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The Effect of Unemployment, Real Interest Rate, Debt Service, and Government Expenditure on the Z"-score of Lebanese Alpha Banks

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Abstract

Lebanon is currently witnessing the most severe banking sector crisis in its history. Thus, nowadays, the demand for financial analyses in banks has increased to examine the financial distress and the potential impact of the macroeconomic factors. Consequently, this research studies bank distress in Lebanese Alpha banks and addresses the question of how the Lebanese major macroeconomic factors affect it.

The researchers calculated the mean Altman Z"-scores for 10 Lebanese Alpha banks for the period 2009 – 2018 as an indicator for financial distress. Furthermore, they collected data regarding the chosen macroeconomic indicators for the same period from the World Bank Data. Consequently, the researchers developed a Regression Model and analyzed the model and a multicollinearity test. The calculated Altman Z"-scores showed that Lebanese Alpha banks were very likely to be financially distressed. Moreover, the results showed that there is a positive relationship between debt service, government expenditures, unemployment, and the real interest rate on one side and alpha banks' high probability to become distressed on the other side**.**

First, gathering data regarding the macroeconomic indicators was a hurdle as there were differences among the sources (Lebanese Ministry of Finance, BDL, Bloomberg, IMF, and World Bank). This is why the authors depended on the values published by the World Bank Data as a reliable source. Second, there is a lack of studies analyzing the relationship between the banking sector's current crisis and the individual macroeconomic variables. However, this limitation also gives value to the results of this study.

This research sheds light on the significance of the Altman Z"-score as an indicator for financial distress in Lebanese Alpha banks. Thus, a model can be developed based on the basic Altman

model that fits for Lebanese banks. Moreover, banking authorities (BdL, ABL, and BCC) should impose yearly calculations of this score to detect probable future distress.
The value of this study stems from it being one of the first studies in the Lebanese market examining the impact of macroeconomic factors on the Z"-scores of the Lebanese Alpha banks using the Multiple Regression Model.

Keywords Altman Z"-score, Unemployment, Real interest rate, Debt service, Government expenditure, Lebanese Alpha banks

1. Introduction

Distress in the banking system greatly affects the economy (Sahut & Mili, 2009; El-Chaarani and El-Abiad, 2019). For a long time, the Lebanese banking sector has acted as the main supporter of the Lebanese economy as it funds its sovereign debt. Nonetheless, the non-diversification of the banks' investments and serving governmental debt (through investing in Treasury bills and Eurobonds) funded from their agents' deposits, along with depreciating macro-environmental factors were a few of the failing steps that have brought about a drastic financial crisis in which Lebanese Banks found themselves on the frontline (Elia, 2020).
As stated by Elia et al., (2020), the Z-score model has yielded suitable results in many cases of critical financial distress and studies on bankruptcy (Aziz & Sar, 2006; Bellovary, Giacomino, & Akers, 2007; Platt & Platt, 2006; Zmijewski, 1984).
Moreover, Chieng's (2013) research has validated the efficiency of the Altman Z"-score model's in predicting the financial failure of banks in the Eurozone. The current study adopts the Altman Z"-score as an indicator of the probability of financial distress.
The value of this study stems from it being one of the first studies in the Lebanese market examining the impact of macroeconomic factors on the Z"-scores of the Lebanese Alpha banks using the Multiple Regression Model. Additionally, the banking sector is considered to be one of the most crucial aspects of the Lebanese economy, being described as its backbone. The Lebanese banking sector is responsible for a high percentage of the gross domestic product (GDP) and employment (El Hajj, Abou Moussa, & Chidiac, 2017; El-Chaarani, 2019; El-Chaarani and El-Abiad, 2020).
Considering the critical distress and instability that the country has been witnessing, Lebanese Alpha banks are an important subject for this study (2018, 2019, and 2020) (Elia, 2020).
Thus, the research question that is based on four sub-questions is defined as: How do the Lebanese major macroeconomic indicators affect the financial distress in the Alpha banks?

2. Literature Review and Hypotheses Development

2.1 Altman Z"-score

In 1968, Altman conceived a model that would foresee financial distress in the manufacturing industry using the MDA approach: The Altman Z-score. To predict the probability of financial distress or an organization's bankruptcy, the Altman Z-score approach simultaneously analyzes several financial ratios. Altman examined multiple essential financial ratios such as liquidity, profitability, efficiency, and productivity (Altman & Hotchkiss, 2010). In other words, Altman's Z-score results from the examination of different financial ratios or variables to determine the chances of financial distress or bankruptcy (Altman, 1968).

In 1993, Altman used the model to examine general service organizations which developed a 4-variable model (Altman & Hotchkiss, 2010). The revised 4-variable "Z-score" model to predict financial distress in the service industry is:

$$Z\text{"-score} = 6.56(X_1) + 3.26(X_2) + 6.72(X_3) + 1.05(X_4) + 3.25$$

In this model Z" = overall index; X1 = working capital / total assets; X2 = retained earnings / total assets; X3 = earnings before interest and taxes / total assets; X4 = equity (book value) / total liabilities. As for the zones of discriminations it is as follows: (1) Z" > 2.6 - "Safe" Zone; (2) 1.1 < Z" < 2.6 - "Grey" Zone; and (3) Z" < 1.1 - "Distress" Zone.
In this study, the authors first calculated the Z"-scores based on the above model and then found the mean for each year (See Appendix A).

"Insert here table 1"

2.2 Macroeconomic Indicators

In this section, we discuss the macroeconomic indicators that did not show multicollinearity in the preliminary test conducted. Consequently, the four chosen macroeconomic indicators are defined as follows:

1) According to the International Labor Organization (ILO), a person is characterized as unemployed if they are (a) not working, (b) currently available for work, and (c) seeking work (OECD,1987).
2) The World Bank data defines total debt service as the total of principal repayments and interest actually paid in currency, goods or services on long-term debt, interest paid on short-term debt, and repayments (repurchases and charges) to the IMF.
3) World Bank data defines the real interest rate as the lending interest rate adjusted for inflation as measured by the GDP deflator. The terms and conditions regarding these lending rates differ by country, which limits their comparability.
4) World Bank Data defines government expenditure as cash payments for managing activities of the government in providing goods and services. It includes compensation of employees (such as wages and salaries), interest and subsidies, grants, social benefits, and other expenses such as rent.

2.3 Hypotheses Development

This section reviews studies in which the four chosen macroeconomic variables were examined as to its effect on the financial stability of banks.

2.3.1 Unemployment and Banking Liquidity

Trenca *et al.* (2015) analyzed in their study the impact of macroeconomic factors on bank liquidity. Unemployment was chosen as one of the macroeconomic indicators. In the results, Trenca et al. concluded that an increase in the unemployment rate can lead to an increase of non-performing loans and thus lowering bank liquidity.
Thus, we can hypothesize the following:
H_1: Unemployment is positively related to the financial distress in Lebanese Alpha banks

2.3.2 Real Interest Rate and Bank Distress

In their study, Sahut & Mili (2009) used macroeconomic variables in their model to predict bank distress. They examined real interest rate growth which could point to the overheating of the economy is overheating and the possibility of an aggravating economic atmosphere shortly. In this

case, as the number of bad loans increases, so does the amount of funds needed to write them off, which in turn threatens the banks and increases their vulnerability. So, we hypothesize the following:

H_2: The real interest rate is positively related to the financial distress in Lebanese Alpha banks

2.3.3 Sovereign Debt Service and Banking Crises

Countries can benefit from borrowing, especially in emerging markets and developing economies (EMDEs) facing consequential development challenges and particularly when employed to finance investments that promote growth in areas such as infrastructure, health care, and education. Temporary government debt accumulation can also be considered appropriate as part of a counter-cyclical fiscal policy to increase demand and activity in economic decline (Koh *et al.*, 2020).

However, particularly for EMDEs, a high risk comes with high debt, since it increases their vulnerability to external blows. High debts threaten a country and make it more vulnerable to economic and financial shocks—including increases in the costs of refinancing—which can lead to financial crises with devastating and lasting detrimental effects on economic activity. Financial crises resulting from rapid debt accumulation have been recurring characteristics of EMDEs over the past fifty years (Koh *et al.*, 2020).

Financial and corporate sectors are in danger of liquidity shocks when funding long-term projects with short-term borrowing as well as currency mismatches caused by the large foreign-denominated debt. This, in turn, establishes the possibility of a twin crisis—currency and banking—if balance sheets deteriorate swiftly with fluctuations in asset prices, including exchange rates (Koh et al., 2020).

For more than 20 years, the Lebanese economy's biggest aggressor has been crippling sovereign debts (Credit Libanais, 2016; BLOMInvest, 2019), as the government was drowning in a heavy public debt burden and recurrent budget deficits (Credit Libanais, 2016). Additionally, the Lebanese banking sector has for long acted as the main support of the Lebanese economy by funding its sovereign debt (Elia, 2020).

Thus, we can hypothesize the following:

H_3: Sovereign debt service is positively related to the financial distress in Lebanese Alpha banks

2.3.4 Government Expenditures and Banking Distress

Elegbe (2013) found that the monetary policy prompted bank failure and that fiscal policy through government expenditure escalated the rate of non-performing loans thus reducing the aggregate economic activity. Also, the period of banking failure thwarted the consistency of economic development. From here we hypothesize the following (Figure 1):

H_4: Government expenditure is positively related to the financial distress in Lebanese Alpha banks

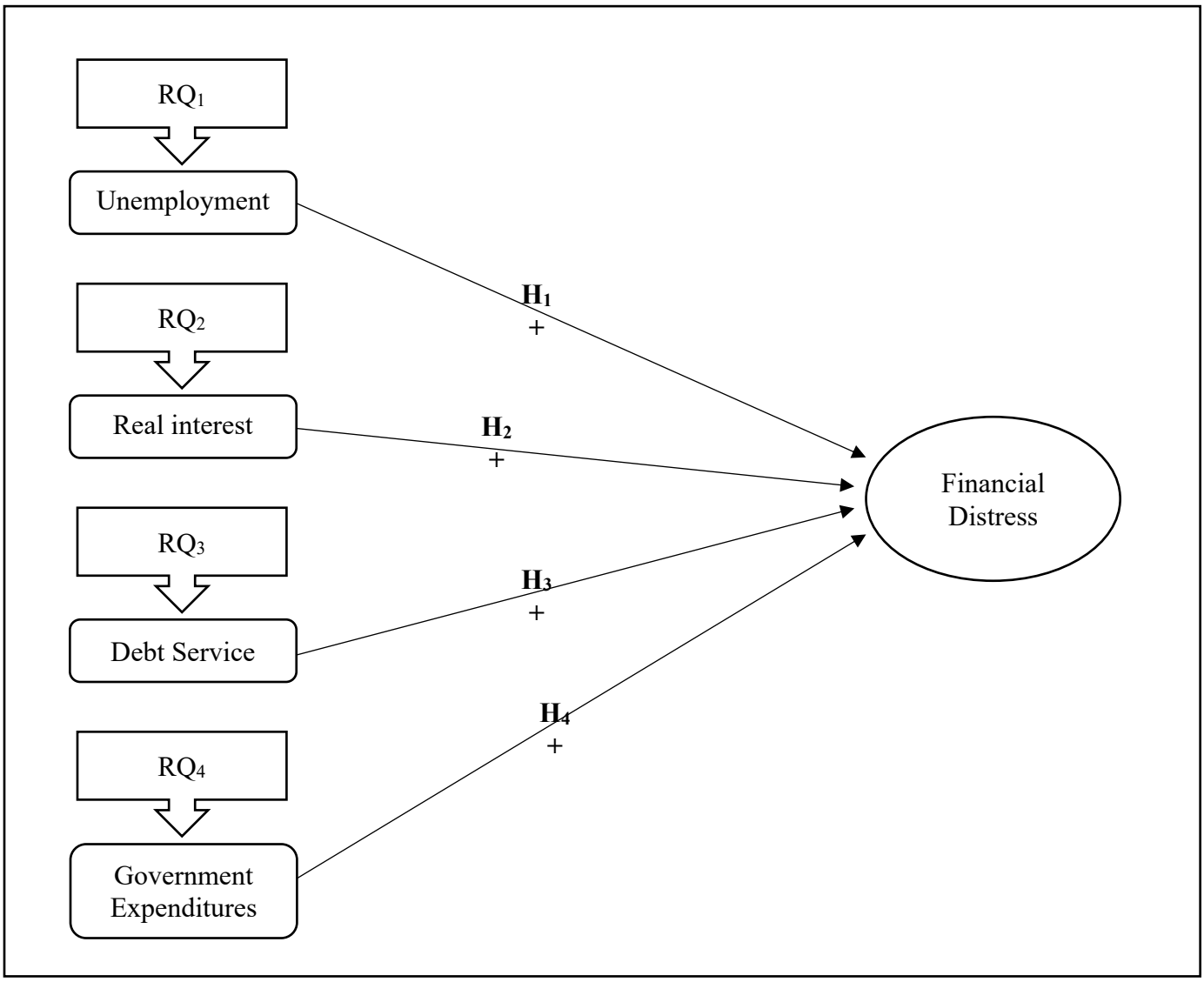

Figure 1: Causal Model

3. RESEARCH METHOD

This research is based on the analytical method. To begin with, the researchers run a regression model to test the relationship between the Log Mean Z"-scores and six Lebanese macroeconomic indicators.

"Insert here table 2"

It is worth it noting that the mean Z"-score is calculated based on the Z"-scores previously gauged for each bank in a previous article for the authors (Elia et al., 2020).
After estimating the model, the results (See Appendix C) showed that out of the six macroeconomic indicators, only debt service (DS) is significant while others are not (Table 1).
Besides, the probability values of both, inflation (IR) and GDP annual growth (GDP AG) are of high values (0.7672 and 0.4761 respectively).

"Insert here table 3"

Therefore, a problem of multicollinearity is suspected in the model. To detect multicollinearity, the researchers run a correlation using all the macroeconomic indicators. Consequently, results show there exists a strong positive correlation between inflation and government expenditures (GE) (0.614019) also a strong positive correlation between GDP annual growth and unemployment (UNE) (0.477047).

"Insert here table 4"

This high multicollinearity was suspected to distort the significance of the model. Thus, to improve the significance of the model, we had to drop the GDP annual growth and the inflation rate.
Therefore, we proceeded to study the impact of the four independent variables (unemployment, real interest rate, debt service, and government expenditure) and the dependent variable (the mean Z"-score).

"Insert here table 6"

The formula for the Multiple Regression Model is defined as:

$$\text{Log } Z'' = A + \beta_1 \text{ DS} + \beta_2 \text{ GE} + \beta_3 \text{ RIR} + \beta_4 \text{ UNE}$$

Where Log Z" is the Log of the mean Z"-scores for the 10 studied Lebanese Alpha banks
DS is the debt service (%)
GE is the government expenditure (%)
RIR is the real interest rate (%)
UNE is the unemployment rate (%)

It is important to note that as the macro variables are measured in percentages, it is convenient to convert the mean Z"-score into Log Z".
Presented the table below are the descriptive analysis of all the variables. This table also shows that all the variables are normally distributed, based on the Jarque-Bera Test and the corresponding p-values that are greater than 5%.

"Insert here table 5"

4. Findings and Discussions

In this section, the results of the tests are analyzed. The tables are shown in Appendix D.

4.1 Regression

The regression results, shown in Table 6 (Appendix D), are interpreted as follows:

4.1.1 Interpretation of the R-square and the Adjusted R-squared

For this model, the R-squared is 86.08% and the adjusted R-squared is 74.94% and both are greater than 60%. This indicates that 86.08% of the variations of the Log mean Z"-score performance can be explained jointly by the independent variables, DS, GE, RIR, and UNE. As a conclusion, the R-squared and adjusted R-squared both show that the developed model is fit.

4.1.2 Interpretation of the Significance of the Individual Independent Variables

The interpretation of the significance of each of the independent variables is based on the t-statistics and the corresponding probability value also presented in Table 6.

For this model, DS, GE, and RIR are all significant as they individually have a probability value of the t-statistics of less than 5%. However, UNE has a *p*-value of 8% which is insignificant based on the 5% confidence level.

Having three significant variables out of four, we can conclude that this model is fit. Hence, the considered macroeconomic variables can influence the mean Z"-score.

4.1.3 Interpretation of the Joint Independent Variables

The significance of the joint independent variables is verified using the F-statistics and its corresponding probability value. The result of the regression model shows an F-statistic value of 7.729453 and a corresponding *p*-value of 0.022789 which is less than 0.05. This means that DS, GE, RIR, and UNE are jointly significant in explaining the mean Z"-score. This result is desirable and the model can be expressed as follows:

$$\text{Log } Z'' = -16.77603 + 0.124341\ DS + 0.134447\ GE + 0.059523\ RIR + 1.399219\ UNE$$

4.2 Residuals

This section interprets the tests of (1) normal distribution, (2) heteroskedasticity, and (3) serial correlation in the residuals.

4.2.1 Normal Distribution

The normal distribution of the residuals is tested as per the null and alternative hypotheses defined hereafter:

H_0: The residuals are normally distributed

H_a: The residuals are not normally distributed

As shown in Figure 2 (Appendix D), the Jarque-Berra value is 1.036508 and the corresponding *p*-value is 59.56%. This value, which is greater than 5%, indicates that the H_0 cannot be rejected meaning that the residuals of the regression model are normally distributed.

4.2.2 Heteroskedasticity

The Breusch-Pagan-Godfrey test is used to verify the heteroskedasticity of the residuals based on the following hypotheses:

H_0: There is no heteroskedasticity in the residuals
H_a: There is a heteroskedasticity in the residuals

According to the results of the Breusch-Pagan-Godfrey test shown in Table 7 (Appendix D), the *p*-value of the observed R-squared is 16.11% which is greater than 5%. This result indicates that the H_0 is accepted and the residuals are homoskedastic.

4.2.3 Serial Correlation

The residuals of the model are also verified for the nonexistence of any serial correlation. For this purpose, the following hypotheses are stated and tested using both the Breusch-Godfrey Serial Correlation LM test and the Variance Inflation Factor (VIF).

H_0: There is no serial correlation in the residuals
H_a: There is serial correlation in the residuals

"Insert here table 8"

Based on the Breusch-Godfrey Serial Correlation LM test presented in Table 8 (Appendix D), the value of the observed R-squared is 2.264720 and the corresponding *p*-value is 0.3223 which is greater than 0.05 meaning that we cannot reject the H_0. Therefore, we conclude that the residuals of the regression model are not serially correlated.

Moreover, the results, shown in Table 9, (Appendix D) indicate that the centered Variance Inflation Factors (VIF) are approximately 1 for all independent variables. Thus, this confirms that the four macroeconomic factors tested in this model do not correlate with each other.

5. CONCLUSION

This study aimed at examining the effect of the macroeconomic variables on the probable financial distress of Lebanese Alpha banks. To begin with, the calculated values for the mean Altman Z"-scores showed that there was a high probability of financial distress. This is consistent with the fact that during the current, drastic financial crisis, Lebanese banks found themselves on the frontline (Elia, 2020).

The regression analysis showed the following developed model:

$$\text{Log } Z'' = -16.77603 + 0.124341\ DS + 0.134447\ GE + 0.059523\ RIR + 1.399219\ UNE$$

The later shows that the debt service (DS), the government expenditures (GE), the real interest rate (RIR), and the unemployment rate (UNE) can explain the financial distress of Lebanese Alpha banks.

Furthermore, the results of this study show that there is a strong positive relationship between debt service and alpha banks' high probability to become distressed. There is a weak negative relationship between unemployment and the mean Z"-scores. There exists a weak positive relationship between the real interest rate and financial distress. Finally, government expenditures were moderately related to the mean Z"-score.

Due to the high deficit and indebtedness of the Lebanese government, it had to borrow heavily through issuing Treasury bonds to meet all its dues and obligations. The main investors in these bonds were Lebanese private banks. This can explain that an increase in debt service leads to an increase in the Z"-score leading to a decrease in financial distress. Hence, there is a positive relationship between debt service and the Altman Z"-scores.

As for unemployment, when it increases, the unemployed lose the source of funds with which they pay their loans. Thus, the default risk for banks increases which harms its financial stability.

Lebanese government expenditure is mainly characterized by spend thrifting, fraud, and theft. This causes a shortage of public finances (deficit). Consequently, this leads to an increase in public debts which are mainly financed by the Lebanese private banks. However, further examination of this variable is requested.

As for the real interest rates, the higher these rates, the less are households and businesses willing to borrow from banks. This has a negative impact on the profitability of banks which leads to a higher probability of financial distress.

6. FUTURE WORK

The researchers recommend that a future study would dig deeper in examining the four stated macroeconomic indicators independently, especially the government expenditures, and to compare them with results from other developing countries. Moreover, the study of the relationship between the Altman Z"-scores of Lebanese banks and the credit ratings defined for them by rating agencies (such as S&P and Moody's) is suggested.

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Appendix A

Mean for the calculated Z"-scores.

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Mean Z"-Score	0.734467	0.958648	1.169231	0.590186	0.471901	0.638149	0.354833	0.664271	0.603369	0.872871

Table 1: Calculated Mean Altman Z"-score

Appendix B

Year	GDP Annual Growth (%)	Inflation Rate (%)	Unemployment rate (%)	Real Interest Rate (%)	Debt Service (%)	Government Expenditure (% GDP)
2009	10.23216	1.195097	6.355000019	-0.649418007	31.54046596	28.78526213
2010	7.975136	3.983479	6.419000149	7.713429522	29.51397316	25.84334288
2011	0.867340	4.971486	6.421999931	4.431035601	32.57262482	26.39701348
2012	2.540542	6.581474	6.434999943	-0.287454011	28.22568036	26.78752562
2013	3.811023	4.821020	6.452000141	4.613391561	26.28981018	26.67535959
2014	2.461361	1.854604	6.395999908	7.116951404	28.16117424	25.92570995
2015	0.211612	-3.749145	6.356999874	3.438827488	28.45020642	22.89294915
2016	1.529520	-0.783360	6.309000015	7.288773638	30.08220361	25.81782204
2017	0.850700	4.321352	6.224999905	5.236714264	31.15145317	25.92835764
2018	-1.926405	6.076989	6.143000126	3.449144697	30.12737533	29.31429015
Links	https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?display=def&locations=LB	https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?display=def&locations=LB	https://data.worldbank.org/indicator/SL.UEM.TOTL.ZS?display=def&locations=LB	https://data.worldbank.org/indicator/FR.INR.RINR?display=def&locations=LB	https://data.worldbank.org/indicator/DT.TDS.DECT.GN.ZS?display=def&locations=LB	https://data.worldbank.org/indicator/GC.XPN.TOTL.GD.ZS?display=def&locations=LB

Source: The World Bank Data (data.worldbank.org/indicator)

	LOGZ"[1]	DS[2]	GDP AG[3]	IR[4]	GE[5]	RIR[6]	UNE[7]
2009	-0.308610	31.54047	10.23216	1.195097	28.78526	-0.649418	6.355000
2010	-0.042231	29.51397	7.975136	3.983479	25.84334	7.713430	6.419000
2011	0.156346	32.57262	0.867340	4.971486	26.39701	4.431036	6.422000
2012	-0.527318	28.22568	2.540542	6.581474	26.78753	-0.287454	6.435000
2013	-0.750986	26.28981	3.811023	4.821020	26.67536	4.613392	6.452000
2014	-0.449183	28.16117	2.461361	1.854604	25.92571	7.116951	6.396000
2015	-1.036108	28.45021	0.211612	-3.749145	22.89295	3.438827	6.357000
2016	-0.409065	30.08220	1.529520	-0.783360	25.81782	7.288774	6.309000
2017	-0.505226	31.15145	0.850700	4.321352	25.92836	5.236714	6.225000
2018	-0.135968	30.12738	-1.926405	6.076989	29.31429	3.449145	6.143000

[1] Log of the mean Altman Z"-score
[2] Debt Service
[3] GDP Annual Growth
[4] Inflation Rate
[5] Government Expenditures
[6] Real Interest Rate
[7] Unemployment Rate

Table 2: All the Data

Appendix C

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-16.50036	8.113011	-2.033814	0.1348
DS	0.130437	0.036943	3.530798	0.0386
GDP AG	-0.008162	0.025190	-0.324001	0.7672
GE	0.107335	0.068665	1.563161	0.2160
IR	0.023547	0.028986	0.812375	0.4761
RIR	0.055648	0.024023	2.316451	0.1034
UNE	1.435645	1.027543	1.397163	0.2568

R-squared	0.904183	Mean dependent var	-0.400835
Adjusted R-squared	0.712550	S.D. dependent var	0.345316
S.E. of regression	0.185139	Akaike info criterion	-0.339393
Sum squared resid	0.102829	Schwarz criterion	-0.127584

Log likelihood	8.696965	Hannan-Quinn criter.	-0.571748
F-statistic	4.718291	Durbin-Watson stat	2.474374
Prob(F-statistic)	0.115351		

Table 3: Regression Model between Log Z" and all the Macroeconomic Indicators

	DS	GDP AG	IR	GE	RIR	UNE
DS	1.000000	0.041374	0.046730	0.284693	-0.098419	-0.375127
GDP AG	0.041374	1.000000	-0.052066	0.208908	-0.188450	**0.477047**
I	0.046730	-0.052066	1.000000	**0.614099**	-0.156606	-0.018672
GE	0.284693	0.208908	0.614099	1.000000	-0.398058	-0.337172
RIR	-0.098419	-0.188450	-0.156606	-0.398058	1.000000	-0.029312
UNE	-0.375127	0.477047	-0.018672	-0.337172	-0.029312	1.000000

Table 4: Pearson Correlation Matrix for all Independent Variables **Appendix D**

	Log Z"	DS	GE	RIR	UNE
Mean	**-0.400835**	29.61150	26.43676	4.235140	6.351300
Median	-0.429124	29.79809	26.16269	4.522213	6.376500
Maximum	0.156346	32.57262	29.31429	7.713429	6.452000
Minimum	-1.036108	26.28981	22.89295	-0.649418	6.143000
Std. Dev.	0.345316	1.878652	1.757228	2.915043	0.099946
Skewness	-0.182396	-0.121782	-0.180888	-0.541289	-1.028544
Kurtosis	2.571730	2.261196	3.329242	2.208519	2.897842
Jarque-Bera	0.131870	0.252148	0.099701	0.749341	1.767519
Probability	0.936192	0.881550	0.951372	0.687516	0.413227
Sum	-4.008349	296.1150	264.3676	42.35140	63.51300
Sum Sq. Dev.	1.073186	31.76399	27.79066	76.47728	0.089902
Observations	10	10	10	10	10

Table 5 : Descriptive Analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-16.77603	4.967069	-3.377450	0.0197
DS	0.124341	0.033677	3.692131	0.0141
GE	0.134447	0.039064	3.441674	0.0184
RIR	0.059523	0.021965	2.709891	0.0423
UNE	1.399219	0.656351	2.131814	0.0862

R-squared	0.860793	Mean dependent var	-0.400835
Adjusted R-squared	0.749428	S.D. dependent var	0.345316
S.E. of regression	0.172855	Akaike info criterion	-0.365872
Sum squared resid	0.149395	Schwarz criterion	-0.214579
Log likelihood	6.829358	Hannan-Quinn criter.	-0.531839
F-statistic	7.729453	Durbin-Watson stat	1.974840
Prob(F-statistic)	0.022789		

Table 6 : Regression Analysis[1]

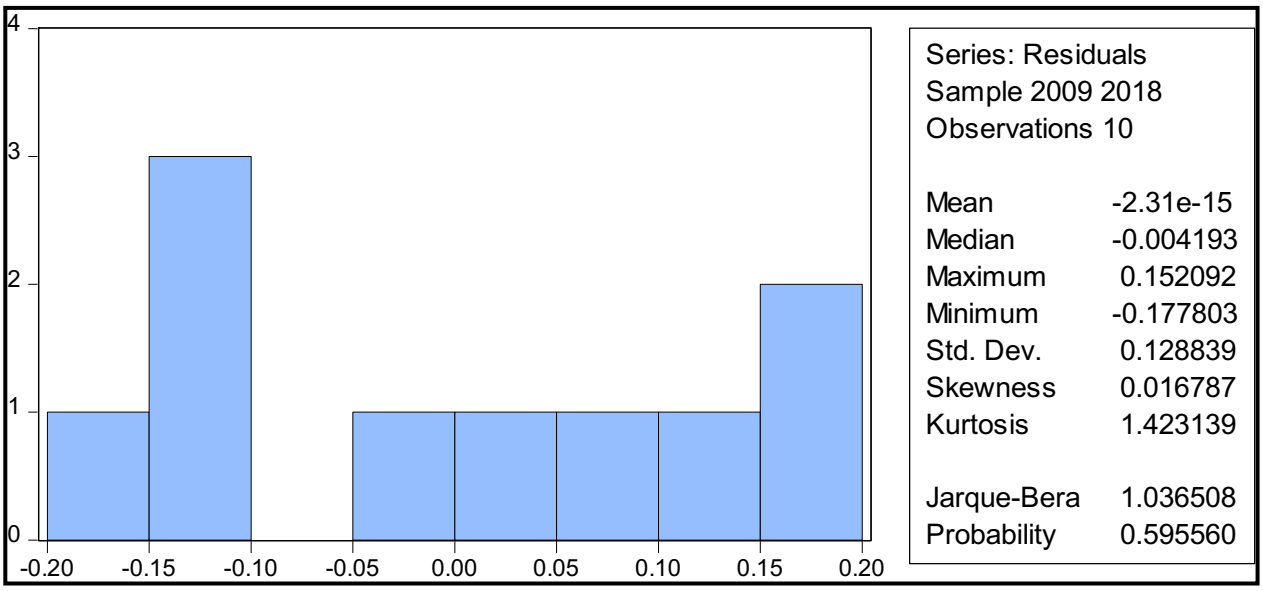

Figure 2: Normal Distribution

F-statistic	2.383169	Prob. F(4,5)	0.1833
Obs*R-squared	6.559477	Prob. Chi-Square(4)	0.1611
Scaled explained SS	0.346946	Prob. Chi-Square(4)	0.9866

[1] Excluding the inflation rate (IR)

Table 7 : Heteroskedasticity Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.439167	Prob. F(2,3)	0.6803
Obs*R-squared	2.264720	Prob. Chi-Square(2)	0.3223

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.233629	6.724710	-0.480858	0.6635
DS	-0.022178	0.048167	-0.460444	0.6765
GE	0.018537	0.049340	0.375705	0.7321
RIR	-0.006714	0.026981	-0.248863	0.8195
UNE	0.538007	0.953127	0.564466	0.6119
RESID(-1)	-0.575832	0.767505	-0.750265	0.5076
RESID(-2)	-0.702108	0.863705	-0.812903	0.4758

R-squared	0.226472	Mean dependent var	-2.31E-15
Adjusted R-squared	-1.320584	S.D. dependent var	0.128839
S.E. of regression	0.196266	Akaike info criterion	-0.222665
Sum squared resid	0.115561	Schwarz criterion	-0.010855
Log likelihood	8.113325	Hannan-Quinn criter.	-0.455020
F-statistic	0.146389	Durbin-Watson stat	1.693698
Prob(F-statistic)	0.976857		

Table 8 : Serial Correlation Lagrange Multiplier Test

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	24.67178	8257.247	NA
DS	0.001134	334.0397	1.205708
GE	0.001526	358.3724	1.419362
RIR	0.000482	4.131217	1.234923
UNE	0.430797	5817.408	1.296216

Table 9 : Multicollinearity Test

	Log Z"	DS	GE	RIR	UNE
Log Z"	1.000000	0.669867	0.540186	0.151692	-0.094190
DS	0.669867	1.000000	0.284693	-0.098419	-0.375126
GE	0.540186	0.284693	1.000000	-0.398058	-0.337172
RIR	0.151692	-0.098419	-0.398058	1.000000	-0.029313
UNE	-0.094190	-0.375126	-0.337172	-0.029313	1.000000