_2 + 6.72 * X_3 + 1.05 * X_4 \quad (2)$$

From this proposal, Altman and Hotchkiss (2006) translated this score to Standard & Poor's ratings. This bond rating equivalent (BRE) of the Z''-Score makes the model very relevant and useful for investors. This is displayed in the following table[v].

Table 1: Altman Z''-Score Model and Standard & Poor Ratings

Safe Zone		Grey Zone		Distress Zone	
Standard & Poor's	**Z-Score Rating**	**Standard & Poor's**	**Z-Score Rating**	**Standard & Poor's**	**Z-Score Rating**
AAA	>8.15	BBB-	5.65-5.85	B-	3.75-4.15
AA+	7.60-8.15	BB+	5.25-5.65	CCC+	3.20-3.75
AA	7.30-7.60	BB	4.95-5.25	CCC	2.50-3.20
AA-	7.00-7.30	BB-	4.75-4.95	CCC-	1.75-2.50
A+	6.85-7.00	B+	4.50-4.75	D	<1.75
A	6.65-6.85	B	4.15-4.50		
A-	6.40-6.65				
BBB+	6.25-6.40				
BBB	5.85-6.25				

Source: Altman E., I., (2005). "An Emerging Market Credit System for Corporate Bonds" Emerging Market Review 6 (2005) pp 311-323

We present below an analysis of the Standard & Poor Ratings and information for investors in emerging stock markets in combination.

[iv] https://www.altmanzscoreplus.com/articles/AltmanZScorePlus_ANF_Abercrombie__Fitch_Co_Class_A.html

[v] Chieng J., R., (2013). "Verifying the Validity of Altman's Z" Score as a Predictor of Bank Failures in the Case of the Eurozone" MSc. Management National College of Ireland

a. Investment Grade[vi]

AAA: An obligor rated 'AAA' has an extremely strong capacity to meet its financial commitments. 'AAA' is the highest issuer credit rating assigned by Standard & Poor's.

- **AA**: An obligor rated 'AA' has a very strong capacity to meet its financial commitments. It differs from the highest-rated obligors only to a small degree. Includes:
  - **AA+**: equivalent to Moody's Aa1 (high quality, with very low credit risk, but susceptibility to long-term risks appears somewhat greater).
  - **AA**: equivalent to Aa2.
  - **AA−**: equivalent to Aa3.
- **A**: An obligor rated 'A' has a strong capacity to meet its financial commitments but is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than obligors in higher-rated categories.
  - **A+**: equivalent to A1.
  - **A**: equivalent to A2.

BBB: An obligor rated 'BBB' has adequate capacity to meet its financial commitments. However, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity of the obligor to meet its financial commitments.

b. Non-Investment Grade (also known as speculative grade)

- **BB**: An obligor rated 'BB' is less vulnerable in the near term than other lower-rated obligors. However, it faces major ongoing uncertainties and exposure to adverse business, financial, or economic conditions, which could lead to the obligor's inadequate capacity to meet its financial commitments.
- **B**: An obligor rated 'B' is more vulnerable than the obligors rated 'BB', but the obligor currently has the capacity to meet its financial commitments. Adverse business, financial, or economic conditions will likely impair the obligor's capacity or willingness to meet its financial commitments.
- **CCC+**: An obligor rated 'CCC' is currently vulnerable, and is dependent upon favorable business, financial, and economic conditions to meet its financial commitments.
- **CCC**: An obligor rated 'CC' is currently highly vulnerable.
- **CCC-**: highly vulnerable, perhaps in bankruptcy or in arrears but still continuing to pay out on obligations.
- **D**: has defaulted on obligations and S&P believes that it will generally default on most or all obligations.

[vi] https://en.wikipedia.org/wiki/S%26P_Global_Ratings

3. Material and Methods

The Z-Score for banks estimates the distance from insolvency for a given bank by combining bank profitability, capitalization, and yield volatility. The Z-Score is defined as:

$$Z = \frac{\overline{ROA}+\overline{EA}}{sdROA} \quad (3)$$

where:

$\overline{ROA}$ = Profit before Tax to Assets is the ROA average of the ROA ratios of the considered time period and saw the profitability of the bank's asset.

$\overline{EA}$ = Equity to Assets is the ratio of average Equity in relation to Assets and saw insolvency and the financial leverage of a bank.

$sdROA$ = sdROA = $\sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(ROAi - \overline{ROA})^2}$ is the standard deviation of the ROA ratio during the considered time period and saw volatility of ROA.

The Z-Score is an indicator of a bank's probability of insolvency as it estimates the number of standard deviations that the bank's earnings would have to fall below their expected value before its equity becomes negative. The value of the Z-Score for banks depends on (i) positive from the bank's profitability and capital ratio, (ii) negative from the fluctuation of the bank's profits. A higher Z-Score for banks indicates that the bank is more stable or less likely to fail. In other words, a higher value of the Z-score for banks indicates a lower risk.[vii]

Edward I. Altman in the year 1968, developed the Z-Score bankruptcy model, which is a multivariate linear analysis separating bankrupt and non-bankrupt companies. The separation is based on the sequential calculation and combination of more than one indicator in a combined Z-Score. This model is based on the use of the financial data and financial sizes of the companies, enabling analysts to predict the bankruptcy of the companies up to five years before it occurs. Over the years, the Z-Score model has improved to become one of the most reliable predictors of bankruptcy.[viii]

The Greek stock market belongs to the category of emerging markets. Thus, in our study, we use the revised Altman Z''-Score model for the emerging market listed firms and banks. The equation is as follows[ix]:

[vii] Casu B., Girardone C., Molyneux P., (2018). "Introduction to Banking", Book 2nd Edition, Giola Publications, Athens, Greece.

[viii] Altman, E., I., (2013). "Predicting financial distress of companies: revisiting the Z-Score and ZETA® models, "Chapters, in: Adrian R. Bell & Chris Brooks & Marcel Prokopczuk (ed.), Handbook of Research Methods and Applications in Empirical Finance, chapter 17, pages 428-456, Edward Elgar Publishing.

[ix] Altman, E., I., (2002). "Revisiting Credit Scoring Models in a Basel II Environment". Prepared for "Credit Rating: Methodologies, Rationale, and Default Risk", London Risk Books, 2002.

$$Z' = 6.56 * X_1 + 3.26 * X_2 + 6.72 * X_3 + 1.05 * X_4 \quad (4)$$

$$Z'' = 3{,}25 + (6{,}56 * X_1) + (3{,}26 * X_2) + (6{,}72 * X_3) + (1{,}05 * X_4) \quad (5)$$

Whereas:
X_1 = Working Capital (Current Assets - Current Liabilities) / Total Assets,
X_2 = Retained Earnings / Total Assets,
X_3 ROA = Earnings Before Interest and Taxes / Total Assets,
X_4 = Book Value / Total Liabilities,

The interpretation of the emerging market Z''-Score model after discounting the constant 3.25 from the score (equation No. 2) are:

- Z'- Score > 2.60 means "Safe" Zones,
- 1.1 < Z-Score < 2.60 means "Grey" Zones,
- Z- score < 1.1 means "Distress" Zones.

The equation of the Z-score model for emerging markets No. (3) is related to the Standard & Poor's ratings.[x]

Altman E., I., analyzed the accuracy of a four-variable Z-Score model that excluded the Sales / Total assets ratio, from the revised model because of a potential industry effect that is more likely to take place when this kind of industry-sensitive variable (asset turnover) is included in the model.[xi]

In the year 1977, Altman, Halderman, Narayanan, introduced a modern revised form of the Z-Score model multivariate analysis model, called ZETA model.

The reasons that contributed to the development of the revised model were the following:[xii]

1) The change in the size and financial profile of the failing firms, as the average size of their assets had increased significantly.
2) The temporary nature of the data. The new model had to reflect the current situation, given the temporal nature of the data.
3) The need to introduce retail companies into the classification sample for the first time.
4) The need to test and evaluate the new, controversial dimensions of multivariate discrete analysis (MDA), as its application was constantly increasing, but also creating many controversies. The new model would try to improve and eliminate the weak elements of the MDA statistical technique.
5) The need to create a model that would be equal or even better than the previous ones, but could also deal with data that would probably arise in the future. This

[x] https://www.spglobal.com/ratings/en/about/intro-to-credit-ratings

[xi] Altman E. I., Kaufman H., Iwanicz-Drozdowska M., Laitinen E., K., (2017). "Financial Distress Prediction in an International Context: A Review and Empirical Analysis of Altman's Z-Score Model" Journal of International Financial Management & Accounting 28:2 pp. 131-171

[xii] Altman. E., I., Haldeman, R. G. and Narayanan, P., (1977), "Zeta Analysis, A new model to identify bankruptcy risk of corporations", Journal of Banking and Finance Volume 1, Issue 1, Pages 29-54.

could be achieved by an accurate analysis of the data, while it was also positive that all the research data and footnotes were thoroughly analyzed, including all recent changes in financial standards and previously known accounting practices.

The main advantage of the zeta credit model is that the use of the ZETA model managed to accurately assign the probability of bankruptcy up to five (5) years before bankruptcy, with a sample classification success rate of over 90% for one year before bankruptcy, while for five years before, the classification success rate reached 70% for bankrupt and 82% for healthy businesses.[xiii]

The seven indicators of the Zeta model are presented below:

X_1: Return on assets (ROA) = earnings before interest and taxes / total assets,

X_2: Stability of earnings $s^2 = \frac{\sum_{i=1}^{n}(X_1 - \overline{X_1})^2}{n}$,

X_3: Debt service = earnings before taxes and interest / financial expenses,

X_4: Cumulative profitability = retained earnings / total assets,

X_5: General liquidity index = current assets / current liabilities,

X_6: Capitalization = current value of equity / total assets),

X_7: Company size (size) = percentage change in a company or bank assets from year to year.

In Table 2 below we recorded the contribution of the variables to the ZETA pattern.

Table 2: Influence of Variables on the ZETA Model

Variables of ZETA Model	Percentage contribution to the ZETA Model
X_1	5%
X_2	20%
X_3	6%
X_4	25%
X_5	11%
X_6	18%
X_7	15%

Source: Altman. E., I., Haldeman, R. G. and Narayanan, P., (1977), "Zeta Analysis, A new model to identify bankruptcy risk of corporations", Journal of Banking and Finance Volume 1, Issue 1, pp. 29-54

The ZETA Model has only two zones to predict bankruptcy:[xiv]

1) Critical price Zeta model > 2.675, the company or the bank is outside the bankruptcy zone,
2) Critical value Zeta model < 2.675, the company or the bank is in bankruptcy zone.

The most important differences between Altman's Zeta model and Z-Score are (i) the Zeta model can predict the probability of bankruptcy of a firm or bank equally well one year before bankruptcy with an accuracy of over 96% against 94% of the Z-score and

[xiii] Altman. E., I., Haldeman, R.G. and Narayanan, P., (1977), "Zeta Analysis, A new model to identify bankruptcy risk of corporations", Journal of Banking and Finance Volume 1, Issue 1, Pages 29-54.

[xiv] Altman. E., I., Haldeman, R.G. and Narayanan, P., (1977), "Zeta Analysis, A new model to identify bankruptcy risk of corporations", Journal of Banking and Finance Volume 1, Issue 1, Pages 29-54

(ii) the Zeta model is much more accurate for years 2-5 before bankruptcy. Specifically, its accuracy for this period is 69.8% compared to only 36% for the first Z-Score developed in 1968.

The main similarities between the two Altman models Zeta model and Z-Score are:

a) two of the seven variables in the new model are shared with the Z-Score model, and
b) The Current Value of Equity / Total Funds is similar to the Current Value of Equity / Book Value of Total Liabilities of the first example.[xv]

It should be mentioned, however, that none of these models can give fully satisfactory results for the ranking of companies (bankrupt or not).

The main advantages of the Altman Z''-Score model are:

1) the model is easy to use,
2) the results are reliable, with more than 80% accuracy in predicting bankruptcy, and
3) it is available to any interested user who wishes to carry out an analysis of the business of interest. The main disadvantage of the Altman Z-Score model is that it cannot be applied to new businesses or banks.

The problem of using lies in the fact that the banks/financial institutions are usually operating under conditions of high current liabilities. A consequence of that is the appearance of a great negative impact on the first variable X_1 (Working Capital/Total Assets) which actually affects and reduces the calculated total Z-Score of banks under examination. In most cases, the current liabilities of banks are exceeding their current assets. Therefore, the outcome of Working Capital (Current Assets minus Current Liabilities) is always negative for the banks/financial institutions. This liquidity ratio is very important for the calculation of the Z-Score because it helps to screen for serious financial problems that a firm could face in the future (Altman, 1995).

However, a negative Working Capital might be an ambiguous indicator as well. In some cases, this can be interpreted as a sign of a firm's managerial efficiency for example a firm with low accounts receivable might also mean that it operates effectively on a cash basis (Damodaran, 2012, p. 268; Stockopedia, 2017). Another significant limitation of prediction models like Altman's Z-Score is that their applicability is principally based on historical information. Eisenbeis (1977) pointed out the insufficient value information used in prediction models like Altman's where the prediction of a firm's future financial status is only based on analysis of past data. The economy as life is changing dynamically.

According to Grice (2001), "*the models' accuracies may significantly decline when using samples from time periods, industries, and financial distress situations other than those used to originally develop the models.*"

[xv] Altman. E., I., Haldeman, R. G. and Narayanan, P. (1977), "Zeta Analysis, A new model to identify bankruptcy risk of corporations", Journal of Banking and Finance Volume 1, Issue 1, Pages 29-54

4. Results and Discussion

In the present study we examine, calculate, and try to predict a possible bankruptcy, using three of the main Z-Score models, of the four Greek systemic banks after the year 2015, which was essentially the year when the acquisitions of all financially sick banks by these four banks were completed. Our research covers the period from 2015 to 2020. It should be noted that the year 2020 was the year of the pandemic in Greece and it changed a lot in the Greek economy, bringing about financial effects on banks, businesses, and households.

In Table 3 below we respectively present the results and the course of the values extracted from the Z-Score for banks for the four Greek Systemic Banks from 2015 to 2020.

Table 3: Z-Score for Banks of the Four Greek Systemic Banks between 2015 and 2020

Years	Piraeus Bank	National Bank	Eurobank	Alpha Bank
2015	-1.82	-2.34	-0.28	-3.42
2016	-0.94	0.062	0.003	0.77
2017	-0.77	-0.15	0.007	0.45
2018	-0.014	0.091	0.017	-0.72
2019	0.151	0.1489	0.012	0.38
2020	-2.15	0.22	-2.43	0.58

Source: Authors' calculations from published financial statements of the 4 Greek systemic banks

From the analysis of the above Table 3 we notice that in the considered period 2015-2020, all four Greek systemic banks are in the bankruptcy zone. Particularly impressive is the course of Alpha Bank's Z index, which although in 2015 showed the maximum negative value compared to the other 3 banks, its positive development ranked it in first place in 2020, showing the maximum value of the Z-Score model for banks 0.77. The values of Alpha Bank's Z-Score model for banks had strong fluctuations, presenting the largest negative value of -3.42 and the highest positive value of 0.77 of all other Greek systemic banks. Of course, this rate is far enough from the desired one to make Alpha Bank to be no longer in the bankruptcy zone. Contrary to the course of Alpha Bank's Z-Score model for banks, the Z-Score model for banks for Piraeus Bank started with a negative sign in the year 2015, and it continued to show negative values, up to the year 2020 with the exception of the year 2019, which demonstrates the inability of the bank to generate pre-tax profits to be able to reverse the negative result. For the National Bank, the year 2015 was the year when the Z-Score model for banks showed the lowest value, but the subsequent course was steadily upward with the exception of the year 2019, however marginally above zero as a result of which it could not leave the dangerous zone. Finally, the course of the Z-Score model for banks of Eurobank started negatively, then recovered at a steady rate, but in the year 2020, it presented the maximum negative value, -2.42. In the specifically examined Z-Score model for banks for the prediction of bankruptcy, the values are mainly affected due to the values obtained by the asset profitability ROA ratio.

Also, the values of the specific Z-Score model for banks are affected by the rates of financial leverage Equity to Assets ratios.

In Table 4 below we, respectively, present the results and the course of the values of the Z''-Score in Emerging Markets with the constant (+3.25) for the four Greek Systemic Banks between 2015 and 2020 in relation to the Standard & Poor's ratings.

Table 4: Z''-Score in Emerging Markets for the Four Greek Systemic Banks between 2015 and 2020 Standardized with the Standard & Poor's Ratings

Years	Piraeus Bank	National Bank	Eurobank	Alpha Bank
2015	5.57 BB+ Grey Zone	4.55 B+ Grey Zone	5.91 BBB Safe Zone	5.41 BB+ Grey Zone
2016	5.45 BB+ Grey Zone	4.79 BB- Grey Zone	5.78 BBB- Safe Zone	5.54 BB+ Grey Zone
2017	4.19 B Grey Zone	3.92 B- Distress Zone	5.15 BB- Grey Zone	5.34 BB+ Grey Zone
2018	3.50 CCC+ Distress Zone	3.70 CCC+ Distress Zone	4.18 B Grey Zone	4.48 B Grey Zone
2019	3.21 CCC+ Distress Zone	3.44 CCC+ Distress Zone	4.02 CCC+ Distress Zone	4.46 B Grey Zone
2020	3.92 B- Distress Zone	3.94 B- Distress Zone	2.70 CCC Distress Zone	4.51 B+ Grey Zone

Source: Authors' calculations from published financial statements of the 4 Greek systemic banks.

Comparing the results of the four Greek systemic banks using the application of the emerging market Z''-Score model standardized with the Standard & Poor's Ratings as presented in the above Table 4, the first conclusion is that in all the years considered in all four systemic banks, the values of the emerging market Z''-Score model is above A-. According to the emerging market Z''-Score model standardized with the Standard & Poor's ratings for the examined four Greek systemic banks between 2015 and 2020 we noticed some useful findings about their credit risk.

In 2015, three of the four examined Greek systemic banks had their values of the Z''-Score model standardized with the Standard & Poor's ratings in the gray area except Eurobank whose rating was in the safe zone. In 2016 we can see exactly the same behavior for the values of the Z''-Score model standardized with the Standard & Poor's ratings. In the year 2017, three of the four examined Greek systemic banks had their values of the Z''-Score model standardized with the Standard & Poor's ratings in the gray area except for National Bank whose rating was in the distress zone. In year 2018 Piraeus Bank and National Bank had their values of the Z''-Score model standardized with the Standard & Poor's ratings in the distress area but Eurobank and Alpha Bank had their values of the Z''-Score model standardized with the Standard & Poor's ratings in the gray area. In year

2019 three of the four examined Greek systemic banks had their values of the Z''-Score model standardized with the Standard & Poor's ratings in the distress area and only Alpha Bank was in the gray area. In 2020, we observed exactly the same behavior for the values of the Z''-Score model standardized with the Standard & Poor's ratings.

In Table 5 below, we present the results and the course of the values extracted from the Z''-Score in Emerging Markets for the four Greek Systemic Banks during 2015-2020 without the constant (+3.25) and without the relation with the Standard & Poor's ratings.

Table 5: Z'-Score in Emerging Markets of the 4 Greek Systemic Banks between 2015 and 2020

Years	Piraeus Bank	National Bank	Eurobank	Alpha Bank
2015	2.32 Gray Area	1.3 Gray Area	2.66 Safe Area	2.16 Gray Area
2016	2.2 Gray Area	1.54 Gray Area	2.53 Gray Area	2.29 Gray Area
2017	0.94 Distress Area	0.67 Distress Area	1.9 Gray Area	2.09 Gray Area
2018	0.25 Distress Area	0.45 Distress Area	0.93 Distress Area	1.23 Gray Area
2019	-0.04 Distress Area	3.44 Distress Area	0.77 Distress Area	1.21 Gray Area
2020	0.67 Distress Area	0.69 Distress Area	-0.55 Distress Area	1.26 Gray Area

Source: Authors' calculations from published financial statements of the 4 Greek systemic banks.

From Table 5 we can see that the course of the Z'-Score in Emerging Markets for the four Greek Systemic Banks between 2015 and 2020 ranges from the positive zone to the distress zone. However, the values of the relevant model that are in the gray zone dominate with twelve observations. In second place are the prices in the distress area with eleven observations. Finally, there is only one value in the safe zone which concerns the Eurobank in 2015. We must notice that we have quite similar results from Table 4 in the Z''-Score in Emerging Markets for the four Greek Systemic Banks between 2015 and 2020 standardized with the Standard & Poor's ratings.

In Table 6 below, we respectively present the results and the course of the values extracted from the ZETA model for the four Greek Systemic Banks between 2015 and 2020.

Table 6: ZETA Model for the Four Greek Systemic Banks between 2015 and 2020

Years	Piraeus Bank	National Bank	Eurobank	Alpha Bank
2015	-4.88	-0.81	-0.67	-1.66
2016	-0.05	0.16	0.17	0.36
2017	-0.70	-0.11	0.15	0.28
2018	0.08	-0.09	0.19	-0.19
2019	0.22	0.22	0.17	0.24
2020	-0.23	0.33	-10.95	0.47

Source: Authors' calculations from published financial statements of the 4 Greek systemic banks.

Comparing the results of the ZETA model in the four Greek systemic banks presented in Table 4 we conclude that in all the years under consideration, the values of the ZETA model are below the safe zone of 2.675 that is necessary to characterize a bank as non-candidate to bankrupt. So, the four Greek systemic banks are headed for bankruptcy according to the ZETA model. In a more detailed analysis, we can notice that Eurobank had the highest value of the ZETA model in 2015 and ended up having the lowest value of all banks in 2020 (≈-10.95). Piraeus Bank on the other hand, while it had the lowest value of the ZETA model, compared to the rest of the banks (-4.8) in the year 2015, in the year 2020 it ended up as the second worst bank based always on the of the ZETA model value (-0.22). Regarding Alpha Bank, while the year 2015 had the second worst position based on the values of the ZETA model, the year 2020 ended up being the best of all with the value of the ZETA model amounting to (0.46) and being the maximum value of the index of all years compared to the rest of the banks, without certainly achieving the desired value to avoid bankruptcy. Finally, National Bank followed a more stable path with low volatility, resulting in the specific bank having the second-best value of the ZETA model, in the year 2020. Note that the X_3 ratio (profits before taxes / financial expenses), played an important role in the formation of final results of the ZETA model in all examined Greek systemic banks. More specifically, the prolonged pre-tax losses that the banks showed, were an analgesic factor in the improvement of their position in the prices of the ZETA model for bankruptcy prediction.

5. Recommendations

The results and conclusions of the research we conducted, we hope will be a trigger for the scientific community for further research and analysis regarding the timely evolution of the four Greek systemic banks.

We would like to recommend the European scientific community and especially the Eurozone community to try to calculate and value the credit risk of each country's systemic banks during the short-term and long-term time period after the completion of a large wave of mergers and acquisitions using the same with our methodology, in order to make a comparative analysis among the systemic banks of the Eurozone countries and identify their problems and trigger their solution.

6. Conclusion

From the results of our study, we demonstrated that the four Greek systemic banks that participated as bidder banks in mergers and acquisitions after the global financial crisis and before the pandemic did not have any safe area values in the examined Z-Score models from the acquisitions of several domestic small and distressed banks. On the contrary, the four bidder Greek systemic banks had negative affection in the examined Z-Score models, because even though in 2020, the cycle of mergers and acquisitions in

the Greek banking system was essentially completed the values of all the examined Z-Score models had not presented any improvement so as to move in a safe area.

According to the Standard & Poor's ratings in the combination of the Z''-Score model for emerging markets, we have the same findings and as we observed there were more distress zones than grey zones and only one safe zone for one bank for the year 2015 that was the first year of the end of acquisitions. This means that only in the short-term time period after all the consolidations manage the four Greek systemic banks have one safe zone.

Perhaps this fact is due to the X_1 ratio (working capital / total assets) which played an important role in shaping the final results of the values of all the examined Z-Score models. Also, the X_3 ratio (earnings before interest and taxes / total assets) had a significant affection on the configuration of the values results of all the examined Z-Score models, because there were negative earnings before taxes.

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