DETERMINANTS OF CAPITAL ADEQUACY RATIO: AN EMPIRICAL STUDY ON EGYPTIAN BANKS

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Abstract

Capital adequacy rules are safety valve for regulators and banks' clients/shareholders to reduce expected risks faced by commercial banks especially for cross border transactions as these rules are applied compulsory by all banks internationally. Applying these rules will achieve rational management and governance. This paper examines explanatory victors that influence capital adequacy ratio (CAR) in the Egyptian commercial banks. The study covers 36 banks during the period from 2004-2013. We examined the relationship between CAR as dependent variable and the following independent variables: earning assets ratio, profitability, and liquidity, Loan loss provision as measure of credit risk, net interest margin growth, size, loans assets ratio and deposits assets ratio. Furthermore, we investigate determinants of CAR before and after the 2007- 2008 international financial crises. Results vary according to the period understudy. For the whole period 2003 to 2013 results show that liquidity, size and management quality are the most significant variables. Before the period 2008 results show that asset quality, size and profitability are the most significant variables. After the period 2009 results show that asset quality, size, liquidity, management quality and credit risk are the most significant variable that explain the variance of Egyptian banks' CAR.

Keywords: Capital Adequacy Ratio (CAR); Commercial Banks; Risk Based Capital; Basel (I) & (II); Egypt; Financial Crisis

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1. Introduction

The international financial community is very keen to apply recent regulations related to capital adequacy to reduce risk exposure for cross border and local transactions. The Egyptian Central Bank is applying capital adequacy rules according to Basel accord (II & III). These rules helped to reform the banking system and assured banks' ability to manage assets and liabilities against perceived risks.

This paper aims to determine factors that explain the CAR variance in the Egyptian commercial banks in order to identify decisions that increase or decrease the quality of capital management.

Research is divided into six sections. The introduction will followed by section two, theoretical and empirical background. Section three will display hypotheses development. Section four will highlight research methodology. Section five will demonstrate empirical analysis. Finally, section **six** will illustrate results and future research.

2. Theoretical and Empirical Background

The literature related to capital adequacy ratios and regulations are very comprehensive and divided into two mean streams of studies.

Stream one includes research focused on assessing the validity of applying capital adequacy and Basel accord regulations on banks' decisions to manage risks [Bailey (2005); Bank of International Settlement BIS (2009); Rose and Hudgins (2008) and Federal Reserve Bank (2003)].

According to Basel (II) CAR is calculated using two main items: core capital and supplementary capital. Both should be added together and divided by risk weighted assets (RWA) and contingent liabilities.

$$\text{CAR} = \frac{Core\ Capital\ (tire\ 1) + Supplemantary\ capital\ (tire\ 2)\ \times 100}{RWA} \quad (1)$$

Core capital [Tier (I)]: Is the core measure of a bank's financial strength and includes paid in capital (common shares and preferred stock), disclosed capital reserves, net income for the year and innovative capital instruments. Aspal et al., (2014) p. 33.

Supplementary capital [Tier (II)]: Measures banks' financial strength with regard to the second most reliable forms of financial capital from the regulator's point of view. It includes assets revaluation reserves, undisclosed reserves, general provisions, general loan loss reserves, long-term holding of

equity securities, hybrid capital instruments and subordinated long term debts. Aspal et al., (2014) p. 34.

The sum of core capital and supplementary capital should not be less than 8% as a percentage of total assets plus off balance sheet risk weighted assets. The Egyptian Central Bank increased this ratio to 10%. In addition, the supplementary capital should not exceed 10% of the core capital. It worth mentioning that CAR includes three important types of risks included in the RWA as expressed by Federal Reserve Bank (2003) and Hasan (2003), credit risk, market risk and operational risk as these are considered as the three pillars for CAR.

A quite number of researches were conducted to examine the impact of applying Basel I & II regulations on bank' decision behaviour. Some authors support the applications of these rules such as Joosen (2002) who studied the impact of applying Basel (II) Accord on Netherland and European banks. The study stressed on the positive side of applying these rules to protect depositors and to avoid banks' solvency risk. Also, Girardone et al., (2004) examined the impact of capital adequacy rules on the economics of banks and Estrella et al., (2000) on predicating banks' failure. Samara and Nikaido (2007) analyzed expected challenges and issues which faced Indian banks when applying Basel (II) rules. One of the most important results of this study was that applying Basel (II) helped in enhancing CAR, on average, up to 12% compared to the international percentage (8%) and the Indian Federal Reserve Bank ratio (9%).

On the other hand, Karacadug and Taylor (2000) focused on identifying restrictions imposed on banks by applying CAR. Meanwhile, Chami and Cosimano (2003) found that applying these rules may increase banks' cost of funds, decrease their profitability, and limit banks' ability of lending.

The second stream of research was directed to develop models and to examine variables and factors that influence CAR in commercial banks. Also, this stream considered the link between the Central Bank's supervisory rules and commercial banks decision behaviour. We will focus on this stream on our paper.

A group of academics Jackson et al. (1999) conducted a study through Basel committee which is affiliated with Bank for International Settlements (BIS) to test the impact of applying Basel regulations on the fixed capital percentage (8%) as minimum requirements by banks. They examined the impact of Basel rules on limiting banks' competitiveness or ability to provide credit. Results were not decisive to judge the impact of Basel (II) committee decisions on banks' ability to grand loans. Bertraned (2000) focused on testing Swiss banks reaction to Basel rules and restrictions. He developed a model to analyze and adjust capital and financial policies in order to keep the minimum required capital. Results showed that regulations pressure encourage Swiss banks to increase capital and have no impact on the level of risks for banks' polices. The study examined the following factors:

- Bank's total size: measured by total assets.
- Bank's profitability: measured by return on assets.
- Credit risk: measured by loans portfolio lose rate.
- CAR: measured by the percentage of capital to risk weights assets, at least 8%.

The study found that there is a positive statistical significant relationship between ROA and CAR. Swiss banks increased their capital to avoid any plenty for violating rules by the Central Bank and the impact of applying the CAR rules on Swiss banks were less compared to English and American banks.

Another study conducted by Bouri and Ban Hamida (2006) to examine the impact of CAR and Basel (II) rules on Tunisian banks. Findings were very positive as banks were very keen to apply capital adequacy rules and to manage risks that threaten banks' decisions. Authors used a number of factors that affect CAR and tested by previous studies: bank's size, credit risk, equity/total loans, Loan Loss Provisions (LLP)/total deposits and bank's risks measurements. However, Rojas-Suarez (2002) examined the impact of applying of CAR and rules in six emerging markets using the following variables:

- Change of banks' share market value.
- Net income to total operating profits ratio.
- Operating cost to total assets ratio.
- Liquidity ratios.
- Interest rate for bank's deposits.

One of the major criticisms raised by the study was that in emerging markets owners/shareholders, most likely, can raise capital by issuing financial instruments with low quality and high degree of risk, relative to primary capital, to achieve the required adequacy in short time. The study recommended number of preventive measures to support Basel accord rules such as: to apply deposit insurance scheme, to limit banks' ability from having liquidity from Central banks, encourage banks to issue long term deposit certificates and the disclosure of information that affects banks' quality. Also, Diamond and Rajan (2000) stressed the importance of applying deposit insurance system to support capital adequacy control rules.

Estrella et al., (2002) examined the relationship between CAR and the probability of banks' losses. They recommend simplifying the required standards to measure CAR in two ratios only: (a)leverage ratio measured by primary capital/total assets and (b)capital to operating revenue ratio=primary capital/interest & commissions received. Results showed the possibility of using those two ratios to predict banks' loss with the same quality by using CAR rules.

In Indonesia, Yudistira (2003) focused on examining the impact of CAR requirements on banks decision behaviour and proved a significant decrease

in loans granted by banks to achieve Basel (II) requirements. In Spain, Barrios and Blanco (2003) focused to answer the following question: Is bank's capital adequacy affected by market conditions or by capital adequacy rules imposed by regulatory agencies? They developed two models one for banks that did not influenced by capital adequacy rules and one related to banks which influenced by these rules. A number of variables that affected banks' capital have been used such as: size, liquidity, operating cost variance, and return on assets, liquidity and credit risk. The study major contribution was that capital adequacy requirements are better influenced by market factors rather than capital adequacy rules imposed by regulatory authorities.

As for the relationship between bank's capital and risk, Altunbas et al., (2007) examined this relationship in European banks. They found a positive relationship between risk and bank's efficiency. This result was explained as European banks are holding a large size of capital, exceed the minimum required, and in the same time invest their funds in less risky assets. The analysis showed a positive relationship between the degree of risk and the required level of capital and liquidity ratios. This result could interpret the reason for the attention of the regulators to increase bank's capital and liquidity to limit bank's ability to allocate funds in investments with high risks. In addition, it proved that the financial strengths for corporations which borrow loans from the banks, have a positive impact in reducing risks faced by banks, probability of default and a positive impact towards increasing CAR levels.

The following variables used to develop a statistical model to test the relationship between bank's risks and capital adequacy.

- Doubtful loans provisions.
- Equity to total assets ratio.
- Net Loans/ Total assets ratio.
- Size: Log total assets.
- Return on assets.
- Liquidity ratio.

A number of other studies focused on identifying determinants of CAR in Germany such as Kleff and Weber (2004); Stolz and Wedow (2005). Authors found a significant positive relationship between risky assets and the change of CAR especially for banks with high capital adequacy. Meanwhile, there was a negative correlation with banks' having law adequacy. In addition, there is a positive correlation between bank's profitability and CAR, a significant positive correlation between clients' deposits and CAR and a negative correlation between banks' size and CAR.

Evidence from Portuguese banks was introduced by Boucinha and Ribeiro (2007) found that larger banks hold less excess capital than small banks and banks with higher risk lend to hold higher capital reserves. Also, they found that the more banks were exposed to securities portfolio in capital markets the more they increase their capital to achieve the required adequacy. In addition, banks with high risk assets are holding high reserves in their capital components. The study confirmed that banks with large size keep law capital as there is a negative relationship with CAR as they can generate funds at law cost and less risk through external sources of finance, deposits, and in the time they preserve required CAR. If banks keep high ratio of primary capital relative to equity this contributes in reducing the need to increase capital reserves to maintain CAR at the required level.

In an emerging market setting, recent study conducted by Bateni et al., (2014) examined the relationship between seven financial factors and CAR in Iranian private banks during the period 2006-2012. The study showed a negative relationship between size and CAR, a positive relationship with: loans assets ratio LAR, ROE, ROA and CAR. In addition, deposits assets ratio DAR and risk assets ratio were not having impact on CAR. In Nigeria, Olalekan and Adeyinko (2013) studied the impact of CAR on profitability. The results revealed that there is a significant positive relationship between capital adequacy and banks' profitability. Also Ogere et al., (2013) examined CAR variance in Nigeria money deposits banks. They found that changes in CAR were explained by a negative relationship between risk ratios, deposits to total assets ratio and CAR.

There are many internal financial indicators have an influence on banks' capital adequacy rules introduced by central banks particularly with reference to size, earning assets, liquidity, loan loss provision loan loss provision LLP, ROA, net interest margin growth NIM. Our study will add evidence to the effect of Egyptian commercial banks risky financial decisions on CAR.

In India, Aspal et al., (2014) reported that CAR is negatively related to loan assets ratio LAR, assets quality and management efficiency. Moreover, liquidity and sensitivity were positively related to CAR. The study showed that the Indian private sectors banks maintain a higher level of capital requirements than required by Reserve Bank of India.

Recent study by Shingjergji and Hyseni (2015) showed that ROA and ROE are not correlated with CAR, meanwhile, size, nonperforming loans NPL, loans to deposits ratio LTD and equity multiplier EM have a negative and significant impact on CAR. An empirical study by Ozili (2015) investigated the relationship between bank profitability and Basel capital regulations. He found that bank capital adequacy is observed to be a significant determinant of bank profitability.

Polat and Al-Kalaf (2014) studied the determinants of CAR in the banking system of Kingdom of Saudi Arabia during the period from 2008 to 2012. They found that all the independent variable were significant with CAR except nonperforming loans. Loans to assets ratio was negatively significant but size and leverage were

positively significant. Loans to deposits ratio was negatively significant and ROA was positively significant with CAR.

A few numbers of researches were directed to study determinants of CAR in Islamic banks. Abusharaba, et al., (2013) examined the CAR in Indonesia and used the same independent variables used by other researchers. Results showed that ROA and Liquidity were positively related to CAR. Nonperforming loans was significant and negatively correlated to CAR. Indonesian Islamic banks are having excessive liquidity to meet their liabilities and to protect shareholders. On the other hand, Abdul Karim et al., (2013) conducted a research to examine capital adequacy, lending and deposit behaviours of conventional and Islamic banks. The study findings reported that there was a positive relationship between CAR and deposits and loans growth in both Islamic and conventional banks.

According to Romdhane et al., (2012) the main determinants of CAR in developed countries are the same for developed ones. They analyzed determinants of CAR in Tunisia. The study found that the interest margin and risk affect strongly the capital ratio.

On the other hand, Atici and Gursoy (2013) applied the same determinants of CAR on the Turkish banking system. Findings provided evidence that Turkish banks employ the capital buffering approach proposed under Basel (III) as an effective management tool. Capital buffer is mainly related to nonperforming loans, loans growth, loans to assets ratio and profitability. Also, Asarkaya and Ozcan (2007) analyzed determinants of CAR in Turkish banks. Findings pointed out that lagged capital, portfolio risk, economic growth, ROE, average capital level were positively correlated with CAR. On the other hand, deposits to assets ratio was negatively correlated with CAR.

Al-Tamimi and Obeidat (2013) studied the important factors that determinate the CAR in Jordan listed commercial banks. Results showed a significant positive correlation between CAR and Liquidity risk, RAO and a negative, but not significant, relationship with credit risk.

A study conducted by Rahari (2014) found that Indonesian state-owned banks CAR is affected by total assets growth, equity to total assets ratio, nonperforming loans, interest rate risk and operational cost and revenue ratios.

3. Hypothesis Development

Prior literature shows that there are significant correlations between the independent variables and CAR. We preliminarily examine the significance and direction of the correlation between the independent variables and CAR in Egyptian commercial banks. Accordingly, the first hypothesis can be stated as:

H1: "There is a significant correlation between CAR as a dependent variable and the study's independent variables".

As the expected impact for each individual independent variable on CAR will vary, bivariate correlation, all these variables jointly may have the same impact in explaining the capital adequacy variance. Thus, the second hypothesis can be stated as:

H2: "All the independent variables, jointly, have equal relative impact on the banks' CAR".

The global banking system has been affected significantly by the financial crisis that hit banks in the late 2007. Kosak, M. et al., (2015) assessed the performance of banks during the financial crisis. They found that the existence of high quality funding strategy, tier 1 bank capital and retail deposits were very important for continuous bank lending during the financial crisis. The study suggested that in crisis period the high quality bank capital is a competitive strength. . Moreover, Nilsson, et al., (2014) examines the Swedish bank capital adequacy before and after 2007 financial crisis. They found that banks have been forced to made noticeable changes to their capital structure to achieve financial stability. Swedish banks set capital ratios above the regulations after the financial crisis. Berger and Bouwman (2013) examined the impact of banks' capital on performance across banking crises. They found that capital help small banks to increase their market share and profitability. In addition, capital enhances the performance of large banks during banking crises.

Consequently, it is important to examine the determinants of CAR variance of Egyptian commercial banks before the financial boom and after the financial crisis period. We aim to evaluate the significant difference of CAR determinants before and after the financial crisis. Thus, the third hypothesis can be stated as:

H_3: There is no statistical significant difference between determinants of CAR before and after the financial crisis; year 2008.

4. Methodology

This section will shed the light on the research methodology in addition; we will develop the research model that will be tested in the following section.

4.1 The Research Sample

We used a financial data gathered from annual financial statements through Bank-Scope database. We have a population of 40 commercial operating banks in Egypt. We conducted our empirical analysis

on 33 banks represent 83% of operating commercial banks in Egypt during the interim period from 2003 till 2013. The sample includes all commercial banks operating in the Egypt and divided into three major groups: Group (A): Local Egyptian Banks count for 23 bank, Group (B): International Bank count for 6 banks. Group (C): Islamic Banks locally or regionally count for 4 banks.

4.2 Statistical Model

The aim of this study is to investigate the influential factors of Egyptian commercial banks' capital adequacy ratio. We selected the independent variables that could explain the CAR variance according to literature review findings. Capital adequacy ratio of commercial banks operating in Egypt is a function of Liquidity, asset management quality, loans to assets ratio, earning quality, credit risk and size. The following equation addresses the relationship between the independent variables and CAR.

$$CAR_{it} = \alpha + \beta_1 (\text{Earning assets/T. Assets}_{it}) + \beta_2 (\text{Securities/Assets}_{it}) + \beta_3 (\text{Loans/Assets}_{it}) + \beta_4 (\text{Loans Loss Reserves/Assets}_{it}) + \beta_5 (\text{Provisions/Loans}_{it}) + \beta_6 (\text{Loans/Deposits } i, t) + \beta_7 (\text{ROA}_{it}) + \beta_8 (\text{ROE}_{it}) + \beta_9 (\Delta \text{ NII}_{it}) + \beta_{10} (\text{lOG\_Assets}_{it}) + \varepsilon_i +$$

$i=1,\ldots 8 \quad t=1,..9$

Where, α is a constant, (β_1: β_{10}) are the parameters for the explanatory variables. The subscript (i) refers to the bank number and the subscript (t) denotes the time period. (ε_i) is the unobservable individual heterogeneity, and v_{it} is the remainder disturbance of the usual disturbance in the regression model that varies with individual units and time. Variables are used in the analysis are summarised in table (1) as follows:

Table 1. Variables Definitions

Dependent Variable	
Capital Adequacy Ratio (CAR)	$\text{CAR} = \frac{Primary\ Capital + Sublmintary\ Capital}{Risk\ Weighted\ Assets} \times 100$ (Tier 1 + Tier 2) / Risky weighted assets
Independent Variables	
Assets Management Quality	$\text{AMQ} = \frac{Earning\ assets}{Total\ assets} \times 100$ Earning assets= Balances with central bank and other banks + TB's + treasury bonds + securities portfolio +Loans portfolio
Liquidity	$L1 = \frac{Net\ Client\ Loans}{Clients' Deposits\ \&\ Short\ term\ funds} \times 100$ $L2 = \frac{Securities}{Average\ Total\ Assets} \times 100$
Credit Risk (CR)	$= \frac{Loan\ \ Provision}{Total\ Loans} \times 100$ $= \frac{Loan\ Loss\ Reserves}{Total\ Loans} \times 100$
Profitability	$\text{ROA} = \frac{Net\ Income\ after\ Tax}{Total\ Assets} \times 100$ $\text{ROE} = \frac{Net\ Income\ after\ Tax}{Total\ Assets} \times 100$
Size (Total assets)	Log total assets
Net Interest Income Growth	NIIG = Change (Interest Received – Interest Expenses)
Management Quality (MQ)	$\text{LAR} = \frac{Total\ Loans}{Total\ Assets} \times 100$

5. Empirical Analysis

5.1 Descriptive Statistics

Table 2. Variables descriptive statistics

	Minimum	Maximum	Mean	Median	Skewness	kurtosis	SD	Jarque-Bera
Dependent Variable								
Capital Adequacy	.0000	.6062	.16982	0.1433	1.3601	2.656	.10323	214,381
Independent Variables								
Earning assets/Total Assets	.0493	1.5130	.8432	0.8772	-1.5465	7.295	.1489	924.05
Securities/ Assets	.0029	2.1107	.2690	0.2472	-1.553-	28.378	.1813	12443.03
Loans/ Assets	.0181	1.2310	.4672	0.4450	3.192	1.618	.1940	81.91329
Loans Loss Reserves/Assets	.0059	3.1111	.1605	0.0989	.858	68.207	.2400	71110.01
Provisions/Loans	.0083	22.6111	.9256	0.610	6.707	100.792	1.6158	153949
Loans/Deposits	.0203	17.2667	.8872	0.5118	8.690	37.358	1.8101	22574.77
Return on Assets	.0000	.0545	.0110	.0089	5.858	3.192	.01034	206.817
Return on Equity	.0000	1.3942	.1238	0.0963	-.987-	11.901	.1374	2333.773
Δ Net Interest Income	.0000	26.2496	.41117	0.1480	-2.064-	148.395	1.5759	325085
LOG Assets	3.2759	5.5598	4.1880	4.171	9.439	.007	.4768	10.68
Observations	363	363	363	363	363	363	363	363

Table (2) illustrates the descriptive statistics of the study variables. The observed calculated descriptive statistics consists of minimum, maximum, standard deviation, skewness and kurtosis. As seen from the tables above all the variables are asymmetrical. Especially skewness is positive for Loans to assets, loans loss reserves to total assets, provisions to loans, loans to deposits, return on assets and log assets. While earning to total assets, securities to assets, return on equity and change in net interest income have a negative skewness.

Kurtosis value of all variables also indicates data is not normally distributed because values of kurtosis are deviated from 3. The measure of Jarque-Bera statistics and corresponding p-values are used to test for the normality assumption. Based on the Jarque-Bera statistics and p-value this assumption is rejected at 5% level of significance for variables.

Table 3. Pearson's Correlations Matrix between Capital Adequacy Ratio and Independent Variables

	CAR	EAR /TA	Secu./ Assets	Loans/ Assets	Res. / Assets	Prov/ Loans	Loans / Deposits	ROA	ROE	Δ NII	Size
CAR	1										
EAR/TA	.191**	1									
Secc/TA	-.063-	.127*	1								
Loans/TA	.258**	.475**	-.325-**	1							
Res/TA	-.067-	-.308-**	-.003-	-.224-**	1						
Pro/Loans	-.153-**	-.377-**	-.038-	-.209-**	.832**	1					
Loa/Depo	.363**	.141**	-.286-**	.599**	-.083-	-.112-*	1				
ROA	.257**	.168**	-.010-	.147**	-.232-**	-.191-**	.357**	1			
ROE	-.194-**	-.100-	-.027-	-.127-*	-.224-**	-.145-**	-.055-	.579**	1		
Δ NII	-.034-	-.049-	-.011-	-.036-	.064	.074	-.020-	-.075-	-.059-	1	
Size	-.489-**	-.130-*	.218**	-.251-**	-.206-**	-.125-*	-.188-**	-.021-	.241**	.067	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

From the table above it is obvious that most of the independent variables have either a significant positive or negative relationship with the capital adequacy ratio except securities to total assets, reserves to total assets variable and the change in net interest income.

Earning to total assets, loans to total assets, loans to deposits and return on assets have a significant positive relationship with the capital adequacy at significant level .01

Provisions to total loans, return on equity and log assets variable have a significant negative relationship with the capital adequacy ratio at a significant level 0.01.

Securities to total assets, reserves to total assets and the change in net interest income have a negative relationship with the capital adequacy ratio but not significant.

Therefore, according to the correlation analysis results we can partially accept the first hypothesis as

most of the independent variables are significantly correlated with the leverage ratios except securities to total assets, reserves to total assets and the change in net interest income. Accordingly we will accept the hypothesis sating that:

"There is a significant correlation between CAR as a dependent variable and the study's independent variables"

Testing the second hypothesis

H2: "All the independent variables, jointly, have equal relative impact on the banks' CAR".

We conducted a panel regression model to explore determinates of the capital adequacy ratio. Panel data involves the pooling of observations on a cross-section of variables over several time periods (2003 till 2013). This approach is useful as the several data points, degree of freedom is increased and collinearity among the explanatory variables is reduced, thus improving the quality of results, Abor (2008; p.13). We used the statistical package for social science version (22) along with Eviews software version (8) to carry out the analysis.

Table (4) reports the multiple regression analysis statistical results and the model's goodness of fit statistics. Three models are developed to test the second and third hypothesis. To test the second hypothesis we conducted the regression analysis for the whole period 2003 to 2013.

Some variables were not normally distributed. Several trails of data transfer were performed, as explained by Field (2005; p.72), depending on the level of Skewness and Kurtosis using log, inverse or square root techniques in order to achieve normality. All the variables Kurtosis below the upper threshold of 3.29 will be accepted with large observations and samples.

5.2 Analysis Output

Table 4. Multiple regression analysis results (2003 to 2013)

Independent Variables	Beta	t	Sig.	Collinearity Statistics	
				Tolerance	VIF
Constant	0.572	10.010	***.000		
Earning Assets / Total Assets	.002	.037	.970	.552	1.813
Securities/ Total Assets	.083	1.679	.094*	.754	1.326
Net Loans / Total Assets	-.043-	-.638-	.524	.394	2.538
Loans Loss Reserves /Total Loans	.057	.687	.493	.269	3.716
Provisions/ Total Loans	-.213-	-2.618-	.009***	.276	3.625
Loans / Deposits	.250	4.076	.000***	.485	2.062
Return on Assets	.201	2.601	.010	.306	3.265
Return on Equity	-.114-	-1.580-	.115	.352	2.843
Change in net interest income	-.007-	-.173-	.863	.985	1.016
Log Assets (Asset Size)	-.454-	-9.499-	.000***	.799	1.251
Goodness of Fit Statistics					
R^2			0.357		
Adjusted R^2			0.339		
F-equation			19.581		
Prob (F-statistics)			0.000****		

*** Significant at 0.01, ** significant at 0.05, * significant at 0.10

As for multi collineariaty the variables coefficient did not face this problem as the variance inflation factor (VIF) was less than 5 for all variables and you can detect multi collineariaty if the largest VIF is greater than 10, then there is cause for concern. Hair, et al., (2006) highlighted that a maximum acceptable VIF value would be 10, anything higher would indicate a problem with multi collineariaty.

The multiple regression analysis reports the following results:

– *Earning Assets to Total Assets* ratio: is not significantly correlated with the capital adequacy ratio, this means the portfolio mix of commercial Egyptian banks allocated between commercial loans, retail or even securities either traded or not traded is not affecting the capital adequacy ratio of Egyptian banks. We can interpret this conclusion to the fact that capital adequacy requirements for the Egyptian banks are better influenced by capital adequacy rules imposed by international regulatory authorities and Local regulatory authority rather than market factors.

– *Securities to Total Assets* is significantly correlated positively with the capital adequacy ratio and this result due to the fact that a considerable portion of the Egyptian banks portfolios are invested in the stock market and since the stock market in Egypt is one of the emerging market characterized by the high volatility so we can expect that Egyptian banks are cautious and reflecting this in calculating the capital adequacy ratio and also previous research

reported positive correlation between securities to total assets as a proxy to the measurement of liquidity and capital adequacy ratio.

- *Net loans to Total Assets* is not significantly correlated with the capital adequacy ratio. The net loans to total assets is a proxy to see if the banks is well operated and has a considerable market share in the credit market compared to other banks and has no impact on the capital adequacy ratio. Egyptian bank are concern to meet the capital adequacy ratio as per the Central Bank of Egypt regulation. And this justify why the relation between net loans to total assets ratio is not significant.
- *A loans loss reserve to total assets* is not significantly correlated to the capital adequacy ratio. Egyptian banks building reserves as a part of equity part in order to meet the nonperforming loans only and are not considering reserves for loans losses when they are justifying the capital adequacy ratio according to the regulations of Central Bank of Egypt.
- *Provisions to Loans* is significantly correlated positively with the capital adequacy ratio as long as Egyptian banks increasing provision to meet the unexpected percentage in nonperforming loans they have to consider provisions when calculating the capital adequacy ratio since the main target is of capital requirement is a cushion against unexpected loss. Of course this explains why provision to loans has a significant relation with the capital adequacy ratio.
- *Loans to deposits* ratio is significantly correlated positively with the capital adequacy ratio and this is supported by previous research as well (altunbas et al., 2007, Bateni et al., 2014) As long as Egyptian banks increase this ratio which into turn should be reflected in the increase of the capital adequacy ratio in order to secure banks against unexpected loss.
- *Return on assets* is significantly correlated positively with the capital adequacy ratio. As the return on assets for Egyptian banks increase due to the increase in the portfolio of loans and assets banks have to increase the capital adequacy ratio to match the associated risk. Increase of return on assets is mainly due to the increase in credit portfolio.
- *Return on equity:* the change in net interest income is not significantly but correlated negatively with the capital adequacy ratio.
- *Log assets as a proxy to measure the size of the bank* is significantly correlated negatively with the capital adequacy ratio as long as the as large banks keep capital at low level as they have long term deposits to finance risky assets.

Therefore, according to the correlation regression analysis results we can reject the second hypothesis as not all of the independent variables jointly have equal relative impact on the banks CAR. Accordingly we will reject the second hypothesis.

Testing the third hypothesis: "There is no statistical significant difference between determinants of CAR before and after the financial crisis; year 2008".

We conducted the multiple regression analysis for the period 2003 to 2007 and then for the period 2009 to 2013. We report the following results.

Table 5. Multiple regression analysis results (before and after financial crisis)

Independent Variables	Before Year 2008			After Year 2008		
	Beta	t	Sig.	Beta	t	Sig.
Constant	0.584	6.673	.000***	0.577	6.767	.000***
Earning Assets / Total Assets	-.204-	-2.073-	.040**	.217	2.924	.004***
Securities/ Total Assets	.094	1.249	.214	-.043-	-.507-	.613
Net Loans / Total Assets	.111	1.139	.256	-.292-	-2.480-	.014**
Loans Loss Reserves /Total Loans	.206	1.458	.147	-.243-	-2.908-	.004***
Provisions/ Total Loans	-.392-	-2.908-	.004***	.050	.604	.547
Loans / Deposits	.141	1.585	.115	.233	2.361	.019**
Return on Assets	.502	4.078	.000***	-.070-	-.640-	.523
Return on Equity	-.383-	-3.276-	.001***	.172	1.637	.104
Change in net interest income	.018	.302	.763	-.040-	-.620-	.536
Log Assets (Asset Size)	-.375-	-5.388-	.000***	-.593-	-8.577-	.000***
Goodness of Fit Statistics						
R^2	0.482			0.386		
Adjusted R^2	0.448			0.346		
F-equation	14.316			9.661		
Prob (F-statistics)	0.000			0.000		

*** Significant at 0.01, ** significant at 0.05, * significant at 0.10

The multiple regression analysis reports the following before and after financial crisis.

- *Earning Assets to Total Assets*: the regression equation shows that it is significantly correlated negatively with the capital adequacy ratio before the crisis and is significantly correlated positively with the capital adequacy ratio after the crisis.

- *Securities to Total Assets*: is not significantly correlated positively with the capital adequacy ratio before the crisis and is not significantly correlated negatively with the capital adequacy ratio after the crisis.
- *Net loans to Total Assets:* is not significantly correlated positively with the capital adequacy ratio before and after the crisis.
- *A Loans loss reserves to Total assets:* is not significantly correlated positively to the capital adequacy ratio before the crisis. *but* is significantly correlated negatively to the capital adequacy ratio after the crisis
- *Provisions to Loans:* is a significantly correlated negatively with the capital adequacy ratio before the crisis and is not significantly correlated positively with the capital adequacy ratio after the crisis.
- *Loans to deposits:* has is not significantly correlated positively with the capital adequacy ratio before and after the crisis.
- *Return on assets:* is significantly correlated positively with the capital adequacy ratio before the crisis and is not significantly correlated positively with the capital adequacy ratio after the crisis.

Return on equity: is significantly correlated negatively with the capital adequacy ratio before the crisis and is not significantly correlated negatively with the capital adequacy ratio after the crisis.

- *The change in net interest income*: is not significantly correlated positively with the capital adequacy ratio before and after the crisis.
- *Log assets as a proxy to measure the size of the bank*: is significantly correlated negatively with the capital adequacy ratio before and after the crisis.

According the to the multiple regression analysis output we can reject the third hypothesis stating that "There is no statistical significant difference between determinants of CAR before and after the financial crisis; year 2008". Since the number of independent variable affecting the capital adequacy ratio before year 2008 -the year of financial crisis- are different than the number of independent variables affecting the capital adequacy ratio after year 2008.

The following table reports only the main independent variables affecting the capital adequacy ratio of Egyptian banks for the three models as follows.

Table 9. Results summary

Independent Variables	2003 to 2013		Before 2008		After 2008	
	Beta	Sig.	Beta	Sig.	Beta	Sig.
Constant	0.572	***.000	0.584	.000	0.577	.000
Earning Assets/ Total Assets	Non	Non	-.204-	.040	.217	.004
Securities/ Total Assets	.083	*.094	Non	Non	Non	Non
Provisions/ Total Loans	-.213-	***.009	-.392-	0.004	Non	Non
Loans / Deposits	.250	***.000	Non	Non	.233	0.019
Return on Assets	.201	***.010	.502	0.000	Non	Non
Log Assets (Asset Size)	-.454-	***.000	-.375-	***.000	-.593-	***.000
Net Loans to total Assets	Non	Non	Non	Non	-.292-	0.014
Loans Loss Reserves / Total Loans	Non	Non	Non	Non	-.243-	0.004
Return on Equity	Non	Non	-.383-	0.001	Non	Non
Goodness of Fit Statistics						
R^2	0.357		0.482		0.386	
Adjusted R^2	0.339		0.448		0.346	
F-equation	19.581		14.316		9.661	
Prob (F-statistics)	****0.000		0.000		0.000	

*** Significant at 0.01, ** significant at 0.05, * significant at 0.10

6. Conclusions

The aim of this paper was to investigate the determinants of capital adequacy ratio on commercial banks operate in Egypt such as: Asset quality, size, liquidity, profitability, and risk and management quality. To test such relation we used multiple regression analysis. The results showed the following conclusions:

- *During the interim period from 2003 to 2013: profitability* has no impact the capital adequacy ratio except return on assets is significantly correlated positively on the capital adequacy ratio. *Assets quality* represented in earning assets to total assets measure is not correlated to the capital adequacy ratio. Liquidity represented in loans to deposits and securities to total assets is significantly correlated positively with the capital adequacy ratio. Management quality

represented in total loans to total assets measure is significantly correlated positively with the capital adequacy ratio. Size of the bank represented in the log of total assets is significantly correlated negatively on the capital adequacy ratio. Risk represented in provisions and loans loss reserves to total loans ratios showed that provision to total loans is significantly correlated negatively to the capital adequacy ratio and loans loss reserves has no relation to the capital adequacy ratio.

- *Before year 2008 (which is the year of financial **crisis)*.** Size of the bank and Risk showed the same results as for the whole period under analysis from 2003 to 2013. Assets quality showed different results since it is significantly correlated negatively with the capital adequacy ratio. Management quality results showed no relation with the capital adequacy ratio. Liquidity has no impact on the capital adequacy ratio. In terms of profitability angle return on assets is significantly correlated positively with the capital adequacy ratio and return on equity is significantly correlated negatively with the capital adequacy ratio and the change in net interest income has no impact.
- After year 2008 to 2013. Profitability showed no impact on the capital adequacy ratio. Liquidity represented only in loans to deposits is significantly correlated positively to the capital adequacy ratio. Asset quality is significantly correlated positively to the capital adequacy ratio. Size of the bank is significantly correlated negatively to the capital adequacy ratio. Risk represented only in loans loss reserves ratio is significantly correlated with the capital adequacy ratio. Management Quality represented in total loans to total assets is significantly correlated positively to the capital adequacy ratio.

We can attribute these results to the fact that after the financial crisis and the failure of many banks worldwide Egyptian banks started to look carefully to loans portfolios and be more strict in providing loans to customer not only that but the portfolio mix for Egyptian banks of industrial loans, retail and securities have been change dramatically to see that retail loans and securities in some banks represent the high portions of Egyptian banks portfolios compared to the portfolio mix in the past years not only that but Egyptian banks started to be more cautious in building reserves and this justify the fact to see Loans Loss Reserves to total loans is significantly correlated negatively to the capital adequacy ratio. Also, earning assets to total assets appears to have an impact with the capital adequacy ratio. So after financial crisis Egyptian banks are more concerned to the loans quality, credit risk.

There is a high need to apply the same study on different banks classification operates in Egypt for example on International commercial banks, Islamic Banks and Egyptian local commercial banks. Also we need to consider other variables in the analysis and to consider the market and operation risk when measuring the capital adequacy ratio.

References

1. Abdul Karim, M., Hassan, M. K. and Hassan, T. (2013). Capital adequacy and lending and deposit behaviours of conventional and Islamic banks, Pacific-Basin Finance Journal, 28, 58-75.
2. Abor, J. (2008), Determinants of Capital Structure of Ghanaian Firms, African Economic Research Consortium, AERC research paper 176.
3. Abusharaba, M. T., Triyuwono, I., Ismail, M. and Rahman, A. F. (2013). Determinants of capital adequacy ratio (CAR) in Indonesian Islamic commercial banks, Global Review of Accounting and Finance, 4 (1), 139-170.
4. Al-Tamimi, K. A. M. and Obeidat, S. F. (2013). Determinants of capital adequacy in commercial banks of Jordan an empirical study, International Journal of Academic Research in Economics and Management Science, 2 (4), 44-57.
5. Altunbas,Y., Carbo, S., Gardener, E. P. M. and Molyneux, P. (2007). Examining the relationships between capital, risk and efficiency in European banking, European Financial Management, 13 (1), 49–70
6. Asarkaya, Y., and Ozcan, S. (2007). Determinants of capital structure in financial institutions: the case of Turkey, Journal of BRSA and Financial Markets, 1 (1), 91-109.
7. Aspal, P. K. and Nazneem, A. (2014). An empirical analysis of capital adequacy in the Indian private sector banks, American Journal of Research Communication, 2 (11), 28-42.
8. Atici, G. and Gursoy, G. (2013). The determinants of capital buffer in the Turkish banking system, International Business research, 6 (1), 224-234.
9. Bailey, R. (2005). Basel II and development countries: understanding the implications, London School of Economics, Working Paper, no. 05-71, 1-27.
10. Bank of International Settlement (BIS) (2009) History of the Basel committee and its membership, Basel Committee on Banking Supervision. Available at http://www.bis.org. https://www.bis.org/publ/bcbsc101.pdf. [Accessed 26 November 2014].
11. Barrios, V. and Blanco, J. M. (2003). The effectiveness of capital adequacy requirements: a theoretical and empirical approach, Journal of Banking and Finance, 27, 1935-1958.
12. Bateni, L., Vakiliford, H. and Asghari, F. (2014). The influential factors on capital adequacy ratio in Iranian banks, International Journal of Economics and Finance, 6 (11), 108-116.
13. Berger, A. N. and Bouwman, H. S. (2013). How does capital affect bank performance during financial crises?, Journal of Financial Economics, 109 (1), 146-176.
14. Bertrand, R. (2000). Capital requirements and bank behavior: empirical evidence for Switzerland, Swiss National Bank, Banking Studies Section, 1-23.

15. Boucinha, M. and Riberiro, N. (2007). The determinants of Portuguese banks' capital buffers, Financial Stability Reports, Banco Portugal, 153-164.
16. Bouri, A. and Ban Hamida, A. (2006). Capital and risk taking of banks under regulation: a simultaneous equations approach in the Tunisian context, Proposition for the sixth international congress of AFFI: Corporate finance and market finance, what complementarities?.
17. Chami, R. and Cosimano, T. F. (2003). The nature of capital adequacy constraints under the Basel Accord, September. Available at SSRN: http://ssrn.com/abstract=456981 or DOI: 10.2139/ssrn.456981. [Accessed 12 December 2014].
18. Diamond, D. W. and Rajan, G. R. (2000). A theory of bank capital, Journal of Finance, 55 (6), 2431-2465.
19. Estrella, A. , Park, S. , and Peristiani, S. (2000). Capital ratios as predictors of bank failure, FRBNY Economic Policy Review, 6 (2), 33-52.
20. Federal Reserve Bank (2003). Capital standards for banks: the evolving of Basel Accord, Federal Reserve Bulletin, September, 395-405.
21. Field, A. (2005), Discovering Statistics Using SPSS, 2nd edition, London, SAGE Publications.
22. Girardone, C., Molyneux, P., and Gardener, E. P. M. (2004). Analyzing the determinants of bank efficiency: the case of Italian banks, Applied Economics, 36 (3), 215-227.
23. Grier, W. A. (2012). Credit analysis of financial institutions, 3rd edition, London, Euromoney Books.
24. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E. and Tatham, R. L. (2006). Multivariate Data Analysis, 6th edition, Person Prentice Hall.
25. Hasan, M. (2003). The significance of Basel 1 and Basel 2 for the future of the banking industry with special emphasis on credit information, a paper presented at the Credit Information Alliance Regional Meeting, Amman, 3-4 April.
26. Jackson, P. D. , Fufine, C., Groeneveld, H., Hancock, D., Jones, D., Perraudin, W., Radeci, L. and Yoneyama, M. (1999). Capital requirements and bank behavior: the impact of the Basle Accord, Bank of International Settlements, Basel Committee on Banking Supervision, Working Paper, no. 1, April.
27. Joosen, B. P. M. (2002), Solvency and capital adequacy regulations for banks in the Netherlands, International Financial Law Review, 21 (4), 17-20.
28. Karacadug, C. and Taylor, M. W. (2000). The new capital adequacy framework: institutional constraints and incentive structures, International Monetary Fund, Working Paper, no.39.
29. Kleff, V. and Weber, M. (2008), How do banks determine capital? Evidence from Germany, German Economic Review, 9 (3), 354-372.
30. Kosak, M., Li, S., Loncarski, I. and Marinc, M. (2015). Quality of bank capital and bank lending behavior during the global financial crisis, International Review of Financial Analysis, 37, 168-183.
31. Nilssona, V., Nordströmb, J. and Bredmar, K. (2014). Need for liquidity and the capital structure of Swedish banks following the financial crisis, International Journal of Finance and Banking Studies, 3 (2), 10-27.
32. Ogere, A. G., Peter, Z. and Inyang, E. E. (2013). Capital adequacy ratio and banking risks in the Nigeria money deposits banks, Research Journal of Finance and Accounting, 4 (17), 17-25.
33. Olalekan, A. and Adeyinka, S. (2013). Capital adequacy and banks profitability: an empirical evidence from Nigeria, American International Journal of Contemporary Research, 3 (10), 87-93.
34. Ozili, P. (2015). Determinants of bank profitability and Basel capital regulation: empirical evidence from Nigeria, Munich Personal RePEc Archive, Paper no. 61069. Available at http://mpra.ub.uni-muenchen.de/6109/ [Accessed 20/1/2015].
35. Polat, A. and Al-Khalaf, H. (2014). What determines capital adequacy in the banking system of Kingdom of Saudi Arabia? a panel data analysis of Tadawal Banks, Journal of Applied Finance and Banking, 4 (5), 27-43.
36. Raharjo, P. G., Hakim, D. B., Manurung, A. H. and Maulana, T. N. A. (2014). Determinants of capital ratio: a panel data analysis on state-owned banks in Indonesia, Buletin Ekonomi Moneter Jan Perbankan, 16 (4), 395-414.
37. Rojas-Suarez, L. (2002), Can international capital standards strengthen banks in emerging markets?, Institute for International Economics, Working Paper. Available at http://www.iie.com/publications/wp/01-10.pdf. [Accessed 12 December 2014].
38. Romdhane, M. (2012). The determinants of bank' capital ratio in developing countries: empirical evidence from Tunisia, Research Journal of Finance and Accounting, 3 (1), 35-46.
39. Rose, P. and Hudgins, S. C. (2008). Bank management and financial services, 7 edition, McGraw-Hill.
40. Sarma, M. and Nikaido, Y. (2007). Capital adequacy regime in India, an overview, Indian Council for Research on International Economics Relations, Working Paper, no 196.
41. Shingjergii, A. and Hyseni, M. (2015). The determinants of capital adequacy ratio in Albanian banking system during 2007-2014, International Journal of Economics, Commerce and Management, 3(1), 1-10.
42. Stolz, S. and Wedow, M. (2005), Banks' regulatory capital buffer and the business cycle: evidence for German savings and cooperative banks, Discussion Paper Series 2: Banking and Financial Studies, No. 7/2005, Deutsche BundesBank Research Center, 1-42.
43. Yudistira, D. (2003), The impact of bank capital requirements in Indonesia, May, Paper provided by EconWPA in its series Finance, number 0212002. Available at URL: http://128.118.178.162/eps/fin/papers/0212/0212002.pdf. [Accessed 12 December 2014].