Measuring a Bank's Financial Health: the case of Greek Banking Sector

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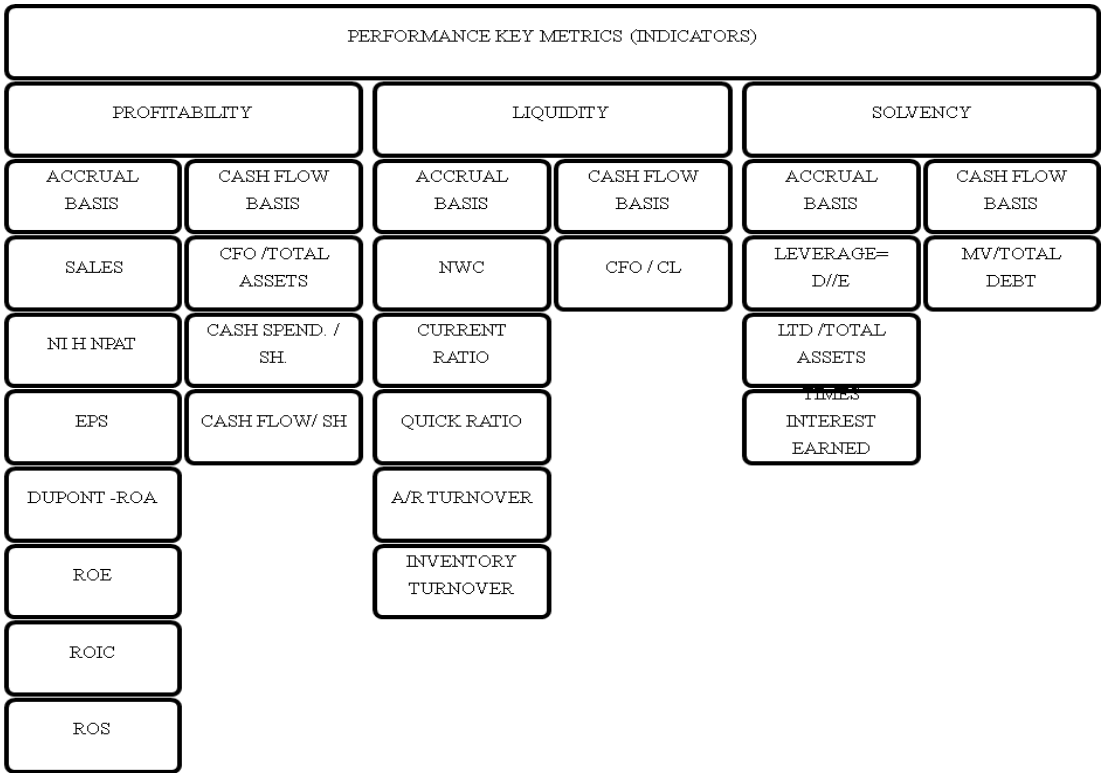
Introduction

Following the surveys of Edward I. Altman (1968, 1973, 1983, 1993, 2000), Edward I. Altman et al. (1977, 1994, 1995), I. Linnell (2001), A. Sironi (2002), Bernd Engelmann, Evelyn Hayden and Dirk Tasche (2003) and T.J. Curry et al.(2008) we develop our model for the the banks financial health.

Our article is organized as follows: In the first part the historical and traditional accounting metrics part are presented ,for the companies and for the banks also. In the second part the Altman Z score methodology and similar investigations in the field of banking sector is described . In the third part the main rating agencies and is discussed the way that they rank the banks are shown . In the fourth part our model is constructed . In the fifth part the data from Greek banking sector and the estimation method are presented. In the seventh part the estimations of our model are given. Finally in the conclusions it is demonstrated that accounting ratios, market and financial market ratios can explain the level of financial strength or health of a bank.

The historical accounting metric components

The historical accounting metric components or accounting ratios or accounting variables are classified into six standard ratio categories including liquidity, profitability leverage, solvency, activity and size. The most commonly used performance key indicators , classified by ratio segment (profitability, liquidity, and solvency) and based on accrual and cash flow accounting method are:



According to the above tree, the leverage is a part of solvency and the activity commonly represented by sales is a part of profitability. The size is represented by total assets. In the literature there are also the value added models. The most common model is called residual income model. The residual income is generally defined as:

$$Residual\ Income(RI) = Income(I) - (Imputed\ Interest(IR) * Investment(INV)$$

$$RI = NOPAT_{acct} - CC_{acct}\ \text{ή}\ RI = NOPAT_{acct} - i_C C_{acct}$$

Where NOPAT is Net Operating Profit After Tax, or operating profit minus the taxes that would be payable without any deduction for interest expense, $CC_{acct}$and C_{acct} are Capital Charge and Accounting Capital correspondently. The capital is the sum of equity book value (E_{bv}) plus debt (D) thus:

$$RI = NOPAT_{acct} - i_C(D + Ebv)$$

The cost of capital or the weighted Average Cost of Capital (WACC) is equal with:

$$WACC\ or\ i_C = i_D(1-\varphi)\frac{D}{D+S} + i_S\frac{S}{D+S}$$

Wherei_D: Average interest rate of debt capital. i_S: Average interest rate of equity capital. D: Debt capital. S : Equity capital. φ : Tax rate.

For any Value Added method there are two calculation methods, the Spread method and the Residual method. According to Spread method the net value added (NVA) defined as total value received (TVR) minus total value paid (TVP). Thus, the $NOPAT$, for RI method, could be written:

$$NOPAT = R * C \; or \; NOPAT = i_R * C \; and \; RI = NOPAT - CC \; thus$$

$$RI = (R - WACC) * C, where \; R = \frac{NOPAT}{C}, or \; RI = (i_R - i_C) * C$$

According to Residual method:

$$RI = NOPAT - CC \; where \; CC = WACC * C \; and \; WACC = \frac{CC}{C} \; or \frac{i_{debt}C_{debt} + i_{equity}C_{equity}}{C_{debt} + C_{equity}}$$

$$RI = NOPAT - \left(i_{debt}C_{debt} + i_{equity}C_{equity} \right)$$

On the Value Added equations based on spread method, the component R approximated could be replaced by ROE, ROC, ROIC, RORAC, RONA, ROGA, CRONA (Stoughton M.N and Zechner J., 2007) taking by this way into account and other information (risk, cash and other).

For the banking industry the most common used ratios per category are:

Size of firm. Total assets

Financial accounting variables. Equity to total assets, Loan-loss reserves to total assets, Loans past-due 90 days to total assets, Nonaccrual loans to total assets, Loan-loss provisions to total assets, Charge-offs to total asset, Annual return-on-assets, Annual return-on-equity, Liquid assets to total assets, deposits to total assets, loan to deposits, spread or margin

Financial market variables. Abnormal or excess quarterly returns Market value of firm to book value of firm, Quarterly turnover of shares.

Supervisory variables. Solvency metrics, capital adequacy, solvency ratio limits, Basel I and II directives and definitions.

Residual income models. Especially for the banks the most famous profitability ratio is Return on Risk Average Capital (RORAC) or from an equivalent way Return on risk weighted assets of the bank which is applied in residual income models for banks. The residual income according to the residual method is equivalent with historical profitability metric which is defined as the movements of equity accounts arising from operational activities.

$$\text{Residual Income} =$$
$$\text{Equity Closing balance} - \text{Equity Opening balance} \pm \text{Share capital increase, decrease}$$
,or
$$Residual\ Income(RI) = Retain\ Earnings \pm increases, decreases\ equity\ reserves$$

According to the spread method of residual income models in the banking industry are calculated and monitored the total or per product the banking spread or margin.

Altman's Z score methodology

The measuring of a company' s financial health according to Altman's Z-score (1968) has been developed in two models. The first model is called specialized model and is used for publicly-traded manufacturing companies. The second is called general model and it is applied for any kind of companies.

The Altman's specialized model

Metric component	Pure ratio X coefficient	Pure ratio mean values of Altman's sampled companies	
		bankrupt	Non bankrupt
1. liquidity metric	$\frac{Working\ Capital}{Total\ Assets} * 1.2$	-0.06	0.41
2. Historical profitability metric	$\frac{Retained\ earnings}{Total\ Assets} * 1.4$	-0.63	0.36
3.Current profitability metric	$\frac{EBIT}{Total\ Assets} * 3.3$	--0.32	0.15
4. Solvency metric	$\frac{Market\ Value}{Total\ Liabilities} * 0.6$ Common and Preferred stock	0.40	2.48
5. Asset turnover metric	$\frac{Sales}{Total\ Assets} * 1.0$	1.50	1.90

The price of Z-score is the sum of five amounts (each pure ratio multiplied by coefficient) i.e. the sum of the values of the last column. The critical values of Z-score are:

Score	Likelihood of failure	Mean Z-score	
… < 1.1	High	bankrupt	-4.06
1.2 < …< 2.5	Possible	Non bankrupt	7.70
2.6 < …	Low		

The Altman's general model

Metric component	Pure ratio X coefficient	Pure ratio mean values of Altman's sampled companies	
		bankrupt	Non bankrupt
1. liquidity metric	$\frac{Working\ Capital}{Total\ Assets} * 6.56$	-0.06	0.41
2. Historical profitability metric	$\frac{Retained\ earnings}{Total\ Assets} * 3.26$	-0.63	0.35
3. Current profitability metric	$\frac{EBIT}{Total\ Assets} * 6.72$	--0.32	0.15
4. Solvency metric	$\frac{Equity}{Total\ Liabilities} * 1.05$	0.49	2.68

The price of Z-score is the sum of five amounts (each pure ratio multiplied by coefficient) i.e. the sum of the values of the last column. The critical values of Z-score are:

Score	Likelihood of failure	Mean Z-score	
… < 1.80	Very high	bankrupt	1.62
1.81 < …< 2.67	High		
		Non bankrupt	4.45
2.68 < …< 2.99	Possible		
3.00 < …	Low		

Bernd Engelmann, Evelyn Hayden and Dirk Tasche.(2003) apply the concepts introduced in the previous sections using a Bundesbank database containing about 325,000 balance sheets for the years 1987–1999. The database includes about 3,000 defaults where default was defined as legal insolvency. To produce rating scores, we applied Altman's Z-score and the score of a logit model that we calibrated on the data from 1987–1993. To be precise, the formula of Altman's Z-score is:

Z-score = 0.717 × working capital/assets + 0.847 × retained earnings/assets + 3.107 × EBIT/assets + 0.420 × net worth/liabilities + 0.998 × sales/assets

While the calibration for the logit model yielded:

Logit score = 5.65 – 0.98 × liabilities/assets – 1.37 × bank debt/assets + 2.42 × cash/current liabilities + 2.08 × cash flow/(liabilities – advances) – 0.81 × current assets/net sales – 1.49 × current liabilities/assets – 5.26 × accounts payable/net assets + 0.19 × net sales/assets + 0.28 × (net sales – material costs)/personnel costs + 8.21 × ordinary business income/assets – 0.17 × net sales/net sales one year ago.

Edward I. Altman, Herbert A. Rijken (2004) formulates two benchmark credit-scoring models: a default-prediction model (DP model) and an agency-rating prediction model (AR model). Both the DP model and AR model employ the same model variables. This allows an unambiguous comparison of the dynamics of AR-scores and DP-scores.

The DP-score (Eq. (2.1)) and the AR-score (Eq. (2.3)) are calculated on the basis of the following set of six model variables:

DP-; AR-score = a + b1WK/TA + b2 RE/TA + b3EBIT/TA + b4 ME/BL + b5 Size+ b6 Age;

where WK is net working capital, RE is retained earnings, TA is total assets, EBIT is earnings before interest and taxes, ME is the market value of equity, and BL is the book value of total liabilities. Size equals total liabilities normalized by the total value of the US equity market (Mkt) and log-transformed: ln(BL/Mkt). Age is the number of years since a firm was first rated by an agency. 11 In order to increase the effectiveness of the RE/TA, EBIT/TA and ME/BL variables in the logit model estimate, these variables are log-transformed as follows: RE/TA--->ln(1-RE/TA), EBIT/TA--->ln(1-EBIT/TA) and ME/BL--->1+ln(ME/BL).

The rating agencies

The financial health of a bank is represented by rating agencies financial strength levels. One practical issue is how we propose to choose between the various ratings assigned to the same counterparty by the different rating agencies. For an example, probably a Bank could be rated A-, A or A+ by FI, S&P and Moody's, respectively. We fixed a table in which we present rating degrees per rating agencies represented and with a common index per level.

Index	Moody's	S&P's	FII
1	Aaa	AAA	A
2	Aa1	AA+	A/B
3	Aa2	AA	B
4	Aa3	AA-	B/C
5	A1	A+	C
6	A2	A	C/D
7	A3	A-	D
8	Baa1	BBB+	D/E
9	Baa2	BBB	E –
10	Baa3	BBB-	-

General according to the rating agencies definitions the above levels represents:

1. Banks with exceptional financial strength. Typically, they will be major institutions with highly valuable and defensible business franchises, strong financial fundamentals, and a very attractive and stable operating environment.

3. Banks with strong intrinsic financial strength. Typically, they will be important institutions with valuable and defensible business franchises, good financial fundamentals, and an attractive and stable operating environment.

5. Banks with good financial strength. Typically, they will be institutions with valuable and defensible business franchises. These banks will demonstrate either acceptable financial fundamentals within a stable operating environment or better than average financial fundamentals with an unstable operating environment.

7. Banks that possess adequate financial strength, but may be limited by one or more of the following factors: a vulnerable or developing business franchise; weak financial fundamentals; or an unstable operating environment.

9. Banks with very weak intrinsic financial strength, requiring periodic outside support or suggesting an eventual need for outside assistance. Such institutions may be limited by one or more of the following factors: a business franchise of questionable value; financial fundamentals that are seriously deficient in one or more respects; or a highly unstable operating environment.

The levels 2, 4, 6,8,10 exist as intermediate levels of above.

From the other hand the credit ratings of Moody's, Standard and Poor's, and Fitch play a key role in the pricing of credit risk and in the delineation of investment strategies. The future role of these agency ratings will be further expanded with the implementation of the Basle II accord, which establishes rating criteria for the capital allocations of banks.

A model for measuring banks financial health

We transpose Altman Z- Score, using and the others mentioned above surveys, for the banking industry. Thus, our model is represented by the following equation:

$$SCORE_{jt} = b_0 + b_1 LM_{jt} + b_2 HPM_{jt} + b_3 CPM_{jt-1} + b_4 SM_{jt} + b_5 ASSETSLN_{jt} + b_6 DEP_{jt} + b_6 BVP_{jt} + b_7 INDEX_t + u_t$$

Where:

$SCORE_j$: *rating of financial strength*, take values from 1 (very good strength) to 10 (bad strength), according to the table mentioned above.

.j= 1…m: for m=11 Greek Banks

.t=2005S1… 2008S2 (semi-annual and annual data), 8 time series data per bank.

.u: stochastic term.

And

Metric component	Pure ratio	Anticipated sign
1. liquidity metric = LM	$\frac{Liquid\ assets}{Total\ Assets}$ Liquid Assets = (Cash and balances with central banks + Treasury bills and other eligible bills +Loans and advances to credit institutions+ Trading securities + Financial instruments at fair value through profit or loss + derivative assets)-(Due to credit institutions – derivative liabilities)	(-)Negative relationship between score and ratio, has as impact stronger bank's financial strength
2. Historical profitability metric = HPM	$\frac{Residual\ Income}{Total\ Assets}$ Residual Income = Equity Closing balance – Equity Opening balance ±Share capital increase / decrease	(+)Positive relationship between score and ratio, decreases bank's financial strength
3.Current profitability metric =CPM (-1)	$\frac{Profit\ after\ taxes}{Total\ Assets}$ A time- lack at the annual data is more suitable for the estimation purposes.	(-)Negative relationship between score and ratio, has as impact stronger bank's financial strength
4. Solvency metric =SM	Capital Adequacy Ratio according to Central Bank Instructions	(-)Negative relationship between score and ratio, has as impact stronger bank's financial strength
5. Asset turnover metric = ASSETSLN	Natural logarithm of total assets of the bank	(-)Negative relationship between score and ratio, has as impact stronger bank's financial strength

6. Leverage - Deposits to total assets = DEP	$\frac{Deposits}{Total\ Assets}$ Deposits = Sight, Saving, Time Deposits or Due to customers	(-)Negative relationship between score and ratio, has as impact stronger bank's financial strength
7. Financial Market Variable = BVP	$\frac{BV}{P} = \frac{book\ Value}{Market\ Value}$	(+)Positive relationship between score and ratio, decreases bank's financial strength
8. Market Variables = index	The Athens Stock exchange index (ASE)	(-)Negative relationship between score and ratio, has as impact stronger bank's financial strength

The data from Greek banking sector and the estimation method

There have been used data for 11 banks from Greek banking sector which arise from annual and semi-annual financial statements starting from 2005 S1 to 2008 S2 i.e. 8 data per bank. Our data is such cross sectional as time series and for this reason the most suitable estimation method is the Panel Least Squares. Exempt from above method are used also and the ML – Ordered Logit (Quadratic Hill Climbing).

The following data are used:

The dependent variable is denoted as SCORE and its values resulting by the index from the part of rating agencies and for each bank correspondently. The rating is biased, especially for the biggest banks, from abroad, which have subsidiaries' banks in Greece, because the rating is applied at group basis. In these cases we have change the values in the dependent variable in order to have a comparative basis. The dependent variable frequencies are:

Dependent Variable: SCORE

Value	Count	Percent	Count	Percent
4	3	3.00	3	3.90
5	16	20.00	19	24.68
6	7	9.00	26	33.77
7	18	23.00	44	57.14
8	3	3.00	47	61.04
9	18	23.00	65	84.42
10	12	15.00	77	100.00

Independent variables are calculated from the published financial data and from the market indexes. In the cases that we did not have data, we calculated these, using

similar ratios for example in the case of solvency metrics we used, at several times, a calculation that integrates the similar ratio equity to assets.

Empirical results

Our data is such cross sectional as time series and for this reason the most suitable estimation method is the Panel Least Squares. Thus the bank financial health is depended by:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	29.56338	3.504393	8.436090	0.0000
LM	1.757074	0.927671	1.894070	0.0625
CPM(-1)	-59.25508	19.94657	-2.970691	0.0041
HPM	46.30144	8.295636	5.581422	0.0000
SM	-32.03276	6.120738	-5.233481	0.0000
DEP	-2.204171	0.916423	-2.405190	0.0189
ASSETSLN	-0.948360	0.172636	-5.493400	0.0000
BVP	0.181123	0.280338	0.646090	0.5204
INDEX	-0.000292	0.000133	-2.189335	0.0320
R-squared	0.775730			
Adjusted R-squared	0.749345			

Except from above method, it is used, also for the estimation and, the ML – Ordered Logit (Quadratic Hill Climbing). The reason for this is that following the above estimation method the interpretation of the model is increased and on the other hand the logistic coefficients are used for easier calculations of a bank financial strength, by multiply coefficients with indexes' values.

	Coefficient	Std. Error	z-Statistic	Prob.
LM	1.540772	2.130815	0.723090	0.4696
CPM(-1)	-229.8313	59.83115	-3.841332	0.0001
HPM	166.5310	31.89421	5.221355	0.0000
SM	-71.13429	17.56209	-4.050445	0.0001
DEP	-5.249632	1.851482	-2.835367	0.0046
ASSETSLN	-2.747423	0.567946	-4.837473	0.0000
BVP	0.443689	0.637313	0.696187	0.4863
INDEX	-0.000866	0.000334	-2.591500	0.0096

Conclusions

The signs of estimations are accorded with anticipated signs from the theory, except for liquidity metrics, that also remains statistically insignificant. The reason for this phenomenon perhaps is that the non-leader banks under government control and the banks early privatized, in the Greek market, have low level of SCORE (high price of index)and they have also high liquidity.. The coefficients are significant, except for liquidity and financial market variable (book value to price). The interpretation of our model remains at a high level 78%, if we also take into account , that the data which are used are (panel) both cross sectional and time series.

Our model could be used for calculation of a bank's financial health and incorporates in addition to accounting metrics, others too, like market and financial markets rates. It could also be used as a monitoring system for a dynamic measuring of financial strength in the banking industry. In the future the use; of more IFRS accounting and financial data, more rating reports, and quality data for corporate governance of the banks, in our model, will permit more accurate estimations.

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