

Is capital conservation buffer or regulatory leverage better at improving bank efficiency? The case of an emerging market

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Abstract

Purpose – This paper is motivated by the heated debates preceding the introduction of additional regulatory requirements of Basel III on capital conservation buffer (CCB) and regulatory leverage (RLEV) in banks of emerging markets. The paper aims to examine which policy ratio can improve bank efficiency (BE), in one of the most resilient banking settings in the Middle East and North Africa (MENA) region.

Design/methodology/approach – The analysis is performed on a sample of 13 banks for the period 2010–2018 in Egypt and proceeds in two steps. In the first step, the data envelopment analysis model is used to derive bank-specific efficiency scores. In the second step, BE scores are regressed on the two types of regulatory capital and a set of control variables.

Findings – The paper is motivated by regulatory debates on the viability of RLEV and CCB in enhancing BE. The results show that higher RLEV and CCB are associated with a reduction in BE and that RLEV is highly associated with BE compared to CCB. Hence, results are relevant to policymakers in designing measures for improving BE in emerging markets.

Originality/value – The findings contribute to a small but growing stream of research on capital adequacy in emerging markets. This study provides results on the viability of risk-based vs non-risk-based capital requirements. The findings are also relevant to bank regulators in similar emerging market settings in their efforts to introduce and phase in minimum leverage requirements according to Basel III.

Keywords Emerging markets, Bank efficiency, Capital conservation buffer, Regulatory leverage

Paper type Research paper



1. Introduction

Banks play a vital intermediation function by keeping savings of depositors and financing businesses. Therefore, customers, regulators, investors and the general public are interested in bank performance. The assessment of bank performance can be done through financial ratios, artificial intelligence and operational research (Fethi and Pasiouras, 2010). A significant measure of bank performance has been cost efficiency, a bank's ability to operate at a lower cost in comparison with a bank's best practice. Measuring the cost efficiency and the other factors that have an impact on cost efficiency has been mentioned to improve the performance of banks (Shamshur and Weill, 2019). Additionally, bank efficiency (BE) is essential for economic growth (Kaur and Kaur, 2010). Furthermore, cost efficiency is similar in banks of the Middle East and North Africa (MENA) region and developing economies, whereas it is slightly lower than the cost efficiency of European banks (Olson and Zoubi, 2011).

Bank regulators have been undertaking diligent efforts to mitigate bank failure and improve the resilience of the banking system by ensuring that banks maintain capital above the required thresholds (Abou-El-Sood, 2016). The banking regulators continuously introduce micro- and macro-prudential regulations to enhance the stability of the banking sectors (Acharya and Thakor, 2016). The micro-prudential regulations may include rules organizing minimum thresholds of capital adequacy ratios and liquidity coverage ratios, whereas the macro-prudential regulations comprise rules maintaining capital conservation buffers (CCB), countercyclical buffers and leverage ratios (Krug *et al.*, 2015). There is an argument regarding the appropriate level of a capital buffer to maintain resilience in the financial system, which represents its ability to resist the incurred losses (Bui *et al.*, 2017).

Regulators require banks to maintain sufficient capital, reduce moral hazard and absorb losses. Therefore, a high capital buffer can enhance financial stability and improve cost efficiency by reducing agency costs between debtholders and shareholders (Pessarossi and Weill, 2015). Additionally, more stringent capital regulation is positively associated with BE (Barth *et al.*, 2013). However, a stricter restriction can result in increasing bank inefficiency (Sassi, 2013).

Capital requirements can influence BE through:

- the sources of funding that can be used by banks;
- the amount as well as the quality of lending; and
- the diversification of assets portfolios (Pasiouras *et al.*, 2009).

Thus, the capital adequacy ratio is negatively associated with the costs of financial intermediation and the bank's risk-taking. Hence, decreasing the bank's risk-taking can enhance financial stability. Furthermore, the reduction of costs of financial intermediation can support economic growth (Sirait and Rokhim, 2019).

The Basel I and II regulatory frameworks had some inadequacies during the 2007 global financial crisis. For this reason, Basel III was introduced to improve banks' absorption of credit losses, enhance banks' efficiency and increase financial stability [1]. Consequently, banks are required to maintain extra capital buffers beyond the minimum capital ratios required under Basel II, including CCB to help banks face credit losses and a regulatory leverage (RLEV) ratio to mitigate manipulations of risk weights used in the calculation of capital ratios. During the financial crisis period, leverage ratios have been considered important predictors of bank performance because of the following reasons:

- Policymakers have viewed the high level of leverage drove a small amount of initial sub-prime loan loss into the worst financial crisis.

- G20 and Basel committee have proposed introducing a leverage ratio to complement the existing risk-based capital requirements (Chen, 2013).

The question of whether keeping these minimum ratios enhances/hinders the efficiency of bank operations remains empirically uninvestigated.

Motivated by the heated debates upon the introduction of Basel III additional regulatory requirements, this paper investigates whether CCB or RLEV is better at improving BE in the banking sector in an emerging market setting. For a sample of publicly traded and state-owned banks in Egypt during the period 2010–2018, we investigate the association between regulatory measures of leverage and conservation buffer, on the one hand, and BE, on the other hand. Financial markets of the MENA region rely largely on bank financing, corporate state-ownership and oil exports (Haque and Brown, 2017). Recently, banking sectors have witnessed several transformations in the MENA region. A sound banking system can provide economic and political growth (Olson and Zoubi, 2011). Egypt represents a crucial emerging market, where the banking sector owns a large number of financial assets compared to other financial institutions. Thus, it is considered as a setting dominated by financial institutions (Mohieldin *et al.*, 2019). We choose Egypt to be our case of emerging markets, as Egypt is considered one of the most resilient economies compared to other emerging markets, which survived the global financial crisis and a massive political/economic distress [2]. Additionally, in the Bloomberg 2019 report, Egypt is the only country from the MENA region in the top ten list of biggest economies by 2030 and its banking sector was one of the most resilient in the region, able to face the negative consequences of the 2007 global financial crisis [3]. This is in addition to the continued stability of the economic situation after the political and economic turmoil of 2011–2013 and the rich data it provides us to investigate [4]. Therefore, Egypt is a very central country in MENA and its growth is vital not only for Egypt but also for other countries in the region.

Our paper contributes to the small but growing accounting and finance literature on banking regulations in several ways. First, to the best of the authors' knowledge, this is the first study that uses CCB and RLEV proxies to test the association between regulatory capital ratios and BE. The CCB is based on risk-weighted calculations, whereas RLEV is a non-risk-based capital ratio. Second, we compare the "strength of association" of the two types of capital with BE. This is motivated by the fact that the CCB is a risk-based measure of regulatory capital whereas RLEV is not, which could be important for their effects on BE. Third, several studies (Staub *et al.*, 2010; Poshakwale and Qian, 2011; Mohieldin and Nasr, 2007; Partovi and Matousek, 2019) have mixed results on the viability of state-ownership. Consequently, the findings of this paper contribute to the debate on whether state-ownership may enhance/hamper the financial conditions of banks. Finally, we examine whether the economic/political turmoil affects the association in an interesting market setting, because of events unfolding during 2011–2013. Our findings are also relevant to bank regulators and policymakers, in similar emerging market settings in their efforts, to introduce and phase in minimum leverage requirements according to Basel III and to equally improve banks' efficiency for the economic growth of emerging markets, as they emphasize on banks' risk-taking mitigation.

The remainder of the paper is organized as follows. Section 2 presents the background on bank capital regulations in Egypt. Section 3 reviews the related literature and develops hypotheses. Section 4 presents the sample and data. Section 5 outlines the research design. Section 6 discusses the results. Finally, Section 7 concludes and lays down some recommendations.

2. Background

2.1 Reform program in the Egyptian banking sector

In 2004, the Central Bank of Egypt (CBE) established the banking reform unit, including a restructuring plan for improving the banking sector, which helps at achieving economic growth. This plan has been implemented from 2004 and continued to 2008 [5]. At the start of 2009, the CBE began its second wave of the reform program to be continued at the end of March 2012, which comprises several main pillars as follows:

- implementation and supervision of a comprehensive financial and operational restructuring plan of the three specialized state-owned banks;
- periodic follow-up to the results of the first wave of the restructuring program for the state-owned commercial banks (Banque Du Caire, Banque Misr and National Bank of Egypt), to ensure their sustainable improvements of efficiency in risk management and financial intermediation;
- implementation of an initiative to provide bank services and activities, especially for small and medium-sized enterprises;
- implementation of Corporate Governance regulations; and
- implementation of the Basel II accord in the banking sector in Egypt [6].

Thus, the banking sector in Egypt applied Pillar 1 of Basel II regulations, starting from December 2012 and June 2013 based on the end of each bank financial year [7].

2.2 Capital conservation buffer

The CCB aims at maintaining capital buffers to face losses when incurred. Banks' ability for capital distribution might be reduced, as many banks made capital distribution (e.g. dividends) although their capital levels were deteriorating during the financial crisis (Kim, 2016) [8]. The difference between the minimum capital requirements and the capital buffer is that the former should be maintained by the bank under any situation, whereas the latter represents the amount above the minimum capital requirements (Moudud-Ul-Huq, 2019). Moreover, the difference between CCB and the minimum capital requirements extends to the penalty imposed by policy regulators, if the bank failed to maintain either of these ratios. If the bank breaches the required minimum capital, the regulatory policies will impose restrictions in its operations, distributions and, in some cases, the bank will be closed if it is considered critically low in the capital. Meanwhile, if the bank does not maintain the CCB, the supervisory action will only be imposed on the bank's earnings distributions (Occhino, 2018).

CBE regulation, issued on 18 December 2012, required banks under their supervision to maintain at least 10% of total regulatory capital started from December 2012 and June 2013 based on the end of each bank financial year [9]. Additionally, CBE issued regulations, concerning the implementation of the CCB on 7 April 2016, to maintain the strength of the capital requirements and absorb the potential losses that may occur during stress or financial crisis periods for banks operating in Egypt. Therefore, banks are required to gradually implement the CCB starting 2016 until reaching 2.5% in 2019. Banks are also required to maintain at least 4.5% of common equity Tier 1 divided by risk-weighted assets (RWA) and at least 6% of Tier 1 capital divided by RWA [10].

2.3 Regulatory leverage

The Basel committee, under Basel III, introduces the RLEV to supplement risk-based capital ratios. It can save the financial system of the banking sector from damaging the whole

economy, through the application of a simple, transparent and non-risk-based leverage ratio, as another safeguard measure against risks [11]. This simpler leverage ratio uses total assets rather than RWA. Moreover, it takes into account both the on-balance sheet and off-balance sheet items. It also considers assets with zero risk-weights (Allahrakha *et al.*, 2018). The RLEV ensures the adequacy of Tier 1 capital relative to the total assets. In Egypt, banks are required to maintain a minimum of 3% RLEV started from December 2015 and continued to 2017, which is tracked by the CBE during this period and this ratio became obligatory in 2018 according to the CBE regulations (as of 7 July 2015) [12].

3. Related literature and hypotheses development

3.1 Capital conservation buffer and bank efficiency

The soundness of the banking system plays an important role in the economy, as it does not only provide credit supply but also enhances the stability of the economy. For this reason, regulators require banks to maintain a sufficient amount of capital, reduce moral hazard and absorb losses. Higher capital buffer can enhance financial stability and improve cost efficiency by reducing agency costs between debtholders and shareholders (Pessarossi and Weill, 2015). These results are also consistent with the evidence that banks which maintain a high capital are more efficient than banks with less capital, which reflects that well-capitalized banks have a high level of performance than banks with low capital levels (Kwan and Eisenbeis, 1997). Therefore, more stringent capital regulation is positively associated with BE (Barth *et al.*, 2013).

Bank regulations represent a set of rules that monitor bank's behavior, whereas bank supervision represents the oversight of the degree of compliance of banks to those set of rules. Capital requirements and the official supervisory power are positively associated with BE. Thus, increasing capital requirements and official supervisory power can improve bank performance and reduce financial distress (Chortareas *et al.*, 2012). The three pillars of Basel II are examined with each of profit and cost efficiency. The findings reveal that stricter capital requirements enhance cost efficiency by reducing the probability of financial distress, resulting in a reduction of cost associated with the activities of risk management. In contrast, stricter capital requirements reduce profit efficiency by moving toward high liquid assets and lower return assets. However, the other two pillars of Basel II, market discipline mechanisms and official supervisory power, increase both profit and cost efficiency. Furthermore, restrictions on bank activities increase (decrease) profit (cost) efficiency (Pasiouras *et al.*, 2009).

Excessive banking regulations may hamper the economic growth, as it may increase the cost of intermediation, limit the ability of banks to expand credit and decrease the profitability of banks (Ben Naceur and Kandil, 2009). This supports the evidence that capital adequacy ratios are positively associated with the cost of financial intermediation. As a result, increasing the cost of financial intermediation may decrease the number of loans demanded by borrowers that can harm the economic output. However, capital adequacy ratios are negatively associated with bank risk-taking, which enhances financial stability. This is consistent with the objectives of Basel III as the quality and the quantity of the required bank capital improved according to it (Rahman *et al.*, 2018). Accordingly, we conjecture the first hypothesis as follows:

- H1. Capital conservation buffer ratio in one year is negatively associated with bank efficiency in the subsequent year.

3.2 Regulatory leverage and bank efficiency

Evidence from prior literature suggests that risk and non-risk-based capital ratios are positively associated with efficiency and profitability. Additionally, non-risk-based capital

ratios are negatively associated with bank risk. However, there is no association between risk-based capital ratios and bank risk. This might be because of the doubt in the validity of the methodologies used for calculating the risk weights (Bitar *et al.*, 2018). The RLEV ratio is not associated with BE and risk in large banks. Meanwhile, there is a negative association between RLEV and bank risk in small banks. Additionally, there is a positive association between RLEV and profit efficiency in small banks. Therefore, RLEV can enhance profit efficiency and stability in small banks (Lee and Chih, 2013). Furthermore, higher capital thresholds, measured by the capital to assets ratio, increase technical and allocative efficiency (Partovi and Matousek, 2019).

Barth and Miller (2018) show benefits and costs that may result from increasing the RLEV from 4% to 15%. They show that the benefits of increasing RLEV exceed its cost. Benefits can result from decreasing the probability of banking distress. Meanwhile, raising leverage increases equity cost which banks tend to shift on borrowers and, consequently, decreases the gross domestic product. Additionally, Rahman *et al.* (2018) indicate that capital adequacy ratios are positively associated with the cost of financial intermediation. One of the proxies of capital adequacy ratios is equity to total assets ratio. As a result, increasing the cost of financial intermediation may decrease the number of loans demanded by borrowers and, hence, this can harm the economic output. Thus, we conjecture the second hypothesis as follows:

- H2. Regulatory leverage in one year is negatively associated with bank efficiency in the subsequent year.

4. Sample and data

The population includes 38 banks registered at the CBE [13] from which the following are excluded: three specialized banks, three Islamic banks, eight banks with data in-availability, four banks with reports in foreign currencies, and seven unlisted, small, or medium-sized banks. The final sample consists of 13 banks over the period 2010–2018 in Egypt. Those banks cover 69% of the total banking assets. This sample is selected in a way to evaluate the impact of large banks, state-ownership of major banks and publicly traded banks on the results. All sample banks are registered at the CBE. This entails that all banks have to follow the CBE rules in the preparation and presentation of the financial statements [14]. Accounting, regulatory and governance data are collected and cross-matched from the banks' annual reports available at Egypt for Information Dissemination Company (EGID) database, banks' web sites and Mubasher database [15].

5. Research design

The empirical framework proceeds in two steps. In the first step, the data envelopment analysis (DEA) model is used to derive bank-specific efficiency scores. In the second step, BE scores are regressed on the CCB and RLEV along with a set of control variables to test research hypotheses.

5.1 First stage: calculating scores of bank efficiency using data envelopment analysis

BE refers to how the bank transforms inputs into outputs in comparison with the best practice frontier. Cost efficiency represents a wider concept in comparison with technical efficiency, as it refers to both technical and allocative efficiency (Pasiouras *et al.*, 2009), whereas the technical efficiency shows the ability to maximize (minimize) outputs (inputs) using specified inputs (outputs) level. Meanwhile, allocative efficiency can be defined as the

ability to produce a certain output level by using optimal proportions of inputs considering their respective prices (Havrylychuk, 2006). Charnes *et al.* (1978) introduced a model, which is known as Charnes, Cooper and Rhodes (CCR) model, to evaluate the efficiency of decision-making units in non-profit organizations. Banker *et al.* (1984) provide the DEA model, which is known as Banker, Charnes and Cooper (BCC), considering the increasing, decreasing or constant returns to scale.

The CCR model provides a score of efficiency for each unit. Those units that lie on the efficiency frontier are considered efficient. Additionally, the CCR (BCC) model assumes constant (variable) returns to scale, which shows that a change in the input causes a proportional (disproportional) change in the output (Poshakwale and Qian, 2011). The DEA has several advantages, as it can be used for small sample size and different bank sizes. However, this method has many disadvantages as it is highly affected by outliers (Havrylychuk, 2006). It does not allow error in data, so it considers the entire distance to the frontier as inefficiency (Weill, 2003).

The BE is measured through four proxies, which are allocative efficiency constant returns to scale (AECRS), cost efficiency constant returns to scale (CECRS), allocative efficiency variable returns to scale (AEVRS) and cost efficiency variable returns to scale (CEVRS), to calculate BE scores. Furthermore, AEVRS and CEVRS are used for robustness checks. We apply the intermediation approach which assumes that banks transform deposits along with capital and labor into loans (Pessarossi and Weill, 2015). Altunbas *et al.* (2000) use total loans, securities and off-balance sheet items as outputs. In addition to that, Pessarossi and Weill (2015) use three input prices of labor, physical capital and borrowed funds. Moreover, Lensink *et al.* (2008) calculate the price of labor as personnel expenses divided by total assets. Total assets are used in the denominator rather than total employees because of the availability of data. Accordingly, three outputs, inputs and their related prices are used to calculate the cost and allocative efficiency scores. Table 1 shows the three outputs, inputs and inputs prices along with their calculations.

5.2 Second stage: regression model

The following ordinary least squares (OLS) regression has been estimated on a pooled sample and hypotheses *H1* and *H2* have been tested using this multiple regression model:

$$BE_{it+1} = \beta_0 + \beta_1 CCB_{it} + \beta_2 RLEV_{it} + \beta_3 DLIST_{it} + \beta_4 DGOV_{it} + \beta_5 DSIZE_{it} + \beta_6 DMA_{it} + \beta_7 DREV_{it} + \epsilon_{it} \quad (1)$$

where BE_{it+1} = scores of BE resulting from the first step for bank i at year $t+1$; CCB_{it} is a dummy variable equals 1 if a bank has a Tier 1 capital threshold of at least 8.5% and zero otherwise; $RLEV_{it}$ is the regulatory leverage ratio; $DLIST_{it}$ is a dummy variable equals 1 if a bank is listed in the Egyptian Stock Exchange and zero otherwise; $DGOV_{it}$ is a dummy variable equals 1 if a bank has at least 60% of governmental ownership and zero otherwise; $DSIZE_{it}$ is a dummy variable equals 1 if a bank has total assets equal to or above the median of total banks' assets and zero otherwise; $\beta_6 DMA_{it}$ is a dummy variable equals 1 during the period of merger or acquisition of a bank and zero otherwise; $DREV_{it}$ is a dummy variable equals 1 during the period (2011–2013) and zero otherwise [16].

The two main variables of interest are CCB and RLEV. We calculated these two ratios for the whole sample period as mentioned below because they became fully obliged in 2019 and 2018, respectively. CCB is a risk-based capital measure. The minimum requirement of CCB plus Tier 1 capital is 8.5%. Thus, the CCB can be measured as CCB_{it} = a dummy variable

Outputs, inputs and input prices	Description
<i>Outputs</i>	
Total customer loans	Loans and advances to customers
Other earning assets	Treasury bills and other governmental notes, trading financial assets, available for sale, held to maturity, investments in subsidiary and associates, investment property, non-current assets held for sale
Off-balance sheet items	Letters of credit, guarantees and other commitments
<i>Inputs</i>	
Total deposits	Customers' deposits
Net fixed assets	Fixed assets less accumulated depreciation
Personnel expenses	Personnel expenses, rather than the number of employees, are used They are equal to staff costs or administrative expenses less other administrative expenses
<i>Input prices</i>	
Price of borrowed fund	Interest and similar expenses divided by Total customer deposits
Price of physical capital	= $\frac{\text{Other non - interest expenses}}{\text{Net fixed assets}}$
Price of labor	= $\frac{\text{Personnel expenses}}{\text{Total assets}}$

Table 1.
Outputs, inputs,
inputs prices and
description

equals 1 if a bank has a Tier 1 capital threshold of at least 8.5% and zero otherwise. We transform it into a dummy variable to avoid multicollinearity with RLEV. The RLEV is a non-risk-based capital measure, as we use total assets instead of RWA in the calculation. [Kim and Sohn \(2017\)](#) measure the leverage ratio as the Tier 1 capital divided by the total average assets. Hence, the RLEV can be measured as follows:

$$RLEV_{it} = \frac{Tier\ 1_{it}}{TA_{it}} \quad (2)$$

where $RLEV_{it}$ is the regulatory leverage ratio, $Tier\ 1_{it}$ is the Tier 1 capital according to Basel for bank i at year t ; and TA_{it} is the total assets for bank i at year t .

The regression model uses ($DLIST_{it}$, $DGOV_{it}$, $DSIZE_{it}$, DMA_{it} and $DREV_{it}$) as control variables, which may have an impact on BE beyond the main variables. $DLIST_{it}$ is a dummy variable equals 1 if a bank is listed in the Egyptian Stock Exchange and zero otherwise. Publicly traded banks may have different scores of cost and allocative efficiencies compared with non-listed banks. $DGOV_{it}$ is a dummy variable equals 1 if a bank has at least 60% of governmental ownership and zero otherwise. We control for state-ownership, as there is a debate regarding whether banks having full or majority government ownership are more cost-efficient compared with non-state-owned banks. In this study, state-owned banks are defined as banks for which the government owns more than 60% of their capital [17]. Several studies show that state-owned banks are more efficient compared with private banks ([Staub et al., 2010](#); [Poshakwale and Qian, 2011](#)). However, state-owned banks suffer from a lower level of performance than private banks ([Mohieldin and Nasr, 2007](#)). Additionally, the government will support state-owned banks during the crisis periods leaving the door open for them to lower their lending, causing an increase in the non-performing loans, and lower their efficiency scores ([Partovi and Matousek, 2019](#)). $DSIZE_{it}$ is a dummy variable equals 1 if a bank has total assets equal to or above the median of total banks' assets and zero otherwise. We control for bank size, which is a good proxy for bank performance ([Ben Naceur and Omran, 2011](#)). DMA_{it} is a dummy variable equals 1 during the period of merger or acquisition of a bank and zero otherwise. We control for whether banks have undergone mergers or acquisitions (M&A) affecting their efficiency. The merger should be between two strong banks to improve cost efficiency rather than between one strong bank and one distressed bank. Because the latter can result in deteriorating the assets' quality of the strong bank ([Kaur and Kaur, 2010](#)). $DREV_{it}$ = a dummy variable equals 1 during the period (2011–2013) and zero otherwise. Finally, we control for periods of economic/political turmoil. The economic and political instability in our setting affected not only the performance of the banking sector but also the overall economy ([Mohieldin et al., 2019](#)). Therefore, we examine whether economic/political turmoil affects the association in an interesting market setting, because of events unfolding during 2011–2013.

6. Empirical results

6.1 Descriptive statistics of the study variables

[Table 2](#) shows the descriptive statistics of CCB, RLEV, BE and control variables. This table presents the summary statistics for the whole sample, as it comprises the mean, median, standard deviation, minimum and the maximum values of each variable used in the analysis. The BE is classified into allocative and cost efficiency. The mean (median) of AECS is 39.4% (21.7%). In addition to that, the mean (median) of CECS is 34.3% (18.8%), the mean (median) of AEVRS is 54.9% (57.4%) and the mean (median) of CEVRS is 53.4% (51.2%). On average, 92% of banks maintain the CCB ratio. The mean (median) of RLEV is

Variables	<i>N</i>	Mean	Median	SD	Min	Max
$BE_{it+1}: AECRS$	104	0.394	0.217	0.392	0.001	1.000
$BE_{it+1}: CECRS$	104	0.343	0.188	0.356	0.001	1.000
$BE_{it+1}: AEVRS$	102	0.549	0.574	0.416	0.006	1.000
$BE_{it+1}: CEVRS$	102	0.534	0.512	0.412	0.004	1.000
CCB_{it}	104	0.920	1.000	0.268	0.000	1.000
$RLEV_{it}$	104	0.081	0.076	0.031	0.030	0.164
$DLIST_{it}$	104	0.692	1.000	0.464	0.000	1.000
$DGOV_{it}$	104	0.308	0.000	0.464	0.000	1.000
$DSIZE_{it}$	104	0.500	0.500	0.502	0.000	1.000
DMA_{it}	104	0.050	0.000	0.215	0.000	1.000
$DREV_{it}$	104	0.375	0.000	0.487	0.000	1.000

Notes: This table illustrates summary statistics using annual data for banks for the period 2010–2018. BE_{it+1} = scores of bank efficiency for bank i at year $t+1$, measured by AECRS (allocative efficiency constant returns to scale, CECRS = cost efficiency constant returns to scale, AEVRS = allocative efficiency variable returns to scale, and CEVRS = cost efficiency variable returns to scale; CCB_{it} = a dummy variable equals 1 if a bank has a Tier 1 capital threshold of at least 8.5% and zero otherwise; $RLEV_{it}$ = is the regulatory leverage ratio; $DLIST_{it}$ = a dummy variable equals 1 if a bank is listed in the Egyptian Stock Exchange and zero otherwise; $DGOV_{it}$ = a dummy variable equals 1 if a bank has at least 60% of governmental ownership and zero otherwise; $DSIZE_{it}$ = a dummy variable equals 1 if a bank has total assets equal to or above the median of total banks' assets and zero otherwise; β_6 , DMA_{it} = a dummy variable equals 1 during the period of merger or acquisition of a bank and zero otherwise; $DREV_{it}$ = a dummy variable equals 1 during the period (2011–2013) and zero otherwise; The sample size is reduced (from 104 to 102) by two observations that are considered outliers under the application of Variable Returns to Scale of bank efficiency

Table 2.
Descriptive statistics
for the annual sample
data for the period
2010–2018

8.1% (7.6%) by comparing the median with the average figures of RLEV is right-skewed, which represents that banks tend to increase their RLEV. Also, the minimum (maximum) of RLEV is 3% (16.4%). On average, 69.2% of banks are listed in the Egyptian Stock Exchange, whereas state-owned banks represent about 30.8% of the total sample.

Table 3 displays the Person's (Spearman) correlation coefficient between each of the predictor variables and measures of the outcome variable $BE_{it+1}: AECRS$, $CECRS$, $AEVRS$ and $CEVRS$, where the listed banks in the Egyptian Stock Exchange has the largest correlation with measures of BE compared with the other predictors. Furthermore, the CCB and $RLEV$ have a negative correlation with measures of the outcome variable. Additionally, there is no multicollinearity between predictors.

6.2 Regression results of using cost and allocative efficiency constant returns to scale

Table 4 shows the regression results using two proxies of BE_{it+1} ($AECRS$ and $CECRS$) in each of the two columns, respectively (i.e. results of testing hypotheses). The first column displays the results of $BE_{it+1}: AECRS$ and the second column shows the results of $BE_{it+1}: CECRS$. Each column is separated into Model (a) and Model (b). Model (a) includes the parameters of CCB and $RLEV$ because of their importance in predicting BE; after that, Model (b) control variables are added along with the CCB and $RLEV$. The result of Model (a) shows that the coefficient of CCB is negative and statistically significant at the 5% level, suggesting a negative association with $AECRS$ and $CECRS$. Additionally, a coefficient of $RLEV$ is negative and statistically significant at the 0.1% level, suggesting a negative association with $AECRS$ and $CECRS$. Model (b) indicates that the standardized coefficients of both CCB and $RLEV$ are the same as in Model (a), but with a difference in significance levels. Therefore, signs of the main variables' coefficients are negative as expected.

Table 3.
Pearson (above diagonal) and Spearman (below diagonal) correlation analysis for the period 2010–2018

Variable	BE_{it+1} : AECRS	BE_{it+1} : CECS	BE_{it+1} : AEVRS	BE_{it+1} : CEVRS	CCB_{it}	$RLEV_{it}$	$DLIST_{it}$	$DGOV_{it}$	$DSIZE_{it}$	DMA_{it}	$DREV_{it}$
BE_{it+1} : AECRS		0.954*** (0.000)	0.707** (0.000)	0.681** (0.000)	-0.337** (0.000)	-0.444** (0.000)	-0.550** (0.000)	0.127 (0.099)	0.407** (0.000)	-0.043 (0.331)	0.209* (0.017)
BE_{it+1} : CECS	0.982** (0.000)		0.714** (0.000)	0.705** (0.000)	-0.349** (0.000)	-0.406** (0.000)	-0.561** (0.000)	0.095 (0.168)	0.371** (0.000)	-0.045 (0.324)	0.214* (0.014)
BE_{it+1} : AEVRS	0.749** (0.000)	0.760** (0.000)		0.992** (0.000)	-0.232** (0.010)	-0.425** (0.000)	-0.463** (0.000)	-0.009 (0.465)	0.356** (0.000)	0.081 (0.210)	0.151 (0.065)
BE_{it+1} : CEVRS	0.744** (0.000)	0.756** (0.000)	0.996** (0.000)		-0.229* (0.010)	-0.404** (0.000)	-0.451** (0.000)	-0.023 (0.409)	0.347** (0.000)	0.090 (0.183)	0.150 (0.067)
CCB_{it}	-0.290** (0.001)	-0.279** (0.002)	-0.233** (0.009)	-0.207* (0.018)		0.392** (0.000)	0.355** (0.000)	-0.433** (0.000)	-0.217* (0.014)	0.065 (0.256)	0.000 (0.500)
$RLEV_{it}$	-0.400** (0.000)	-0.367** (0.000)	-0.452** (0.000)	-0.429** (0.000)	0.404** (0.000)		0.469** (0.000)	-0.187* (0.029)	-0.520** (0.000)	0.021 (0.416)	0.241** (0.007)
$DLIST_{it}$	-0.462** (0.000)	-0.453** (0.000)	-0.458** (0.000)	-0.442** (0.000)	0.355** (0.000)	0.489** (0.000)		-0.278** (0.002)	-0.542** (0.000)	0.150 (0.065)	0.000 (0.500)
$DGOV_{it}$	0.115 (0.123)	0.055 (0.289)	0.019 (0.424)	-0.004 (0.482)	-0.433** (0.000)	-0.226* (0.010)	-0.278** (0.002)		0.042 (0.337)	-0.150 (0.065)	0.000 (0.500)
$DSIZE_{it}$	0.376** (0.000)	0.344** (0.000)	0.347** (0.000)	0.337** (0.000)	-0.217* (0.014)	-0.484** (0.000)	-0.542** (0.000)	0.042 (0.337)		0.225* (0.011)	-0.139 (0.080)
DMA_{it}	0.053 (0.295)	0.049 (0.312)	0.089 (0.186)	0.097 (0.166)	0.065 (0.256)	0.091 (0.180)	0.150 (0.065)	-0.150 (0.065)	0.225* (0.011)		-0.081 (0.206)
$DREV_{it}$	0.278** (0.002)	0.274** (0.002)	0.162 (0.052)	0.158 (0.057)	0.000 (0.500)	0.269** (0.003)	0.000 (0.500)	0.000 (0.500)	-0.139 (0.080)	-0.081 (0.206)	

Notes: This table illustrates Pearson and Spearman correlation coefficients using annual data for banks for the period 2010–2018. BE_{it+1} = scores of bank efficiency for bank i at year $t+1$, measured by AECRS = allocative efficiency constant returns to scale, CECS = cost efficiency constant returns to scale, AEVRS = allocative efficiency variable returns to scale and CEVRS = cost efficiency variable returns to scale; CCB_{it} = a dummy variable equals 1 if a bank has a Tier 1 capital threshold of at least 8.5% and zero otherwise; $RLEV_{it}$ = the regulatory leverage ratio; $DLIST_{it}$ = a dummy variable equals 1 if a bank is listed in the Egyptian Stock Exchange and zero otherwise; $DGOV_{it}$ = a dummy variable equals 1 if a bank has at least 60% of governmental ownership and zero otherwise; $DSIZE_{it}$ = a dummy variable equals 1 if a bank has total assets equal to or above the median of total banks' assets and zero otherwise; β_6 , DMA_{it} = a dummy variable equals 1 during the period of merger or acquisition of a bank and zero otherwise; $DREV_{it}$ = a dummy variable equals 1 during the period (2011–2013) and zero otherwise. **Correlation is significant at the 1% level (one-tailed); *correlation is significant at the 5% level (one-tailed)

Model: $BE_{it+1} = \beta_0 + \beta_1 CCB_{it} + \beta_2 RLEV_{it} + \beta_3 DLLST_{it} + \beta_4 DGOV_{it} + \beta_5 DSIZE_{it} + \beta_6 DMA_{it} + \beta_7 DREV_{it} + \epsilon_{it}$

Variables	(a) BE_{it+1} : AECRS			(b) BE_{it+1} : CECRS		
	Coef.	t-stat.	t-stat.	Coef.	t-stat.	t-stat.
CCB_{it}	-0.193	-2.031*	-1.315	-0.225	-2.335**	-1.811*
$RLEV_{it}$	-0.368	-3.875***	-2.671***	-0.317	-3.296***	-2.174**
$DLLST_{it}$			-3.467***			-4.138***
$DGOV_{it}$			-0.869			-1.525
$DSIZE_{it}$			0.830			0.253
DMA_{it}			0.016			0.361
$DREV_{it}$			3.594***			3.413***
Adjusted R^2		0.213	0.400		0.192	0.400
F		14.950***	10.829***		13.200***	10.790***
No. of Obs.		104	104		104	104

Notes: BE_{it+1} = scores of bank efficiency for bank i at year $t + 1$, measured by AECRS= allocative efficiency constant returns to scale and CECRS= cost efficiency constant returns to scale; CCB_{it} = a dummy variable equals 1 if a bank has a Tier 1 capital threshold of at least 8.5% and zero otherwise; $RLEV_{it}$ = is the regulatory leverage ratio; $DLLST_{it}$ = a dummy variable equals 1 if a bank is listed in the Egyptian Stock Exchange and zero otherwise; $DGOV_{it}$ = a dummy variable equals 1 if a bank has at least 60% of governmental ownership and zero otherwise; $DSIZE_{it}$ = a dummy variable equals 1 if a bank has total assets equal to or above the median of total banks' assets and zero otherwise; $\beta_6 DMA_{it}$ = a dummy variable equals 1 during the period of merger or acquisition of a bank and zero otherwise; $DREV_{it}$ = a dummy variable equals 1 during the period (2011–2013) and zero otherwise. ***, ** and * indicate the statistical significance at the 1%, 5% and 10% levels, respectively. (a) Predictors: (Constant), CCB_{it} , $RLEV_{it}$; (b) Predictors: (Constant), CCB_{it} , $DLLST_{it}$, $DGOV_{it}$, $DSIZE_{it}$, DMA_{it} , $DREV_{it}$

Table 4. Regression results of the association between capital conservation buffer ratio, regulatory leverage and bank efficiency (the application of constant returns to scale)

Consequently, these results support research hypotheses H_1 and H_2 . However, the results show that an increase in capital requirements tends to decrease BE. This is consistent with Ben Naceur and Kandil (2009) and Rahman *et al.* (2018). Therefore, in the case of the Egyptian banking sector, a decrease in capital requirements would likely improve BE. Additionally, the results reveal that *RLEV* (i.e. non-risk capital measure) is highly associated with *AECRS* and *CECRS* compared with the *CCB*, as evidenced by the higher standardized coefficient. These results may be because of the reasons that *CCB* is a risk-based capital measure and the transformation of it into a dummy variable. Furthermore, the estimated coefficients on the control variables show that banks which are listed in the Egyptian Stock Exchange (*DLIST*) tend to have lower *AECRS* and *CECRS*, whereas banks have relatively high scores of *AECRS* and *CECRS* during economic/political turmoil (*DREV*), which is consistent with the reform program of the CBE to enhance banks' financial soundness.

6.3 Regression results of robustness tests

The regression is repeated in this section to check the robustness of the results that have been discussed above. Robustness was verified by replacing (BE_{it+1} : *AECRS* and *CECRS*) with (BE_{it+1} : *AEVRS* and *CEVRS*). The regression results remain qualitatively and quantitatively similar as shown in Table 5. Additionally, the estimated coefficients on the control variables show that *DMA* and *DREV* are positively associated with *AEVRS* and *CEVRS*, whereas banks that are listed in the Egyptian Stock Exchange (*DLIST*) tend to have lower *BE*. Consistent with the result of Partovi and Matousek (2019), we find that banks with a relatively low score of *AEVRS* and *CEVRS* are state-owned banks (*DGOV*).

7. Conclusions and policy implications

This paper uses risk-based and non-risk-based proxies, to test the association between regulatory capital ratios and BE, in an attempt to provide insight into the mixed results of prior studies. Thus, BE is classified into allocative and cost efficiency. The results show that *CCB* and *RLEV* are negatively associated with BE (allocative and cost efficiency). The results also reveal that *RLEV* is highly associated with BE compared with the *CCB*. Thus, this finding is in line with the introduction of the leverage requirement, according to Basel III, as a non-risk-based capital ratio to supplement the risk-based capital ratios. However, our results show that higher regulatory capital thresholds add more regulatory costs and restrictions on banks, which result in reducing BE. The overall result shows that an increase in capital requirements tends to decrease BE. Thus, the benefit of increasing BE should be weighed against the cost of reducing the stability of the banking system, which we leave for further research.

Further results reveal that state-owned banks have relatively lower allocative and cost efficiencies than their counterparts when using the variable returns to scale. Recently, the two waves of the reform program of the CBE comprise restructuring state-owned commercial banks, to ensure their sustainable improvements of efficiency, risk management and financial intermediation. Our results indicate that the reform programs do not particularly improve the efficiency of state-owned banks, and hence more focused and tailored measures are required according to ownership type. The findings show that banks' mergers/acquisitions improve BE when using the variable returns to scale. Additionally, BE is relatively higher during economic/political turmoil, which is consistent with Bloomberg report on the resilience of the banking sector in Egypt and upon the reform program of the CBE to enhance banks' financial soundness.

The overall results indicate that higher *RLEV* and *CCB* increase regulatory costs and restrictions on banks, which in turn reduce BE. Those ratios became fully obliged in 2018

$$\text{Model: } BE_{it+1} = \beta_0 + \beta_1 CCB_{it} + \beta_2 RLEV_{it} + \beta_3 DLLIST_{it} + \beta_4 DGOV_{it} + \beta_5 DSIZE_{it} + \beta_6 DMA_{it} + \beta_7 DREV_{it} + \epsilon_{it}$$

Variables	(a)			(b)		
	Coef.	t-stat.	t-stat.	Coef.	t-stat.	t-stat.
BE_{it+1} : AEVRS						
BE_{it+1} : CEVRS						
CCB_{it}	-0.074	-0.745	-0.483	-0.081	-0.807	-0.062
$RLEV_{it}$	-0.396	-4.002***	-3.279***	-0.372	-3.724***	-2.991***
$DLLIST_{it}$			-3.262***			-3.280***
$DGOV_{it}$			-1.730*			-0.177
$DSIZE_{it}$			-0.131			-0.018
DMA_{it}			1.690*			0.159
$DREV_{it}$			3.043***			0.255
Adjusted R^2	0.169	0.329	0.152	0.152	0.314	0.314
F	11.268***	8.079***	10.055***	10.055***	7.617***	7.617***
No. of obs.	102	102	102	102	102	102

Notes: BE_{it+1} = scores of bank efficiency for bank i at year $t + 1$, measured by AEVRS= allocative efficiency variable returns to scale and CEVRS = cost efficiency variable returns to scale; CCB_{it} = a dummy variable equals 1 if a bank has a Tier 1 capital threshold of at least 8.5% and zero otherwise; $RLEV_{it}$ = is the regulatory leverage ratio; $DLLIST_{it}$ = a dummy variable equals 1 if a bank is listed in the Egyptian Stock Exchange and zero otherwise; $DGOV_{it}$ = a dummy variable equals 1 if a bank has at least 60% of governmental ownership and zero otherwise; $DSIZE_{it}$ = a dummy variable equals 1 if a bank has total assets equal to or above the median of total banks' assets and zero otherwise; $\beta_6 DMA_{it}$ = a dummy variable equals 1 during the period of merger or acquisition of a bank and zero otherwise; $DREV_{it}$ = a dummy variable equals 1 during the period (2011–2013) and zero otherwise. ***, ** and * indicate the statistical significance at the 1%, 5% and 10% levels, respectively. (a) Predictors: (Constant), CCB_{it} , $RLEV_{it}$; (b) Predictors: (Constant), CCB_{it} , $RLEV_{it}$, $DLLIST_{it}$, $DGOV_{it}$, $DSIZE_{it}$, DMA_{it} , $DREV_{it}$

Table 5. Regression results of the association between Capital conservation buffer ratio, regulatory leverage and bank efficiency (the application of variable returns to Scale-Robustness tests)

and 2019, as mentioned previously, for banks operating in Egypt. Accordingly, our findings are important for bank regulators, not only in Egypt but also the emerging markets, in their efforts to enhance the efficiency of the banking sector through refinements of highly stringent regulations of Basel and in their phasing in of Basel III regulations. Having high scores of BE is equally important to bank risk-taking in enhancing the resilience of the banking sector and improving economic growth. Our paper has the following limitations:

- By transforming the CCB into a dummy variable, its variability is significantly reduced, which could cause a decrease in its partial correlation with the dependent variable, thereby making it less significant.
- DEA model has several disadvantages, but we select it because it is appropriate for the small sample size; that is why we verify the robustness of the findings.

Notes

1. Available at: www.bis.org/publ/bcbs189.pdf (accessed 10 April 2020).
2. Available at: www.bloomberg.com/news/articles/2019-05-30/emerging-market-scorecard-favors-growth-stars-as-trade-war-bites (accessed 7 June 2020).
3. Available at: www.bloomberg.com/news/articles/2019-01-08/world-s-biggest-economies-seen-dominated-by-asian-ems-by-2030 (accessed 7 June 2020).
4. Available at: www.cbe.org.eg/en/BankingSupervision/Pages/ReformPhase1.aspx (accessed 19 April 2020).
5. Available at: www.cbe.org.eg/en/BankingSupervision/Pages/ReformPhase1.aspx (accessed 10 February 2020).
6. Available at: www.cbe.org.eg/en/BankingSupervision/Pages/ReformPhase2.aspx (accessed 19 April 2020).
7. Available at: www.cbe.org.eg/en/BankingSupervision/Pages/ReformPhase2.aspx (accessed 10 February 2020).
8. The minimum ratio of 2.5% of CCB has been fully effective on 1st January 2019. Otherwise, earnings distribution (e.g. dividends and staff bonus payments) constraints have to be imposed on the bank that does not maintain the required minimum ratio.
9. Available at: www.cbe.org.eg/en/BankingSupervision/Documents/BaselIIregulationAR.PDF (accessed 10 February 2020).
10. Available at: www.cbe.org.eg/en/BankingSupervision/Pages/BaselIII.aspx (accessed 10 February 2020).
11. Available at: www.bis.org/publ/bcbs189.pdf (accessed 10 April 2020).
12. Available at: www.cbe.org.eg/en/BankingSupervision/Pages/BaselIII.aspx (accessed 10 February 2020).
13. Available at: www.cbe.org.eg/en/BankingSupervision/Pages/LicenseLists.aspx (accessed 8 July 2020).
14. Available at: www.cbe.org.eg/en/BankingSupervision/Pages/PresentationAndPreparation.aspx (accessed 10 February 2020).
15. Available at: www.mubasher.info/countries/eg/companies (accessed 10 March 2020).

16. All regressors are lagged by one year which helps avoid reverse causality.
17. Accordingly, Banque Misr, National Bank of Egypt, Housing & Development Bank and Export Development Bank of Egypt are considered state-owned banks.

References

- Abou-El-Sood, H. (2016), "Are regulatory capital adequacy ratios good indicators of bank failure? Evidence from US banks", *International Review of Financial Analysis*, Vol. 48, pp. 292-302.
- Acharya, V.V. and Thakor, A.V. (2016), "The dark side of liquidity creation: leverage and systemic risk", *Journal of Financial Intermediation*, Vol. 28, pp. 4-21.
- Allahrakha, M., Cetina, J. and Munyan, B. (2018), "Do higher capital standards always reduce bank risk? The impact of the basel leverage ratio on the US triparty repo market", *Journal of Financial Intermediation*, Vol. 34, pp. 3-16.
- Altunbas, Y., Liu, M.-H., Molyneux, P. and Seth, R. (2000), "Efficiency and risk in Japanese banking", *Journal of Banking and Finance*, Vol. 24 No. 10, pp. 1605-1628.
- Banker, R.D., Charnes, A. and Cooper, W.W. (1984), "Some models for estimating technical and scale inefficiencies in data envelopment analysis", *Management Science*, Vol. 30 No. 9, pp. 1078-1092.
- Barth, J.R., Lin, C., Ma, Y., Seade, J. and Song, F.M. (2013), "Do bank regulation, supervision and monitoring enhance or impede bank efficiency?", *Journal of Banking and Finance*, Vol. 37 No. 8, pp. 2879-2892.
- Barth, J.R. and Miller, S.M. (2018), "Benefits and costs of a higher bank 'leverage ratio'", *Journal of Financial Stability*, Vol. 38, pp. 37-52.
- Ben Naceur, S. and Kandil, M. (2009), "The impact of capital requirements on banks' cost of intermediation and performance: the case of Egypt", *Journal of Economics and Business*, Vol. 61 No. 1, pp. 70-89.
- Ben Naceur, S. and Omran, M. (2011), "The effects of bank regulations, competition, and financial reforms on banks, performance", *Emerging Markets Review*, Vol. 12 No. 1, pp. 1-20.
- Bitar, M., Pukthuanhong, K. and Walker, T. (2018), "The effect of capital ratios on the risk, efficiency and profitability of banks: evidence from OECD countries", *Journal of International Financial Markets, Institutions and Money*, Vol. 53, pp. 227-262.
- Bui, C., Scheule, H. and Wu, E. (2017), "The value of bank capital buffers in maintaining financial system resilience", *Journal of Financial Stability*, Vol. 33, pp. 23-40.
- Charnes, A., Cooper, W.W. and Rhodes, E. (1978), "Measuring the efficiency of decision making units", *European Journal of Operational Research*, Vol. 2 No. 6, pp. 429-444.
- Chen, S. (2013), "How do leverage ratios affect bank share performance during financial crises: the Japanese experience of the late 1990s", *Journal of the Japanese and International Economies*, Vol. 30, pp. 1-18.
- Chortareas, G.E., Girardone, C. and Ventouri, A. (2012), "Bank supervision, regulation, and efficiency: evidence from the European union", *Journal of Financial Stability*, Vol. 8 No. 4, pp. 292-302.
- Fethi, M.D. and Pasiouras, F. (2010), "Assessing bank efficiency and performance with operational research and artificial intelligence techniques: a survey", *European Journal of Operational Research*, Vol. 204 No. 2, pp. 189-198.
- Haque, F. and Brown, K. (2017), "Bank ownership, regulation and efficiency: perspectives from the Middle East and North Africa (MENA) region", *International Review of Economics and Finance*, Vol. 47, pp. 273-293.
- Havrylychuk, O. (2006), "Efficiency of the polish banking industry: foreign versus domestic banks", *Journal of Banking and Finance*, Vol. 30 No. 7, pp. 1975-1996.

- Kaur, P. and Kaur, G. (2010), "Impact of mergers on the cost efficiency of Indian commercial banks", *Eurasian Journal of Business and Economics*, Vol. 3 No. 5, pp. 27-50.
- Kim, S. (2016), "Potential impacts of recently developed capital regulations on banking industry", *International Business Management*, Vol. 10 No. 6, pp. 827-841.
- Kim, D. and Sohn, W. (2017), "The effect of bank capital on lending: does liquidity matter?", *Journal of Banking and Finance*, Vol. 77, pp. 95-107.
- Krug, S., Lengnick, M. and Wohltmann, H.-W. (2015), "The impact of Basel III on financial (in)stability: an agent-based credit network approach", *Quantitative Finance*, Vol. 15 No. 12, pp. 1917-1932.
- Kwan, S. and Eisenbeis, R.A. (1997), "Bank risk, capitalization, and operating efficiency", *Journal of Financial Services Research*, Vol. 12 Nos 2/3, pp. 117-131.
- Lee, T.-H. and Chih, S.-H. (2013), "Does financial regulation affect the profit efficiency and risk of banks? Evidence from China's commercial banks", *The North American Journal of Economics and Finance*, Vol. 26, pp. 705-724.
- Lensink, R., Meesters, A. and Naaborg, I. (2008), "Bank efficiency and foreign ownership: do good institutions matter?", *Journal of Banking and Finance*, Vol. 32 No. 5, pp. 834-844.
- Mohieldin, M., Hussein, K. and Rostom, A. (2019), "On financial development and economic growth in Egypt", *Journal of Humanities and Applied Social Sciences*, Vol. 1 No. 2, pp. 70-86.
- Mohieldin, M. and Nasr, S. (2007), "On bank privatization: the case of Egypt", *The Quarterly Review of Economics and Finance*, Vol. 46 No. 5, pp. 707-725.
- Moudud-Ul-Huq, S. (2019), "Banks' capital buffers, risk, and efficiency in emerging economies: are they counter-cyclical?", *Eurasian Economic Review*, Vol. 9 No. 4, pp. 467-492.
- Occhino, F. (2018), "Are the new Basel III capital buffers countercyclical? Exploring the option of a rule-based countercyclical buffer", Economic Commentary, available at: www.clevelandfed.org/newsroom-and-events/publications/economic-commentary/2018-economic-commentaries/ec-201803-countercyclical-capital-buffers (accessed 24 August 2019).
- Olson, D. and Zoubi, T.A. (2011), "Efficiency and bank profitability in MENA countries", *Emerging Markets Review*, Vol. 12 No. 2, pp. 94-110.
- Partovi, E. and Matousek, R. (2019), "Bank efficiency and non-performing loans: evidence from Turkey", *Research in International Business and Finance*, Vol. 48, pp. 287-309.
- Pasiouras, F., Tanna, S. and Zopounidis, C. (2009), "The impact of banking regulations on banks' cost and profit efficiency: cross-country evidence", *International Review of Financial Analysis*, Vol. 18 No. 5, pp. 294-302.
- Pessarossi, P. and Weill, L. (2015), "Do capital requirements affect cost efficiency? Evidence from China", *Journal of Financial Stability*, Vol. 19, pp. 119-127.
- Poshakwale, S.S. and Qian, B. (2011), "Competitiveness and efficiency of the banking sector and economic growth in Egypt", *African Development Review*, Vol. 23 No. 1, pp. 99-120.
- Rahman, M.M., Zheng, C., Ashraf, B.N. and Rahman, M.M. (2018), "Capital requirements, the cost of financial intermediation and bank risk-taking: empirical evidence from Bangladesh", *Research in International Business and Finance*, Vol. 44, pp. 488-503.
- Sassi, H. (2013), "The impact of bank regulations and institutions on efficiency in selected MENA banks", *International Journal of Economics and Finance*, Vol. 5 No. 8, pp. 84-100.
- Shamshur, A. and Weill, L. (2019), "Does bank efficiency influence the cost of credit?", *Journal of Banking and Finance*, Vol. 105, pp. 62-73.
- Sirait, R.A. and Rokhim, R. (2019), "Capital adequacy requirement, the cost of financial intermediation and risk taking behavior of the Indonesia banking sector, advances in economics", *Business and Management Research*, Vol. 72, pp. 99-104.
- Staub, R.B., Souza, G.S. and Tabak, B.M. (2010), "Evolution of bank efficiency in Brazil: a DEA approach", *European Journal of Operational Research*, Vol. 202 No. 1, pp. 204-213.

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