THE EFFECT OF MACROPRUDENTIAL REGULATION ON BANKS' PROFITABILITY DURING FINANCIAL CRISES

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Abstract

This study aims to investigate the effect of macroprudential regulation on banks' profitability during financial crises, to find out whether the instruments of the Central Bank of Jordan (CBJ) enhance the performance of the Jordanian banking sector in terms of increasing banks' profitability and reducing banking sector exposure to financial crisis vulnerability. The sample of the study consists of twelve listed banks in Jordan over the period 2000–2018. The bank's return on assets (ROA) was regressed on instruments by using the fully modified ordinary least square (FMOLS) method. The results had shown a slightly weak significant effect of stress testing (ST) on the banks' ROA. Capital adequacy ratio (CAR) had no significant effect, leverage ratio had the deepest effect, and banks are highly leveraged with more debt-to-equity ratio. In addition to that, a good number of the banks maintain CAR, loan-to-value (LTV), and leverage ratios higher than the minimum limit required by the CBJ and Basel requirements, suggesting that the Basel standards did not take into consideration the particularity of some countries. The results also revealed that CBJ prudential regulation instruments are succeed in keeping the stability of the banking sector profitability during previous financial crises, but still need to enhance the level of gearing for banks against future shocks.

Keywords: Macroprudential Regulation, Macroeconomic Policy, Banks, Stabilization, Policy-making, Financial Sector Development, Financial Crises, ROA

Authors' individual contribution: Conceptualization — J.A.M.; Methodology — J.A.M.; Formal Analysis — J.A.M.; Investigation — A.A.B.A.; Resources — S.S.A.-Q., E.M., and A.B.A.; Writing — Original Draft — A.A.B.A.; Writing — Review & Editing — S.S.A.-Q., E.M., and A.B.A.; Visualization — A.A.B.A.; Supervision — J.A.M.

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1. INTRODUCTION

In the latest decades, worldwide financial systems have witnessed many numbers of financial crises. In 2020 and still many countries are facing serious pressure and problems of bank failures, especially during crises; hence, attention is needed for more appropriate regulation instruments to improve the performance of banks and their contribution to financial systems.

Most central banks can use different macroprudential regulation instruments that reduce the losses banks may expose to during the crisis, like capital adequacy ratio (CAR), leverage ratio, debt-to-income (DTI) ratio, loan-to-value (LTV) ratio, and upper limits on loan growth. Many of these instruments are binding, while in other cases they can be implemented according to financial situation circumstances. At the same time, the focus on individual institutions' (microprudential) needs to be complemented by a system-wide view (macroprudential regulation) (Allen & Gale, 2009), taking into account general equilibrium effects to achieve resilience of a financial system.

In Jordan, banks play a major role in economic development. The regulator, the Central Bank of Jordan (CBJ), aims to ensure financial stability through its policies including prudential regulation instruments, with high monitoring and control of banks' key performance indicators (KPIs) affected by systematic and unsystematic risks. Examples of such KPIs are profitability, liquidity, non-performing loans (NPL), and credit growth rate (CGR).

Although prudential regulations have been in place to help the CBJ in regulating the banking practices in Jordan, the problem of facing a low profitability growth rate during the financial crises has continued to be one of the major concerns. As a result, much attention is required for finding appropriate ways to improve the performance of banking systems. Indeed, banking prudential regulation and supervision are considered major components that mitigate the effect of the financial crisis.

This research aims to investigate how macroprudential regulation instruments affect the banking sector's return on assets (ROA) during financial crises, to find out whether the CBJ macroprudential regulation instruments enhance the performance of the Jordanian banking sector in terms of increasing the bank's profitability. In addition, to find out if Basel I, II, and III reforms and standards are appropriate for reducing the banking sector's exposure to financial crises, and updates according to the economic and political situation of the country.

The study is based on panel data analysis covering the period 2000–2018. More specifically, we consider the effect of four major macroprudential regulation instruments, stress testing (ST) instrument, LTV ratio, CAR, and leverage ratio, on the bank's ROA as a key performance and profitability indicator of the banking sector.

2. LITERATURE REVIEW

Several works of literature have been conducted on the effect of macroprudential regulation instruments on banks' profitability, but the results of these studies were inconsistent with debates.

In 1980, Bank for International Settlements (BIS) introduced the first related study in the literature; the study explored the importance of prudential capital regulation on banks' behavior. After that, several studies have been focused on developed countries' banking systems by studying the experience of the US and European banks (Shrieves & Dahl, 1992; Aggarwal & Jacques, 2001; Rime, 2001) and Asian banks (Zhang et al., 2008; Awdeh et al., 2011). In general, these studies introduced the question of banks' performance concerning microprudential and macroprudential regulation.

Berger et al. (1995) conducted a study, utilizing data from US banks during the period 1983–1989. The study aimed to prove that higher capital results in a higher after-tax ROE and ROA. The result disclosed that the book values of capital adequacy ratios positively related to ROA and ROE, and this relationship is statistically and economically significant. Jacques and Nigro (1997) explored the effect of the risk-based capital requirements on bank profitability, they found that the regulatory risk-based capital had an adverse effect on portfolio risk and bank profitability for banks that encountered regulatory risk-based standards. They also suggested a negative relationship between banks' capital and risk exposure at the beginning of applying capital standards, because the undercapitalized commercial bank can meet the risk-based requirement by increasing capital, to decrease portfolio risk, but this also reduces profitability.

Several recent pieces of literature estimate the costs and benefits of macroprudential regulation and have examined the response of banks' behavior to changes in prudential standards. Some studies argued failures that lead to fire sales, and lending constraints by pro-cyclicality measures of the risk-weighted asset (Hanson et al., 2011; Goodhart et al., 2004; Basel Committee on Banking Supervision [BCBS], 2011).

Kerwer (2005) asserted that the increase in minimum capital requirements to reduce the risk of banks leads to an increase in banks' profitability in India. They suggested that banks with higher capital requirements have the ability to face unexpected losses easily and have reduced cost-borrowing capital, which reflects on their profit levels. (Goodhart, 2008; Aiyar et al., 2015) argued that the widespread use of macroprudential regulation is aimed at reducing systemic risks, yet the use of national sector-based measures may be subject to a boundary problem, causing substitution flows to less regulated parts of the financial sector. At the same time, Nier et al. (2008) suggested that higher capital levels in a network have high levels of interbank connectivity, which can increase resilience against contagious defaults.

Jokipii and Milne (2008) conducted a study in Europe. They examined if banks' capital modification costs impulse on banks to build a great capital buffer can cause a slow speed toward target levels. They conclude that the introduction of the Basel II accord will face some challenges given its potential "pro-cyclical" impact on bank capital adequacy. Their findings suggested a negative co-movement of capital buffers with the economic cycle in the case of larger commercial banks in recession. In contrast, small banks increased their capital levels during the economic upturn.

Kodres and Narain (2009) explored the responses of the private and public sectors to the crisis outcomes. They found that the prudential regulatory reforms raising bank costs and regulatory policies are moving the overall financial system to a lower point on the risk-return trade-off lowering risks, and thus, lowering sector profitability.

Recently, a number of empirical researches have tried to estimate the impact of prudential regulation instruments on a sample of countries from different regions, notwithstanding the challenge of regulation measures, most of this empirical literature suggests that some individual macroprudential instruments, such as DTI and LTV ratios, have been effective restrain excessive credit and asset price growth. Lim et al. (2011) investigated the impact of macroprudential instruments in 46 countries, by estimating the impact of individual instrument straining in reducing the pro-cyclicality of financial risks. They found that many of the most used instruments contributed to lowering systemic risks.

Hanson et al. (2011) provided evidence that leverage restrictions may not reduce risk. Even if the risk of individual assets remains constant, bank financial managers are incentivized into choosing assets with more highly correlated returns. Hence, as this argument goes leverage ratios may encourage banks to increase the riskiness of their asset portfolio not reduce it, a classic Goodhart's law result.

Kuttner and Shim (2012), exploring indices of housing-related measures for 57 countries in 1980–2011, found that macroprudential policies are effective in dampening housing prices and credit. Angelini et al. (2012) suggested that macroprudential regulation has a single task, maintaining financial stability. It tightens its regulatory standards too much in response to an adverse financial shock, imposing negative externalities on the monetary authority through a reduced profit growth rate.

Claessens et al. (2013) found that macroprudential policy instruments are necessary to reduce overall systemic risk. They also suggested LTV ratio limit is an effective prudential regulation instrument in reducing asset growth, leverage growth, and growth during booming periods. In addition to that, they found that other instruments like the DTI ratio and limits on credit growth are also effective in reducing bank risk exposures.

Galati and Moessner (2014) suggested that it is difficult to assess the effect of many macroprudential instruments in developed countries because they have been introduced only in response to the recent crisis, which makes it difficult to empirically assess their effect and transmission channels, and thus providing a guideline in the design of macroprudential instruments going forward. Cerutti et al. (2015) examined instruments targeting borrowers. They found that limits on DTI ratios and LTV instruments and limits on leverage and dynamic provisioning be effective in reducing credit growth.

The available work on the effects of regulation is generally limited to the effect of capital structure on bank profitability, which will be partly driven by capital adequacy regulation. Results of empirical estimates of the effect of financial structure on bank profitability are mixed. Rather than using risk-adjusted measures as in the original Basel agreement, this variable is most commonly computed as a reciprocal measure of leverage, namely capital/assets (Saona, 2016). Suggested that this is a measure of solvency unadjusted for risk that has only recently become a regulatory measure for most countries under Basel III.

Goddard et al. (2004) found a positive effect, suggesting that higher capital ratios grant banks greater flexibility in taking advantage of new business opportunities, which in turn allows for improved profitability.

Topak and Talu (2017) suggested that CAR (equity/total assets) had a negative effect on bank return on average assets (ROAA) and return on average equity (ROAE) by using a sample of Turkish banks for the period 2005–2015.

Some theories suggest that the increased Basel III requirements may have a positive or neutral impact on the bank's performance. De Bandt et al. (2021) examined the effect of different capitalization measures on bank ROE and ROA. They based their study on a sample of French banks before and after the financial crisis in 2008. The study showed that an increase in the capital proportion results in an important increase in ROE and ROA; this positive relationship resulted from the operating efficiency factor. The result was not influenced by the method that the bank chooses to raise equity.

Davis et al. (2022) estimated the effects of macroprudential tools like LTV, DTI, leverage ratios, and CAR on bank ROAA and ROAE, they found that DTI and tax reduced banks' profitability, but, leverage and capital requirements affect positively small banks but negatively larger ones.

Regulatory changes might also influence banks' profitability (Gržeta et al., 2023). They examined the impact of two major regulatory changes from Basel II to Basel III on profitability and efficiency. They revealed that in large- and medium-sized banks, regulation positively affects both efficiency and profitability, whereas, for small banks, it negatively affects performance.

Adeleke and Ibrahim (2022) estimated the impact of capital adequacy, leverage, and asset quality on the financial performance peroxide by earnings per share in Nigeria from 2011 to 2020. They found that capital adequacy has a positive effect on financial performance using the earning per share (EPS).

Tillmann (2015) considered the impact of the LTV ratio and debt service-to-income (DSTI) ratio limits on household credit in Korea. He found an unexpected tightening in LTV and DSTI limits had a significant effect on household credit growth. On the other hand, Reite et al. (2022), found the possibility of increasing the financially vulnerable households when LTV regulations are executed only on mortgage loans.

Tarne et al. (2022) estimated the effect of LTV caps for different types of agents on household debt. They suggested that borrower-specific LTV caps affect household debt differently.

Behncke (2022) examined the impacts of a countercyclical capital buffer and a cap LTV ratio. He suggested that both instruments reduced mortgages.

Recent studies in the literature focused on the effects of macroprudential policy on aggregate macroeconomic variables such as total credit in the economy, asset prices (particularly housing prices), and leverage ratios. For example, Akinci and Ohmstead-Rumsey (2018) showed that tightening macroprudential regulation instruments are associated with lower bank credit growth, housing credit growth, and house price inflation. Similarly,

Juliana et al. (2020) examined the effects of macroprudential regulation on credit, based on results from 58 empirical studies. They argued that a constriction of macroprudential regulation instruments had a significant impact on credit growth, with robust effects caused by liquidity instruments, also bounds on LTV and DSTI ratios produce the same effects on reducing mortgage credit growth.

On the adoption of both microprudential and macroprudential regulation instruments, Ayyagari et al. (2018) used a combination of balance sheet data, they found that these instruments are associated with lower credit growth and ROA. These effects are especially significant for micro, small, and medium institutions and young, suggesting that these instruments can enhance financial stability.

More recently, Alam et al. (2019) aimed towards evaluating macroprudential regulation instruments' response to financial risks. Based on banks' empirical data they quantify the impact of a one-percentage-point change in LTV limits on household credit and house prices, from various sources by covering 32 countries in advanced and emerging economies from January 1990 to December 2016, which allows quantifying the effects of many instruments in a precise method. They found that macroprudential regulation shocks have effects on the price level, real gross domestic product (GDP), and credit.

Davis et al. (2020) empirically investigated the effect of prudential regulation instruments such as the DTI and LTV ratios on ROA and ROE in both developing and developed countries' banks' profitability and credit growth. They found the effect of macroprudential regulation on banks' profitability varies between advanced and emerging financial systems with small variances also apparent between retail and other types of banks.

In the light of the Basel standard impact on banks' profitability, Ben Naceur et al. (2018) explored the effects of Basel III liquidity and capital standards on banks' profit, the findings showed an adverse impact of capital ratios on high lending growth banks, and small banks support their financial resilience when spreading retail and commercial lending operations. They argued that banks increase their leverage ratios when permitting riskier loans, and increase illiquid assets. They exposed that leverage ratios have a positive impact on banks' profitability, and credit growth. Obadire et al. (2022) examined the impact of Basel III regulations on the efficiency of African banks, after the 2008 crisis. They found that a capital buffer positively increases banks' profitability and efficiency, reduces economic shocks, and affects banks' strategies.

Gaganis et al. (2021) investigated the effect of macroprudential regulations on banks' profit of over 3000 banks in over 130 countries, they found that macroprudential regulation reduces bank ROA.

This study contributes to the current finance literature, examining the effect of macroprudential regulations by using data from Arabic countries (Jordan), whose financial market is not efficient. Jordanian banks applied different prudential regulation instruments on both micro and macro levels, this mainly aims to improve banks' resilience and reduce the systemic risk of the financial system. Therefore, this study differs from the previous studies conducted on Jordanian listed banks by specifying the analysis of the effect of CBJ macroprudential regulation instruments on the banking sector ROA. To date, empirical evidence on the association between macroprudential regulation instruments and bank ROA is limited and focused on developed countries.

The purpose of this research is to evaluate the effectiveness of implementing such instruments on the performance of Jordanian banks. Following Houston et al. (2010) and Beck et al. (2013), Gaganis et al. (2021), we estimated the dependent variable (ROA) by the ratio of net income to total assets. In particular, total assets consider as a control variable proxy for bank size (Size), since banks with different sizes have different degrees of ROA (Elsas et al., 2010; Yuan et al., 2022). The independent variable, stress testing (ST), is an important risk management instrument that is used by banks as part of their internal risk management and, through the Basel II capital adequacy framework (BCBS, 2009). The independent variables CAR, LTV, and leverage ratios are proxies for macroprudential regulation instruments as proposed by Matutes and Vives (2000), Hellmann et al. (2000), Laeven and Claessens (2004), and Agoraki et al. (2011), considered the effect of previous prudential regulation instruments on bank profitability.

The capital measurement system commonly referred to as the Basel Capital Accord was approved by the G10 Governors, then executed by banks in 1988. The Accord called for decided the minimum ratio of capital to risk-weighted assets of 8% to be implemented until now.

However, practically there are some serious questions regarding the effectiveness of the above prudential regulation instruments in monitoring and controlling the banking sector, translated into the main hypotheses of the study as follows:

H1: Macroprundial regulation instruments improve Jordanian banks' ROA.

H2: Loan-to-value (LTV), leverage, and stress testing (ST) ratios have a positive significant effect on the ROA of the Jordanian banking sector.

H3: Capital adequacy ratio (CAR) does not have a significant effect on the ROA of the Jordanian banking sector.

Central banks can use macroprudential instruments to restrain the losses banks may incur during the crisis (Claessens et al., 2013). In this context, macroprudential instruments, such as countercyclical capital buffers, LTV ratio, leverage ratio, and ST ratio, have become increasingly common among banks in addition to the supervisory toolkit. However, the effect of these prudential instruments on banks' performance is still an open question (Svensson et al., 2012). This led to the following hypothesis:

H4: The macroprudential regulation of the Central Bank of Jordan reduces the banking sector's exposure to financial crisis vulnerabilities.

At the end of 2013, the CBJ implemented Basel III standardized approach to calculate CAR. In this regard, it is worth mentioning that the value of CAR and the Tier 1 capital ratio are very close to each other, which implies that the bulk of banks' capital in Jordan is the core capital (the minimum amount of capital that the bank must have on hand to comply with the CBJ instructions). Bank

regulators decide this ratio to ensure credit discipline to protect depositors and promote stability and efficiency in the financial system to stand against and reduce systematic and unsystematic risks.

H5: Basel forums and regulations do not take into consideration countries' differences.

The study also controlled for business cycles by including GDP growth, as macroeconomic indicator usually develops in line with the business cycle (Shi et al., 2021).

Therefore, the regression models are estimated as follows:

$$ROA_{i,t} = \alpha_0 + \beta_1 SIZE_{i,t} + \beta_2 LEVERAGE_{i,t} + \beta_3 ST_{i,t} + \beta_4 LTV_{i,t} + \beta_5 CAR_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 NI_{i,t} + \varepsilon_{i,t} \quad (1)$$

where,
i subscript refers to a bank, and *t* subscript to a sample year;
ROA is the bank's return on assets ratio: net income/total assets;
ST is the bank's implementation of stress testing estimates by a dummy variable which is equal to 0 for the period 2009–2018 if the bank *i* committed to Basel III and 0 otherwise;
LEVERAGE is the bank's leverage ratio estimated by Tier 1 capital (stockholders equity + RE – goodwill) / total assets;
LTV is the loan-to-value ratio estimated by total real estate credit (loans) / total value of mortgaged real estate;
CAR is the capital adequacy ratio estimated by Tier 1 capital / total risk-weighted assets;
NI is net income;
SIZE is total assets, the control variable of ROA estimated by *ln* total assets;
GROWTH is the GDP growth rate as a macroeconomic indicator.

3. RESEARCH METHODOLOGY

Multiple linear regression models were estimated by using E-views 10 software to the data on the effect of prudential regulation instruments on Jordanian banks' ROA.

The data obtained were analyzed by use of descriptive statistics and inferential statistics (statistical analysis and panel multiple regression analysis).

3.1. Data

To carry out the analysis, we collected the annual data of 12 listed banks in Jordan during the period 2000–2018. The database was arranged in the form of a panel and was analyzed using descriptive statistics, and regression analysis. The collection of this sample was based on the availability of adequate information. The data were extracted from the annual financial reports of banks and the official CBJ's website (https://www.cbj.gov.jo).

3.2. Descriptive analysis

The descriptive statistics for the database are provided in Tables 1 and 2. Based on the tables, one can see that the average ROA ratio over the sample period was equal to 1.135 about 0.183% higher than the median. There is a fair bit of variation in ratios across banks, with the highest ROA for the sample of the banking sector at 5.470, in contrast, the lowest ratios were equal to 0.012.

Table 1. Sample central tendency descriptive statistics

Variable	*No. of observations*	*Mean (%)*	*Median (%)*	*Mode (%)*
ROA	228	1.135	0.952	#N/A
LTV	228	89.893	89.388	#N/A
CAR	228	19.214	16.970	16.000
LEVERAGE	228	12.5	12.7	#N/A

Table 2. Spread descriptive statistics

Variable	*No. of observations*	*Maximum (%)*	*Minimum (%)*	*VAR*	*SD*	*kurtosis*	*skewness*
ROA	228	5.470	0.012	0.744	0.862	8.985	2.194
LTV	228	80.220	79.165	87.729	9.366	0.256	0.275
CAR	228	32.5	8.740	129.177	11.366	137.177	10.445
LEVERAGE	228	31.4	3.2	0.001	0.037	2.359	0.295

Outputs of Tables 1 and 2 indicate the mean value is a good estimator of variables in the analysis. For further analysis, Table 3 shows the banking sector's yearly mean values of the dependent variable of the study.

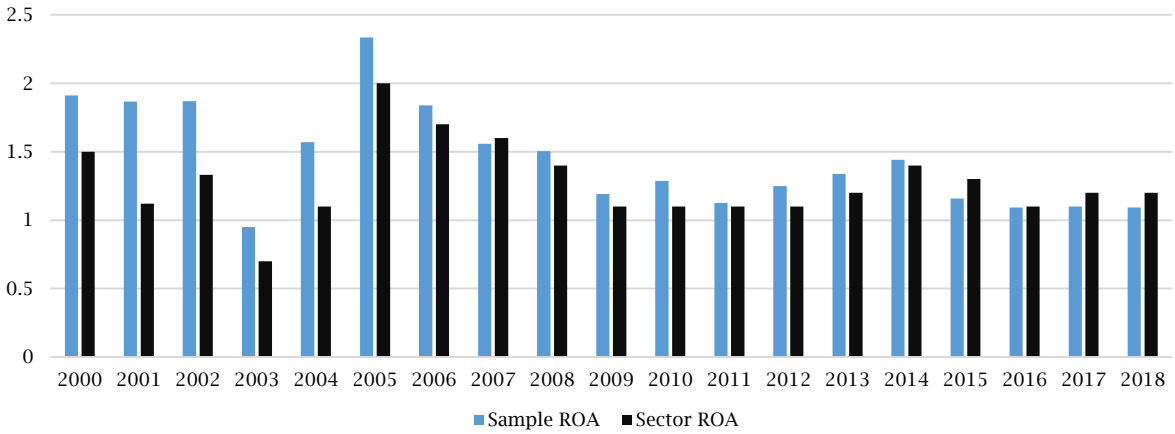
Table 3. Annual average ROA (%)

Year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*
Sample ROA	1.9105	1.867	1.87	0.95	1.56994	2.3342	1.8375	1.5575	1.5042	1.191
Sector ROA	1.5	1.12	1.33	0.7	1.1	2	1.7	1.6	1.4	1.1
Year	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	
Sample ROA	1.2875	1.125	1.25	1.3383	1.44	1.1575	1.0917	1.1	1.093	
Sector ROA	1.1	1.1	1.1	1.2	1.4	1.3	1.1	1.2	1.2	

The average ROA of the banking sector in Jordan witnessed a sharp decrease during the years (2001–2003) reaching 0.7% in 2003. This negative value was attributed to increases in banks size of a bank, and poor performances of four other banks in Jordan. That means the performance of individual bank affects the performance of the sector, and show the importance of macroprudential regulation

to keep the financial system stable. Another obvious drop occurred at the end of 2009 to reach 1.1%, followed by a downward trend in 2009 and 2010 because of the repercussion of the global financial crisis, the euro sovereign debt crisis, and the Arab Spring and their impact on the performance of foreign branches of Jordanian banks. ROA level remained at 1.1% until the end of 2012 then increased in 2013 and 2014 to reach 1.2% and 1.4%, respectively, because of the sizeable growth in banks' profits. In the years 2015 and 2016, the ratio declined slightly to reach 1.3% and 1.1%, respectively. This decline resulted from the increase of tax rate on banks from 30.0% in 2014 to 35.0% in 2015. Then the ratio witnessed an increasing trend to reach 1.2% at the end of 2018. For the study sample, ROA witnessed a sharp decrease at the end of 2003 to reach 0.95%, and a decline in the index during the period 2007–2009 due to the reasons mentioned above. Then it fluctuated to reach 1.093% at the end of the year 2018 (Figure 1).

Figure 1. Annual average ROA (%)



The development of the average ROA range between 0.7 to 1.7 across the period of the study. Table 4 estimates the sample means of ROA for the 12 banks in addition to the sector grouping, as well as for year intervals: 2000–2008 and 2009–2018, to compare profitability relative to financial crisis synchronized by applying stress testing.

Table 4. Average ROA time periodic segmentation

Sector	***ROA***
2000–2008	1.383%
2009–2018	1.48%
Sample	***ROA***
2000–2008	1.124%
2009–2018	1.197%

The results provided in Table 4 showed that the average ROA for the sample when stress testing was adopted after financial crises was equal to 1.197% with 0.073% higher than the average of the last period. In fact, the major problem faced by most banks during the period 2008-2009 was the shortage in bank liquidity, so it is a normal result. For the overall sector, results show that ROA for the period 2009–2018 was 1.48% higher than the previous period by 0.097%.

The above tables indicate that the Jordanian banking sector was characterized by a stable level of ROA during the period of the study except for certain years that will be explained below.

One of the basic requirements for every bank and financial institution is to keep adequate capital through a balance between capital and available risk in its assets in order to guarantee its stability. The Basel Capital Accord is an international standard for the calculation of CAR equal to 8% in Basel II, and 10.5% in Basel II. Table 5 presented the annual average CAR. The Jordanian banking sector had a high CAR and witnessed a continuous increase in it since 2009, ranging between 15.9%–21.4% during the period 2000–2018. It is generally higher than the ratio set by the CBJ and Basel Committee of 12.0% and 10.5%, respectively. However, it declined during 2017 and 2018 to 17.8% and 16.9%, respectively. This decline resulted from the implementation of International Financial Reporting Standard Number 9 (IFRS 9) to the 2018 financial statements to enhance the soundness and resilience of banks over the medium and long term through improving transparency and timely recognition of credit losses compared to the International Accounting Standard (IAS) 39.

Table 5. Annual average CAR (%)

Year	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***
Sector	14.50	15.60	16.30	15.90	17.80	17.60	21.40	20.80	18.40	19.60
Sample	18.58	19.07	19.35	19.71	19.12	19.55	20.12	21.63	19.20	19.46
Year	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	
Sector	20.30	19.30	19.00	18.40	18.40	19.10	18.50	17.80	16.90	
Sample	19.11	17.22	17.95	31.20	17.61	17.71	16.83	16.06	15.59	

The leverage ratio is another important ratio after the 2008 crisis. For the Jordanian banking sector, it is relatively high compared to the limit of 6.0% set by the CBJ, it has taken an upward trend from 2009 until the end of 2012, reaching 13.31%, it witnessed a small decline at the end of 2013 and 2014 and reached 12.9% and 12.46%, respectively. In 2015, it increased slightly to 12.7%. Jordanian banking sector leverage ratio data was reported at 12.3% in 2018. These records decrease by 0.6% from the previous number of 13.2% for 2017. Jordanian bank leverage ratio data updated yearly, averaging 11.6% from 2000 to 2018, with 19 observations. The yearly average leverage for the Jordanian banking sector in addition to the study sample is presented in Table 6.

Table 6. Annual average leverage ratio (%)

Year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*
Sample leverage	10.1	9.9	9.8	11.3	10.8	12.8	13.5	14.3	14.6	14.10
Sector leverage	8.6	8.5	7.2	7.5	8.9	10.5	13.2	13.3	12.9	13
Year	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	
Sample leverage	13.9	13.8	14.2	13.6	13.2	12.8	13.1	12.9	12.3	
Sector leverage	13.1	13.1	13.31	12.9	12.46	12.7	12.9	13.2	12.6	

Table 7 presents the yearly average LTV ratio for the banking sector and the study sample for the period 2005–2018. The LTV ratio is relatively high compared to the maximum limit of 85% that is set by the CBJ, it has taken an upward trend from 2009 until the end of 2017, reaching 89.8%, it witnessed a small decline at the end of 2013, 2014, 2015 reached 88.9%, 89.9%, and 88.8%, respectively. In 2016 and 2017, it increased slightly to reach 89.4% and 89.8%, respectively with a slight drop in 2018 to reach 87%.

Table 7. Annual average LTV ratio (%)

Year	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*
Sample LTV	79.3	81.3	85.05	85.2	89.3	89.5	87.4
Sector LTV	78	82.5	83.2	83.3	89.1	89.2	89.25
Year	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
Sample LTV	89.3	89.9	89.7	89.1	89.5	89.7	88.3
Sector LTV	89.4	88.9	89.6	88.8	89.4	89.8	87

At the end of 2019, world economics witnessed the COVID-19 pandemic. It introduced extreme uncertainty around the global economic growth forecast, because of the unknown lasting spread of COVID-19 in the whole world.

Table 8 presents the last 10 semi annuals Jordanian banking sector financial soundness indicators (FSIs) as follows:

Table 8. FSIs of the Jordanian banking sector

FSI	*6/2016*	*2016*	*6/2017*	*2017*	*6/2018*	*2018*	*6/2019*	*2019*	*6/2020*
NPL	4.7	4.3	4.4	4.2	4.6	4.9	5.2	5	5.4
Coverage ratio	76.2	77.9	73	75.4	74.1	79.3	68.2	69.5	68
CAR	18.2	18.5	17.87	17.8	17.15	16.94	16.99	18.28	17.93
LEVERAGE	12.7	12.9	12.9	13.2	12.6	12.6	12.4	12.4	12.6
ROE	9.6	8.9	9.6	9.1	9.8	9.6	9.4	9.44	5.2
ROA	1.2	1.1	1.2	1.2	1.2	1.2	1.17	1.18	0.64
Liquidity	147.2	137.8	129.2	130.1	126.7	131.9	129.5	133.8	128.9
Total assets growth rate	0.9	2.6	0.3	1.6	1.1	3	1.9	5.4	0.5
Customers' deposits growth rate	1.2	1.1	-0.4	0.9	1.6	2	0.46	4.35	-1
Credit facilities growth rate	5	8.9	5	8	4	5.3	2.6	3.1	4.3

Table 8 revealed that the pandemic has impacted severe effects on banks' performances. The table also shows downward trends in major indicators of banks. By the end of June 2020, the banks' profitability growths; ROA and ROE, sharply declined by 0.54% and 4.24%, respectively, compared with 2019. In addition, NPL increased by 0.4% in June 2020. The coverage ratio was also decreased by 1.5% (excluding restructured and rescheduled loans). This might increase the bank's credit risk together with the low level of capitalization in high-NPL banks. This increase does not represent the actual increase, as banks have postponed and restructured many credit facilities in 2020 that are likely to falter in the future. For liquidity buffer, the table shows that the liquidity ratio decreased by 4.9% by June 2020. The customers' deposits growth rate also declined by 5.35% for the same period. It is important to note that customer deposits represent the major source of banks' liquidity with a high drop in customers' deposits growth rate to reach -1% at the end of the period, indicating a shortage of banks' liquidity and thus increases in banks' liquidity risk. The overall results suggest that the COVID-19 crisis represents the hardest shock that faces the Jordanian banking sector and is expected to put the banking sector under significant stress. This introduces the need for more stringent macroprudential regulation policies, and updates of current CBJ macroprudential instruments to reduce the negative effects on banks' performance to avoid bank failures.

3.3. Regression analysis

The previous results presented only a cursory analysis and description of the historical patterns and paths of the three key performance indicators during the study period. There are a number of factors that may have effects on these indicators, to find out the effects, the study uses panel ordinary least squares (OLS) regression analysis, those panel OLS formulas are built into statistical software. Stock and Watson (2003) point out that can be used easily for analysis purposes.

The Hausman specification test fails to reject the random effects model. Therefore, the regression models are estimated, to find out which instrument has the most effect on banks' ROAs by using eq. (1).

The results of the stationarity test are indicated that the data series of size and GDP contain a unit root and show that the data is conclusively and consistently stationary in the first difference, therefore, we proceed to the first difference at which the data is stationary. The dependent variables panel, unit root test statistics, and critical values for the relevant variables are given in Table 9.

Table 9. The dependent variable data series unit root tests

Dependent variable	*Probability Levin-Lin-Chu**	*Probability ADF-Fisher/Chi-square*	*Probability PP Fisher/Chi-square*
ROA	0.0196	0.0083	0.0005

*Note: * the null hypothesis that all the panels contain a unit root.*

The results of dependent variable I(0) tests indicated that ROA data series are stationary in three types of tests with probabilities less than 5%. The results of independent variables data series unit root tests are given in Table 10. The majority of probabilities for macroprudential regulation instruments are less than 5%, rejecting the null hypothesis that data series have unit roots, indicating that CAR, LTV, and leverage data series are stationary at all levels.

Table 10. The independent variables data series unit root tests

Independent variables	*Probability Levin-Lin-Chu**	*Probability ADF-Fisher/Chi-square*	*Probability PP Fisher/Chi-square*
CAR	0.000	0.0129	0.0055
LTV	0.0001	0.0000	0.0001
LEVERAGE	0.0017	0.045	0.11
SIZE	0.469	0.494	0.945
NI	0.333	0.009	0.001
GROWTH	0.0332	0.627	0.639

*Note: * the null hypothesis that all the panels contain a unit root.*

Both CAR and LTV data series are stationary at I(0) in the three types of unit root tests with probabilities less than 5%. Leverage data series are stationary in two types of tests; Levin-Lin-Chu, and ADF-Fisher/Chi-square. Other variables data series unit root tests results reported above indicated that total assets (*SIZE*) and GDP growth rate (*GROWTH*) so the study proceeds the first difference unit root tests for the non-stationary data series as reported in Table 11.

Table 11. Non-stationary variables data series first difference I(1) unit root tests

First difference variables	*Probability Levin-Lin-Chu**	*Probability ADF-Fisher/Chi-square*	*Probability PP Fisher/Chi-square*
D(SIZE)	0.012	0.007	0.007
D(GROWTH)	0.000	0.000	0.0000

*Note: * the null hypothesis that all the panels contain a unit root.*

The results of Table 11 indicated that the data series of *SIZE* and *GROWTH* are stationary at the first difference. The study employed the cointegration technique to test for the presence of long-run relationships among integrated variables to avoid spurious regression in panel data.

Table 12. Residual cointegration test summary

Residual cointegration test		
Model	*t-statistic*	*Prob.*
ROA	-6.9	0.0000

The results of the cointegration test reported in Table 12 revealed that the variables in the models are cointegrated. The random effect test is also employed. The results are summarized in Table 13.

Table 13. Redundant fixed effect test summary

Variable	*Chi-square statistic*	*Chi-square df*	*Probability*
ROA	54	11	0.000

The probability is higher than 5% to show a failure to reject the null hypothesis, and insure study results that the appropriate method is random for the regression of ROA. Cointegration regressions are built by using FMOLS in the models for this study to examine the relationships between the bank's ROA and the prudential regulation instruments, by using data from 12 listed banks in Jordan for the period 2000–2018.

The cointegration regression results analysis undertaken at a 5% significance level. The criteria for comparing whether the predictor variables were significant in the model was through comparing the corresponding probability value get and $\alpha = 0.05$. If the probability value was less than α, then the predictor variable was significant.

The estimated ROA (FMOLS) regression model (eq. (3)) is as follows:

$$ROA \approx -0.001CAR + 5.4LEVERAGE + 0.009LTV - 0.002GROWTH + 1.12NI + 0.35ST - 0.94SIZE + \varepsilon_{i,t}$$

SE	≈	(0.002)	(1.058)	(0.005)	(0.016)	(0.094)	(0.12)	(0.21)
t	≈	(-0.297)	(5.06)	(1.922)	(-0.106)	(11.96)	(3.002)	(-4.596)
p	≈	(0.767)	(0.000)	(0.05)	(0.91)	(0.000)	(0.003)	(0.000)

(3)

$R^2 \approx 60.8\%$, *adjusted* $R^2 \approx 57.2\%$

From the above regression model holding all the other factors constant, ROA measured by the efficiency and effective implementation of macroprudential regulation instruments from their corresponding predictor values probability were equal or below 5%. The sample overall regression results of ROA showed that LEVERAGE, LTV, NI, and dummy variable (ST) are statistically significant positive coefficient signs. On the other hand, a negative relationship cleared by a negative coefficient sign between ROA with CAR, GROWTH, and SIZE, only size was statistically significant with probability. Similar to the study results, Topak and Talu (2017), suggested that the CAR (equity/total assets) had a negative effect on bank ROAA and ROAE by using a sample of Turkish banks for the period 2005–2015. Ayyagari et al. (2018) found that micro and macro instruments are associated with lower bank's ROA they found that macroprudential policies have real effects, as they are associated with lower investment and profitability. The above results are consistent with hypotheses related to the effect of leverage, LTV, and ST on ROA, at the same time results showed that CAR had an insignificant impact on the bank's ROA on both sector and study sample. The reason stands behind this is that bank's CAR during the study period higher than the percentage decided by the CBJ. While Basel III requires banks to hold higher liquidity ratios along with higher capital ratios, the above findings of a negative relationship between CAR and banks' profitability suggest that imposing higher capital ratios may have a negative effect on the efficiency and profitability of liquid banks.

4. CONCLUSION

This research aims to investigate how macroprudential regulation instruments affect the banking sector's return on assets during financial crises, to find out whether the CBJ macroprudential regulation instruments enhance the performance of the Jordanian banking sector in terms of increase banks' profitability to achieve compatibility between costs and benefits, and to find out if Basel committee reforms and standards appropriate for reducing banking sector exposure to financial crises, and update according to the economic and political situation of the country. More specifically, we consider the effect of four major macroprudential regulation instruments: ST instrument, LTV ratio, CAR, and leverage ratio, on banks' ROA as a key performance and profitability indicator of the banking sector. The main finding of this study is that the macroprudential regulation instruments succeed in keeping the stability of banking sector profitability and showed that leverage, LTV, and dummy variable (ST) are statistically significant with a positive relationship with ROA. On the other hand, CAR had no significant effect, indicating that a good number of the banks in Jordan maintain a CAR higher than the minimum limit required by the CBJ and Basel requirements, LTV and leverage ratios are also higher than the limit decided by regulators, suggest that the Basel standards did not take into consideration the particularity of some countries. This holds pressure on particular capital requirements and suggests that banks operating in Jordan must reconsider the CAR and not freeze assets that can be reinvested to increase profitability and liquidity at banks.

The LTV ratio is considered one of the most important ratios in managing a bank's credit portfolio and must be monitored in order to minimize the bank's exposure to real estate market risks. Since 2008, the CBJ has taken some prudential tools with regard to credit with households. These measures include a risk weight of 100% for mortgage loans with an LTV ratio not exceeding 80% of real estate value. The LTV ratio maximum limit in the licensed banks in Jordan averaged 85.0%. The actual average approximated 87.0% at the end of 2018. This implies that despite the high limit of financing that the banks are allowed to provide house loans, banks contain higher ratios relative to the value of the mortgaged real estate, the reason that might stand beside a higher ratio is that some banks have additional guarantees when granting real estate loans.

The results generated from the regression of analysis stress testing also showed a slightly weak significant effect on the bank's ROA. However, the leverage ratio had the highest deep effect and those banks are highly leveraged with more debt-to-equity ratio. Banks with high leverage are more exposed to default risks arising from debt contracts which aggravate the transmission of risks from the financial system to the real economy.

A new COVID-19 economic crisis came up by the end of 2019. This crisis has unspecified economic impacts due to the spread of the coronavirus and the inability to control its spread, and it is expected to be the worst crisis that the global economy will face.

Despite the problems facing banks in Jordan, the CBJ has taken precautionary measures such as delaying and restructuring the installments of credit facilities and requested banks to grant small, medium, and large companies commercial loans at a reduced interest of 2%. On the other side, the CBJ has reduced the obligatory reserve and lends to banks at a zero interest rate, and reduced interest rate. However, these measures were not sufficient to protect banks from the risks of the crisis, and the performance of banks declined significantly in 2020.

The results of the first half of the year 2020 show a proper level of banks gearing against future economic crises. In addition to that, the annual banks' average CAR, leverage, and LTV ratios are higher than the limits set by the CBJ, imposing higher risk weights on mortgage loans in the calculation of capital-asset ratios, and requiring

larger coverage provisions on mortgage loans. Proper regulating instrument ratios may avoid wasteful use of capital and enhance financial institutions' resilience by restraining asset substitution and risk exposure.

Another important inference is that banks basically depend on their net profit to construct their capital buffer. Essentially, banks have to raise the size of their capital pillars, no matter the risk weights to relevant exposures, and a proportion of the net increase in the value of the bank assets. A weighted instrument ratio is simple to apply and monitor to eliminate regulatory arbitrage and the bank's ability to restore confidence in capital data that was severely undermined by risk-weighted capital requirements and financial innovation.

The last financial crisis exposed weaknesses in several aspects of stress testing schedules. Before the financial crisis in 2008, stress testing at some financial institutions was implemented as an isolated instrument by the bank's risk department with slight interaction with the financial sector. Moreover, for some banks, the ST instrument was a yearly repeated exercise. In fact, to achieve its objective effectively tests can be achieved from the degree of an individual level up to the financial sector as a whole.

Stress tests should be conducted for most risk types including (market, credit, operational, and liquidity risk). In Jordan, however, they mostly focus on banks' solvency or liquidity by investigating whether individual banks have an appropriate capital buffer and adequate liquidity to meet regulation requirements, without considering the case of an undesirable scenario. They, however, can conduct "generation stress testing that infer their recommendations by linearly aggregating individual bank's results, and identifying macroeconomic vulnerabilities generating from network externalities, or liquidity dry-ups stress tests" (Borio et al., 2012, p. 18). This needs a forward paradigm shift, instead of just summing up historical analysis across individual banks.

The Jordanian financial sector trends witnessed negative rating pressure for all banks after the COVID-19 pandemic with a growing need for proper CBJ prudential regulation instruments to reduce the future negative effects. Moreover, supervisors focused mainly on the risks of individual entities or markets without explicitly factoring in the potential impact on bank performance especially profitability.

In fact, the current CBJ macroprudential instruments are traditional and underdeveloped with the word economic developments that affect the privacy of the economy in Jordan. They should be more updated in a way to enhance financial stability to can reduce the banking sector's exposure to financial crises.

The CBJ might review the cost of microprudential and macroprudential regulation instruments implementation for banks, in a relation to the benefits of its implementation. This can be achieved by developing prudential regulation instruments, taking into consideration the economic conditions in Jordan. This improvement may include introducing microprudential and macroprudential regulation instruments relate to profit recognition measurements, this may help banks to increase profitability, and increase hedge against shocks by reducing NPL and keeping sufficient levels of liquidity.

REFERENCES

1. Adeleke, I. A., & Ibrahim, U. A. (2022). Effect of prudential regulation on the financial performance of quoted deposit money banks in Nigeria. *WSEAS Transactions on Business and Economics, 19*, 1195–1205. https://doi.org/10.37394/23207.2022.19.105
2. Adelopo, I., Lloydking, R., & Tauringana, V. (2018). Determinants of bank profitability before, during, and after the financial crisis. *International Journal of Managerial Finance, 14*(4), 378–398. https://doi.org/10.1108/IJMF-07-2017-0148
3. Admati, A. R., DeMatzo, P. M., Hellwig, M. F., & Pfleiderer, P. C. (2018). The leverage ratchet effect. *Journal of Finance, 73*(1). https://doi.org/10.2139/ssrn.2304969
4. Afanasieff, T. S., Carvalho, F. L. C. A., de Castro, E. C., Coelho, R. L. P., & Gregório, J. (2015). *Implementing loan-to-value ratios: The case of auto loans in Brazil (2010-11)* (Working Paper 380). Central Bank of Brazil. https://www.bcb.gov.br/pec/wps/ingl/wps380.pdf
5. Agénor, P.-R. (2019). Growth and welfare effects of macroprudential regulation. *Macroeconomic Dynamics, 23*(8), 3140–3162. https://doi.org/10.1017/S1365100517001080
6. Aggarwal, R., & Jacques, K. T. (2001). The impact of FDICIA and prompt corrective action on bank capital and risk: Estimates using a simultaneous equations model. *Journal of Banking and Finance, 25*(6), 1139–1160. https://doi.org/10.1016/S0378-4266(00)00125-4
7. Agoraki, M.-E. K., Delis, M., & Pasiouras, F. (2011). Regulations, competition and bank risk-taking in transition countries. *Journal of Financial Stability, 7*(1), 38–48. https://doi.org/10.1016/j.jfs.2009.08.002
8. Aguirre, H., & Repetto, G. (2017). *Capital and currency-based macroprudential policies: An evaluation using credit registry data* (BIS Working Paper No. 672). Bank for International Settlements. https://www.bis.org/publ/work672.pdf
9. Aiyar, S., Bergthaler, W., Garrido, J. M., Ilyina, A., Jobst, A., Kang, K. H., Kovtun, D., Liu, Y., Monaghan, D., & Moretti, M. (2015). *A strategy for resolving Europe's problem loans* (IMF Staff Discussion Notes No. 2015/019). International Monetary Fund. https://doi.org/10.5089/9781513591278.006
10. Akinci, O., & Olmstead-Rumsey, J. (2018). How effective are macroprudential policies? An empirical investigation. *Journal of Financial Intermediation, 33*(C), 33–57. https://doi.org/10.1016/j.jfi.2017.04.001
11. Alam, M. M., Sanchez-Azqueta, A., Janha, O., Flannery, E. L., Mahindra, A., Mapesa, K., Char, A. B., Sriranganadane, D., Brancucci, N. M. B., Antonova-Koch, Y., Crouch, K., Simwela, N. V., Millar, S. B., Akinwale, J., Mitcheson, D., Solyakov, L., Dudek, K., Jones, C., Zapatero, C., … Tobin, A. B. (2019). Validation of the protein kinase PfCLK3 as a multistage cross-species malarial drug target. *Science, 365*(6456), Article eaau1682. https://doi.org/10.1126/science.aau1682
12. Albertazzi, U., & Gambacorta, L. (2009). Bank profitability and the business cycle. *Journal of Financial Stability, 5*(4), 393–409. https://doi.org/10.1016/j.jfs.2008.10.002

13. Alkhwaldi, A. F., Alharasis, E. E., Shehadeh, M., Abu-AlSondos, I. A., Oudat, M. S., & Bani Atta, A. A. (2022). Towards an understanding of FinTech users' adoption: Intention and e-loyalty post-COVID-19 from a developing country perspective. *Sustainability, 14*(19), Article 12616. https://doi.org/10.3390/su141912616
14. Angelini, P., Neri, S., & Panetta, F. (2012). *Monetary and macroprudential policies* (Working Paper Series No. 1449). European Central Bank. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1449.pdf
15. Arregui, N., Beneš, J., Krznar, I., Mitra, S., & Santos, A. O. (2013). *Evaluating the net benefits of macroprudential policy: A cookbook* (IMF Working Paper 2013/167). International Monetary Fund. https://doi.org/10.5089/9781484335727.001
16. Awdeh, A., El-Moussawi, C., & Machrouh, F. (2011). The effect of capital requirements on banking risk. *International Research Journal of Finance and Economics, 66*, 133–146. https://www.researchgate.net/publication/281297216_The_Effect_of_Capital_Requirements_on_Banking_Risk
17. Ayyagari, M., Beck, T., & Peria, M. S. M. (2018). *The micro impact of macroprudential policies: Firm-level evidence* (IMF Working Paper 2018/267). International Monetary Fund. https://doi.org/10.5089/9781484385654.001
18. Bakker, B. B., Dell'Ariccia, G., Laeven, L., Vandenbussche, J., Igan, D. O., & Tong, H. (2012). Policies for macrofinancial stability: How to deal with credit booms (IMF Staff Discussion Notes 2012/006). International Monetary Fund. https://doi.org/10.5089/9781475504743.006
19. Barroso, J. B. R. B., Barbone Gonzalez, R., & Van Doornik, B. F. N. (2017). *Credit supply responses to reserve requirement: Loan-level evidence from macroprudential policy* (Working Paper 467). Central Bank of Brazil. https://www.bcb.gov.br/pec/wps/ingl/wps467.pdf
20. Basel Committee on Banking Supervision (BCBS). (2009). *Principles for sound stress testing practices and supervision*. Bank for International Settlements. https://www.bis.org/publ/bcbs155.pdf
21. Basel Committee on Banking Supervision (BCBS). (2010). *Basel III: A global regulatory framework for more resilient banks and banking systems*. Bank for International Settlements. https://www.bis.org/publ/bcbs189_dec2010.htm
22. Basel Committee on Banking Supervision (BCBS). (2011). *A global regulatory framework for more resilient banks and banking systems*. Bank for International Settlements. https://www.bis.org/publ/bcbs189.htm
23. Beck, T., Demirgüç-Kunt, A., & Merrouche, O. (2013). Islamic vs. conventional banking: Business model, efficiency and stability. *Journal of Banking & Finance, 37*(2), 433–447. https://doi.org/10.1016/j.jbankfin.2012.09.016
24. Behncke, S. (2022). Effects of macroprudential policies on bank lending and credit risks. *Journal of Financial Services Research*. Advance online publication. https://doi.org/10.1007/s10693-022-00378-z
25. Ben Naceur, S. (2003). *The determinants of the Tunisian banking industry profitability: Panel evidence*. https://www.mafhoum.com/press6/174E11.pdf
26. Ben Naceur, S., Pepy, J., & Roulet, C. (2017). *Basel III and bank-lending: Evidence from the United States and Europe* (IMF Working Paper No. 2017/245). International Monetary Fund. https://www.imf.org/en/Publications/WP/Issues/2017/11/15/Basel-III-and-Bank-Lending-Evidence-from-the-United-States-and-Europe-45345
27. Benediktsdottir, S., Feldberg, G., & Liang, N. (2020, April 6). What macroprudential policies are countries using to help their economies through the COVID-19 crisis? *Brookings Up Front*. https://www.brookings.edu/blog/up-front/2020/04/06/what-macroprudential-policies-are-countries-using-to-help-their-economies-through-the-covid-19-crisis/
28. Berger, A. N., Herring, R. J., & Szego, G. P. (1995). The role of capital in financial institutions. *Journal of Banking and Finance, 19*(3–4), 393–430. https://doi.org/10.1016/0378-4266(95)00002-X
29. Black, L, Correa, R., Huang, X., & Zhou, H. (2016). The systemic risk of European banks during the financial and sovereign debt crises. *Journal of Banking and Finance, 63*, 107–125. https://doi.org/10.1016/j.jbankfin.2015.09.007
30. Blundell-Wignall, A., & Atkinson, P. E. (2010), Thinking beyond Basel III: Necessary solutions for capital and liquidity. *OECD Journal of Financial Market Trends, 2010*(1), 9–33. https://doi.org/10.1787/fmt-2010-5km7k9tpcjmn
31. Bonner, C., & Eijffinger, S. C. W. (2016). The impact of liquidity regulation on bank intermediation. R*eview of Finance, 20*(5), 1945–1979. https://doi.org/10.1093/rof/rfv058
32. Borio, C. (2003). *Towards a macroprudential framework for financial supervision and regulation?* (BIS Working Paper No. 128). https://doi.org/10.2139/ssrn.841306
33. Borio, C., Drehmann, M., & Tsatsaronis, K. (2012). *Stress-testing macro stress testing: Does it live up to expectations?* (BIS Working Papers No. 369). Bank for International Settlements. https://www.bis.org/publ/work369.pdf
34. Borio, C., Furfine, C., & Lowe, P. (2001). Procyclicality of the financial system and financial stability: Issues and policy options. In Bank for International Settlements (Ed.), *Marrying the macro- and micro-prudential dimensions of financial stability* (BIS Papers No. 1, pp. 1–57). Bank for International Settlements. https://www.bis.org/publ/bppdf/bispap01a.pdf
35. Brand, A., Allen, L., Altman, M., Hlava, M., & Scott, J. (2015). Beyond authorship: Attribution, contribution, collaboration, and credit. *Learned Publishing, 28*(2), 151–155. https://doi.org/10.1087/20150211
36. Brunnermeier, M., Crocket, A., Goodhart, C., Persaud, A. D., & Shin, H. S. (2009). *The fundamental principles of financial regulation* (Geneva Reports on the World Economy 11). International Center for Monetary and Banking Studies. https://www.princeton.edu/~markus/research/papers/Geneva11.pdf
37. Bučková, V., & Reuse, S. (2011). Basel III global liquidity standards: Critical discussion and impact onto the European banking sector. *Financial Assets and Investing, 3*, 7–18. https://is.muni.cz/do/econ/soubory/aktivity/fai/27900200/FAI_issue2011_03_buckova_reuse.pdf
38. Cavallo, M., & Majnoni, G. (2002). Do banks provision for bad loans in good times? Empirical evidence and policy implications. In R. M. Levich, G. Majnoni, & C. Reinhart (Eds.), *Ratings, rating agencies and the global financial system* (pp. 319–342). Kluwer Academic Publishers. https://link.springer.com/chapter/10.1007/978-1-4615-0999-8_19
39. Cerutti, E. M., Claessens, S., & Laeven, L. (2015). *The use and effectiveness of macroprudential policies: New evidence* (IMF Working Paper No. 15/61). International Monetary Fund. https://www.imf.org/external/pubs/ft/wp/2015/wp1561.pdf
40. Ciuriak, D. (2001). (2010). *Implementing better banking regulation and standards: Lessons from the past*. https://doi.org/10.2139/ssrn.1556026
41. Claessens, S., Ghosh, S. R., & Mihet, R. (2013). Macro-prudential policies to mitigate financial system vulnerabilities. *Journal of International Money and Finance, 39*, 153–185. https://doi.org/10.1016/j.jimonfin.2013.06.023

42. Clement, P. (2010). The term "macroprudential": Origins and evolution. *BIS Quarterly Review, 2010*, 59–67. https://www.bis.org/publ/qtrpdf/r_qt1003h.htm
43. Crockett, A. (2000, September 21). *Marrying the micro- and macro-prudential dimensions of financial stability* [Remarks]. The Eleventh International Conference of Banking Supervisors. Bank for International Settlements. https://www.bis.org/speeches/sp000921.htm
44. Dănilă, O. M. (2012). Impact and limitations deriving from Basel II within the context of the current financial crisis. *Theoretical and Applied Economic, 19*(6), 121–134. http://store.ectap.ro/articole/740.pdf
45. Davis, E. P., & Karim, D., & Noel, D. (2022). The effects of macroprudential policy on banks' profitability. *International Review of Financial Analysis, 80*, Article 101989. https://doi.org/10.1016/j.irfa.2021.101989
46. Davis, H. E., Assaf, G. S., McCorkell, L., Wei, H., Low, R. J., Re'em, Y., Redfield, S., Austin, J. P., & Akrami, A. (2021). Characterizing long COVID in an international cohort: 7 months of symptoms and their impact. *eClinicalMedicine, 38*, Article 101019. https://doi.org/10.1016/j.eclinm.2021.101019
47. de Bandt, O. R., Luc, J., & Thibault, L. (2021). *Climate change in developing countries: Global warming effects, transmission channels and adaptation policies* (Banque de France Working Paper No. 822). HAL Science. https://hal.science/hal-03948704v1/file/BFwp822_0.pdf
48. Demirgüc-Kunt, A., & Huizinga, H. (1999). Determinants of commercial bank interest margins and profitability: Some international evidence. *The World Bank Economic Review, 13*(2), 379–408. https://doi.org/10.1093/wber/13.2.379
49. Elsas, A., Hackethal, A., & Holzhäuser, M. (2010). The anatomy of bank diversification. *Journal of Banking & Finance, 34*(6), 1274–1287. https://doi.org/10.1016/j.jbankfin.2009.11.024
50. Fell, J., Grodzicki, M., Krušec, D., Martin, R., & O'Brien, E. (2017). Overcoming non-performing loan market failures with transaction platforms. *Financial Stability Review, 2*, 130–144. European Central Bank. https://www.ecb.europa.eu/pub/pdf/other/ecb.sfafinancialstabilityreview201711.en.pdf
51. Financial Stability Board (FSB). (2017, July 3). F*ramework for post-implementation evaluation of the effects of the G20 financial regulatory reforms*. https://www.fsb.org/wp-content/uploads/P030717-4.pdf
52. Gaganis, C., Galariotis, E., Pasiouras, F., & Staikouras, C. (2021). Macroprudential regulations and bank profit efficiency: International evidence. *Journal of Regulatory Economics, 59*, 136–160. https://doi.org/10.1007/s11149-021-09424-5
53. Galati, G., & Moessner, R. (2014). *What do we know about the effects of macroprudential policy?* (DNB Working Paper No. 440). De Nederlandsche Bank. https://www.dnb.nl/media/i4cbkhdm/working-paper-440.pdf
54. Goddard, J., Molyneux, P., & Wilson, J. O. S. (2004). The profitability of European banks: A cross-sectional and dynamic panel analysis. *The Manchester School, 72*(3), 363–381. https://doi.org/10.1111/j.1467-9957.2004.00397.x
55. Goddard, J., Molyneux, P., & Wilson, J. O. S. (2014). Banking in the European Union: Deregulation, crisis, and renewal. In A. N. Berger, P. Molyneux, & J. O. S. Wilson (Eds.), *The Oxford handbook of banking* (2nd ed.). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199688500.013.0035
56. Goodhart, C. (2008). The boundary problem in financial regulation. *National Institute Economic Review, 206*, 48–55. https://www.jstor.org/stable/23880793
57. Goodhart, C., Hofmann, B., & Segoviano, M. (2004). Bank regulation and macroeconomic fluctuations. *Oxford Review of Economic Policy, 20*(4), 591–615. https://doi.org/10.1093/oxrep/grh034
58. Goyal, A. (2013). Impact of capital structure on the performance of listed public sector banks in India. *International Journal of Business and Management Invention, 2*, 35–43.
59. Gržeta, I., Žiković, S., & Tomas Žiković, I. (2023). Size matters: Analyzing bank profitability and efficiency under the Basel III framework. *Financial Innovation, 9*(1), Article 43. https://doi.org/10.1186/s40854-022-00412-y
60. Hanson, S. G., Kashyap, A. K., & Stein, J. C. (2011). A macroprudential approach to financial regulation. *Journal of Economic Perspectives, 25*(1), 3–28. https://doi.org/10.1257/jep.25.1.3
61. Hellmann, T. E., Murdock, K. C., & Stiglitz, J. E. (2000). Liberalization, moral hazard in banking, and prudential regulation: Are capital requirements enough? *American Economic Review, 90*(1), 147–165. https://doi.org/10.1257/aer.90.1.147
62. Hoffmann, P. S. (2011). Determinants of the profitability of the US banking industry. *International Journal of Business and Social Science, 2*(22), 255–269. https://ijbssnet.com/journals/Vol_2_No_22_December_2011/30.pdf
63. Houston, J. F., Lin, C., Lin, P., & Ma, Y. (2010). Creditor rights, information sharing, and bank risk taking. *Journal of Financial Economics, 96*(3), 485–512. https://ideas.repec.org/a/eee/jfinec/v96y2010i3p485-512.html
64. Igan, D. O., & Kang, H. (2011). *Do loan-to-value and debt-to-income limits work? Evidence from Korea* (IMF Working Paper 2011/297). International Monetary Fund. https://doi.org/10.5089/9781463927837.001
65. Izquerido, A., Loo-Kung, R. J., & Rojas-Suarez, L. (2013). *Macroprudential regulations in Central America* (Center for Global Development Working Paper No. 318). https://doi.org/10.2139/ssrn.2236383
66. Jablecki, J. (2009). The impact of Basel I capital requirements on bank behaviour and the efficacy of monetary policy. *International Journal of Economic Sciences and Applied Research, 2*(1), 16–35. https://www.econstor.eu/bitstream/10419/66656/1/65895587X.pdf
67. Jacques, K., & Nigro, P. (1997). Risk-based capital, portfolio risk, and bank capital: A simultaneous equations approach. *Journal of Economics and Business, 49*(6), 533–547. https://doi.org/10.1016/S0148-6195(97)00038-6
68. Jokipii, T., & Milne, A. (2008). The cyclical behaviour of European bank capital buffers. *Journal of Banking & Finance, 32*(8), 1440–1451. https://doi.org/10.1016/j.jbankfin.2007.12.001
69. Juelsrud, R. E., Wold, E. G. (2020). Risk-weighted capital requirements and portfolio rebalancing. *Journal of Financial Intermediation, 41*, Article 100806. https://doi.org/10.1016/j.jfi.2018.10.002
70. Juliana, P., He, X., Kabir, M. R., Roy, K. K., Anwar, M. B., Marza, F., Poland, J., Shrestha, S., Singh, R. P., & Singh, P. K. (2020). Genome-wide association mapping for wheat blast resistance in CIMMYT's international screening nurseries evaluated in Bolivia and Bangladesh. *Scientific Reports, 10*(1), Article 15972. https://doi.org/10.1038/s41598-020-72735-8
71. Kerwer, D. (2005). Holding global regulators accountable: The case of credit rating agencies. *Governance: An International Journal of Policy, Administration, and Institutions, 18*(3), 453–475. https://doi.org/10.1111/j.1468-0491.2005.00284.x
72. Kim, D., & Sohn, W. (2017). The effect of bank capital on lending: Does liquidity matter? *Journal of Banking and Finance, 77*, 95–107. https://doi.org/10.1016/j.jbankfin.2017.01.011

73. Kodres, L., & Narain, A. (2009). What is to be done. *Finance and Development, 46*(1), 23–26. International Monetary Fund. https://www.imf.org/external/pubs/ft/fandd/2009/03/kodres.htm
74. Korytowski, M. (2018). Banks' profitability determinants in post-crisis European Union. *Journal of Finance & Banking Studies, 7*(1), 1–12. https://www.ssbfnet.com/ojs/index.php/ijfbs/article/view/14
75. Kuttner, K., & Shim, I. (2012). Taming the real estate beast: The effects of monetary and macroprudential policies on housing prices and credit. In A. Heath, F. Packer, & C. Windsor (Ed.), *Property markets and financial stability*. Reserve Bank of Australia.
76. Laeven, L., & Claessens, S. (2004). *What drives bank competition? Some international evidence*. https://ssrn.com/abstract=509605
77. Lim, E. L., Hollingsworth, K. G., Aribisala, B. S., Chen, M. J., Mathers, J. C., & Taylor, R. (2011). Reversal of type 2 diabetes: Normalisation of beta cell function in association with decreased pancreas and liver triacylglycerol. *Diabetologia, 54*(10), 2506–2514. https://doi.org/10.1007/s00125-011-2204-7
78. Marzuki, A., Atta, A. A. B., & Worthington, A. (2022). Attributes and performance of fund management companies: Evidence from the largest Shariah-compliant fund markets. *Journal of Nusantara Studies (JONUS), 7*(1), 114–141. https://doi.org/10.24200/jonus.vol7iss1pp114-141
79. Matutes, C., & Vives, X. (2000). Imperfect competition, risk taking, and regulation in banking. *European Economic Review, 44*(1), 1–34. http://web.worldbank.org/archive/website01589/WEB/IMAGES/MATUTES.PDF
80. Maudos, J., & Pastor, J. M. (2001). Cost and profit efficiency in banking: An international comparison of Europe, Japan and USA. *Applied Economics Letters, 8*(6), 383–387. https://doi.org/10.1080/135048501750237829
81. Messai, A. S., & Jouini, F. (2013). Micro and macro determinants of non-performing loans. *International Journal of Economics and Financial Issues, 3*(4), 852–860. https://www.econjournals.com/index.php/ijefi/article/view/517
82. Minaya, E., Lupú, J., & Cabello, M. (2017). *Macroprudential policies in Peru: The effects of dynamic provisioning and conditional reserve requirements* (BIS Working Paper No. 675). Bank for International Settlements. https://www.bis.org/publ/work675.pdf
83. Morgan, P. J., Regis, P. J., & Salike, N. (2019). LTV policy as a macroprudential tool and its effects on residential mortgage loans. *Journal of Financial Intermediation, 37*, 89–103. https://doi.org/10.1016/j.jfi.2018.10.001
84. Mustafa, J. A. (2020). The impact of prudential regulation on Jordanian banks liquidity. *International Journal of Business and Economics Research, 9*(5), 342–347. https://www.sciencepublishinggroup.com /journal/paperinfo?journalid=178&doi=10.11648/j.ijber.20200905.17
85. Navajas, M., & Thegeya, A. (2013). *Financial soundness indicators and banking crisis* (IMF Working Paper 2013/263). International Monetary Fund. https://doi.org/10.5089/9781484327616.001
86. Neagu, F., Tatarici, L., & Mihai, I, (2015). *Implementing loan-to-value and debt service-to-income measures: A decade of Romanian experience* (MPRA Paper 65988). Munich Personal RePEc Archive. https://mpra.ub.uni-muenchen.de/65988/
87. Nieminen, P., Lehtiniemi, H., Vähäkangas, K., Huusko, A., & Rautio, A. (2013). Standardised regression coefficient as an effect size index in summarising findings in epidemiological studies. *Epidemiology, Biostatistics and Public Health, 10*(4). https://doi.org/10.2427/8854
88. Nier, E., Yang, J., Yorulmazer, T., & Alentorn, A. (2008). *Network models and financial stability* (Working Paper No. 346). Bank of England. https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2008/network-models-and-financial-stability.pdf
89. Noss, J., & Toffano, P. (2016). Estimating the impact of changes in aggregate bank capital requirements on lending and growth during an upswing. *Journal of Banking & Finance, 62*, 15–27. https://doi.org/10.1016/j.jbankfin.2015.09.020
90. Nour, A. N., & Albustanji, J. (2013). The role of the Central Bank of Jordan in capturing the repercussions of the global financial crisis on the banks working in Jordan. *Jordan Journal of Business Administration, 9*(2), 356–370. https://archives.ju.edu.jo/index.php/JJBA/article/view/4455
91. Nymoen, R., Pedersen, K., & Sjaberg, J. I. (2019). Estimation of effects of recent macroprudential policies in a sample of advanced open economies. *International Journal of Financial Studies, 7*(2), Article 23. https://doi.org/10.3390/ijfs7020023
92. Obadire, A. M., & Moyo, V., & Munzhelele, N. F. (2022). Basel III capital regulations and bank efficiency: Evidence from selected African countries. *International Journal of Financial Studies, 10*(3), Article 57. https://doi.org/10.3390/ijfs10030057
93. Ostry, J. D., Ghosh, A. R., Chamon, M., & Qureshi, M. S. (2012). Tools for managing financial-stability risks from capital inflows. *Journal of International Economics, 88*(2), 407–421. https://doi.org/10.1016/j.jinteco.2012.02.002
94. Pacces, A. M., & Heremans, D. (2011). Regulation of banking and financial markets. In A. Pacces, R. J. Van den Berg (Eds.), *Regulation and economics: Second edition encyclopedia of law and economics*. Cheltenham. https://repub.eur.nl/pub/34943/
95. Pasiouras, F., & Kosmidou, K. (2007). Factors influencing the profitability of domestic and foreign commercial banks in the European Union. *Research in International Business and Finance, 21*(2), 222–237. https://doi.org/10.1016/j.ribaf.2006.03.007
96. Peria, M. S. M, Majnoni, G., Jones, M. T., & Blaschke, W. (2001). Stress testing of financial systems: An overview of issues, methodologies, and FSAP experiences (IMF Working Paper 2011/088). International Monetary Fund. https://doi.org/10.2139/ssrn.879626
97. Peterson, R. A., & Brown, S. P. (2005). On the use of beta coefficients in meta-analysis. *Journal of Applied Psychology, 90*(1), Article 175. https://doi.org/10.1037/0021-9010.90.1.175
98. Petria, N., Capraru, B., & Ihnatov, I. (2015). Determinants of banks' profitability: evidence from EU 27 banking systems. *Procedia Economics and Finance, 20*, 518–524. https://doi.org/10.1016/S2212-5671(15)00104-5
99. Reinhardt, D., & Sowerbutts, R. (2015). *Regulatory arbitrage in action: Evidence from banking flows and macroprudential policy* (Bank of England Working Paper No. 546). https://doi.org/10.2139/ssrn.2660121
100. Reite, E. J., Prestmo, J. B., & Oust, A. (2022). Loan-to-value regulations on mortgages and the use and refinancing of unsecured debt. *Journal of Real Estate Research.* Advance online publication. https://doi.org/10.1080 /08965803.2022.2109654
101. Rice, K., Higgins, J. P. T., & Lumley, T. (2018). A re-evaluation of fixed effect(s) meta-analysis, *Journal of the Royal Statistical Society: Series A: Statistics in Society, 181*(1), 205–227. https://doi.org/10.1111/rssa.12275

102. Richter, B., Schularick, M., & Shim, I. (2019). The costs of macroprudential policy. *Journal of International Economics, 118*, 263–282. https://doi.org/10.1016/j.jinteco.2018.11.011
103. Rime, B. (2001). Capital requirements and bank behaviour: Empirical evidence for Switzerland. *Journal of Banking & Finance, 25*(4), 789–805. https://doi.org/10.1016/S0378-4266(00)00105-9
104. Roulet, C. (2018). Basel III: Effects of capital and liquidity regulations on European bank lending. *Journal of Economics and Business, 95*, 26–46. https://doi.org/10.1016/j.jeconbus.2017.10.001
105. Saona, P. (2016). Intra- and extra-bank determinants of Latin American banks' profitability. *International Review of Economics & Finance, 45*, 197–214. https://doi.org/10.1016/j.iref.2016.06.004
106. Shi, Y., Zhang, W., Yang, Y., Murzin, A. G., Falcon, B., Kotecha, A., van Beers, M., Tarutani, A., Kametani, F., Garringer, H. J., Vidal, R., Hallinan, G. I., Lashley, T., Saito, Y., Murayama, S., Yoshida, M., Tanaka, H., Kakita, A., Ikeuchi, T., Robinson, A. C., … Scheres, S. H. W. (2021). Structure-based classification of tauopathies. *Nature, 598*, 359–363. https://doi.org/10.1038/s41586-021-03911-7
107. Shrieves, R. E., & Dahl, D. (1992). The relationship between risk and capital in commercial banks. *Journal of Banking & Finance, 16*(2), 439–457. https://doi.org/10.1016/0378-4266(92)90024-T
108. Siregar, R. Y., & Lim, V. C. S. (2010). The Role of central banks in sustaining economic recovery and in achieving financial stability. *Journal of Advanced Studies in Finance, 1*(1), 83–99. https://journals.aserspublishing.eu/jasf/article/view/28
109. Sorge, M. (2004). *Stress-testing financial systems: An overview of current methodologies* (BIS Working Paper No. 165). https://doi.org/10.2139/ssrn.759585
110. Stanley, T. D. (2001). Wheat from chaff: Meta-analysis as quantitative literature review. *Journal of Economic Perspectives, 15*(3), 131–150. https://doi.org/10.1257/jep.15.3.131
111. Stanley, T., & Doucouliagos, H. (2014). Meta-regression approximations to reduce publication selection bias. *Research Synthesis Methods, 5*(1), 60–78. https://doi.org/10.1002/jrsm.1095
112. Stock, J. H., & Watson, M. W. (2003). Forecasting output and inflation: The role of asset prices. *Journal of Economic Literature, 41*(3), 788–829. https://doi.org/10.1257/jel.41.3.788
113. Svensson, K., Ramirez, O. F., Peres, F., Barnett, M., & Claudio, L. (2012). Socioeconomic determinants associated with willingness to participate in medical research among a diverse population. *Contemporary Clinical Trials, 33*(6), 1197–1205. https://doi.org/10.1016/j.cct.2012.07.014
114. Tantasith, C., Ananchotikul, N., Chotanakarn, C., Limjaroenrat, V., & Pongsaparn, R. (2018). *The impact of LTV policy on bank lending: Evidence from disaggregate housing loan data* (PIER Discussion Papers 90). Puey Ungphakorn Institute for Economic Research. https://ideas.repec.org/p/pui/dpaper/90.html
115. Tarne, R., Bezemer, D., & Theobald, T. (2022). The effect of borrower-specific loan-to-value policies on household debt, wealth inequality and consumption volatility: An agent-based analysis. *Journal of Economic Dynamics and Control, 144*, Article 104526. https://doi.org/10.1016/j.jedc.2022.104526
116. Tillmann, P. (2015). Estimating the effects of macroprudential policy shocks: A Qual VAR approach. *Economic Letters, 135*, 1–4. https://doi.org/10.1016/j.econlet.2015.07.021
117. Topak, M. S., & Talu, N. H. (2017). Bank specific and macroeconomic determinants of bank profitability: Evidence from Turkey. *International Journal of Economics and Financial Issues, 7*(2), 574–584. https://dergipark.org.tr/en/download/article-file/365937
118. Yuan, M., Xia, P., May, C., Van Durme, B., & Boyd-Graber, J. (2022). Adapting coreference resolution models through active learning. In *Proceedings of the 60th Annual Meeting of the Association for Computational Linguistics* (Vol. 1: Long Papers, pp. 7533–7549). Association for Computational Linguistics. http://doi.org/10.18653/v1/2022.acl-long.519
119. Zhang, Z.-y., Wu, J., & Liu, Q.-f. (2008). Impacts of capital adequacy regulation on risk-taking behaviors of banking. *Systems Engineering — Theory & Practice, 28*(8), 183–189. https://doi.org/10.1016/S1874-8651(09)60035-1