Economics and Statistics Research Journal (ESRJ)
Volume.13, Number 5; May-2022;
ISSN: 2836-8398 | Impact Factor: 6.56
https://zapjournals.com/Journals/index.php/esrj
Published By: Zendo Academic Publishing

EXPLORING THE IMPACT OF REGULATORY MEASURES ON CAPITAL AND RISK-TAKING OF TUNISIAN BANKS

[1]Louzis D. P and [2]Vouldis, A. T

Article Info
Keywords: capital buffers, risk-taking adjustments, Tunisian commercial banks, panel ARDL-PMG approach

Abstract
This study examines the long-term determinants of capital buffers and risk-taking adjustments of listed Tunisian commercial banks in response to regulatory and macroeconomic events in the post-revolution era. The research uses a panel autoregressive distributed lags technique to investigate the factors that influence the capital and risk-taking decisions in Tunisian banks, taking into account the impact of bank-specific, macroeconomic and regulatory variables. The empirical findings suggest that capital standards are still a significant prudential tool for maintaining the robustness of Tunisian banks. However, the study also confirms the existence of a moral hazard and procyclical behavior of Tunisian banks in response to capital requirements. Moreover, the sample size could be extended if more data were available, and a possible long-term simultaneous relationship between capital and risk-taking was not considered. The study recommends that Tunisian banks diversify their sources of revenue and revise their business models to become less dependent on revenue from traditional intermediation activities. By doing so, they will be able to reduce the procyclicality of the banking system and minimize the banking risks.

1. Introduction

Recently, in the aftermath of the revolution, the Tunisian regulatory authority (the Central Bank of Tunisia - CBT) adopted several prudential directives inspired by Basel III. More specifically, between 2012 and 2014, the minimum risk-weighted capital ratio moved from 8% to 10% and further steps were taken to enhance the quality of regulatory capital through a redefinition of regulatory capital instruments. Banks have had to deal with several other prudential reforms related to loan loss and liquidity management.

In addition to this stringent regulatory environment, the Tunisian economy experienced a twin deficits deterioration (current and budgetary deficits) causing a depreciation of the Tunisian dinar and exposing banks to a liquidity stress. More importantly, the hike of the price inflation rate led the CBT to revise upward, on several occasions, its policy rate. With the increase of the money market rate, Tunisian banks experienced a deceleration of their credit supply mainly caused by an increase in borrowing costs. Tunisian banks were also forced to

[1] École Supérieure de Commerce de Tunis, Manouba University, Tunisia
[2] École Supérieure de Commerce de Tunis, Manouba University, Tunisia

increase the remuneration of deposit and saving accounts and to bear higher borrowing costs on the interbank market. During this period, the economic growth rate was also quite volatile and reached its lowest levels in decades, exposing banks to business cycle fluctuations.

Consequently, it is interesting to explore the long-term reaction of Tunisian Banks in response to these turbulent regulatory and macroeconomic environments and especially to the capital regulation reform. This paper focuses exclusively on the long-term impacts of bank-specific variables, business cycle and regulatory pressure on the capital buffers and risk-taking adjustment of the largest Tunisian banks during the post-revolution era. Even though recent macroeconomic and regulatory events exerted, and are still exerting, a tremendous impact on the business environment in which Tunisian banks are operating, there are as yet, to the best of our knowledge, no studies that focus on this issue in the context of the Tunisian banking system in the turbulent post-revolution era. Moreover, although several studies have explored the determinants of capital and risk-taking adjustment, this has mainly been through the estimation of simultaneous equation frameworks that focus on short-term causality (El-Khoury, 2020; Godlewski, 2005; Jacques & Nigro, 1997; Nguyen, Gan, & Li, 2019; Rime, 2001; Saadaoui, 2014; Shim, 2013; Shrieves & Dahl, 1992; Zheng, Moudud-Ul-Huq, Rahman, & Ashraf, 2017). Static or dynamic panel models have been used for this purpose without disentangling the short-term from the long-term effects. Also, these methods may produce biased estimators, due to the problem of non-stationarity. This paper innovates by assuming that a set of bank-specific, macroeconomic and regulatory variables exerts a long-term rather than a short-term effect on capital buffers and risk-taking. We expect these explanatory factors to have a homogenous long-term impact on the capital buffers and risk adjustments of listed Tunisian banks. The Panel autoregressive distributed lags technique is used to control for unit root processes and to check for long-term determinants of capital and risk-taking adjustment.

The second section of this paper provides a brief review of the theoretical and empirical literature focusing on banks' responses to capital requirements. The third section presents the research methodology used to explore the reaction of banks to capital requirements and the long-term determinants of Tunisian banks' capital and risk-taking decisions. In the fourth section, after running unit root tests, we present the statistical properties of the selected variables. Then, the estimation results are presented and interpreted. The last section concludes the paper with some policy implications.

2. How Do Banks React to Capital Requirements?

2.1. Theoretical Arguments

The purpose behind the adoption of the Basel Committee's capital standards by a large number of jurisdictions around the world was to contain excessive bank risk-taking and prevent banking crises. However, this regulatory tool may unexpectedly induce excessive risk-taking when depositors' funds are insured. When the deposit insurance premium is under-priced, bank shareholders are expected to boost asset returns by increasing debts and reducing capital investment in order to maximize deposit-insurance option value (Merton, 1977). This risky behaviour is theoretically explained by the moral hazard related to deposit-insurance systems with flat premiums. In their seminal work, Shrieves & Dahl (1992) proved the existence of a negative relationship between bank risktaking and bank capital.

In addition, regarding their funding structure, banks often prefer debt over capital instruments because the latter are costly. Equity capital requires high risk-premiums in addition to administrative, screening and operational costs. Binding capital requirements and leverage restrictions in the presence of market imperfections like asymmetric information, agency conflicts and costly-state screening may induce banks to follow risky strategies in order to increase earnings more rapidly and/or to preserve shareholders' value, while avoiding regulatory sanctions (Besanko & Kanatas, 1996; Blum, 1999; Jeitschko & Jeung, 2005; Kopecky & VanHoose, 2006).

Also, banks seeking to recapitalize faster or to improve their conformity to capital standards may adopt risky competitive strategies. In monopolistic competitive deposit markets, capital requirements generate additional costs that make this prudential tool Pareto-inefficient. Indeed, harsh competition may push banks to increase interest rates on deposits in order to preserve their market power. This behaviour is likely to undermine the intermediation margin of value-maximizing banks, making them more inclined to invest in riskier assets or even to pursue gambling strategies to increase revenues (Hellmann, Murdock, & Stiglitz, 2000). In response to more stringent capital standards, banks that want to preserve their market power may target a higher charter value by setting higher interest rates on loans which may induce higher risk taking behaviour in borrowing firms. In consequence, increased capital requirements could destabilize the banking system through higher intermediation costs (Hakenes & Schnabel, 2011).

Moreover, banks are also expected to adjust their capital in reaction to boom and bust periods. Cognitive biases, leading to a disaster myopia problem, may exacerbate the countercyclical behaviour of capital buffers. Under this assumption, banks are expected to underestimate risk and reduce capital coverage during upturns and expected to adopt excessive deleveraging strategies during downturns (Borio, Furfine, & Lowe, 2001; Curry, Fissel, & Hanweck, 2008; Lowe, 2002). In addition, the existence of capital adjustment costs due to asymmetric information in capital markets impedes forward-looking banks from reacting instantaneously to unexpected loan losses during upturns. These adjustment costs give rise to a negative co-movement between bank capital and the business cycle (Estrella, 2004). On the other hand, imperfections related to risk measurement biases often lead to an underestimation of unexpected loan losses during upturns and to an overestimation of risks during downturns (Borio et al., 2001; Curry et al., 2008).

2.2. Empirical Evidence

On the empirical side, several American researchers have explored the determinants of the capital decisions of US banks before the adoption of the Basel I international capital framework in June 1988 (Keeley, 1988; Marcus, 1983; Mingo, 1975). They found that capital standards were already efficient in improving the capital position of US banks. The literature after the adoption of the Basel I and Basel II international capital standards by a large number of developed and emerging economies has explored the main research issues of the simultaneous relationship between capital and risk-taking, the impact of regulatory pressure on bank behaviour and the procyclicality of banking systems.

The empirical contributions have mainly focused on the short-term mechanisms governing the simultaneous relationship between bank capital and risk-taking. They have shown ambiguous results concerning the bidirectional causality between capital and risk-taking. Some studies demonstrated that banks operating under capital constraints increase risk-taking in response to upward capital adjustments, reflecting an asset-substitution problem in the presence of asymmetric information between banks and regulatory authorities (Godlewski, 2005; Jacques & Nigro, 1997; Rime, 2001; Saadaoui, 2011; Shrieves & Dahl, 1992; Zheng et al., 2017). In conformity with Marcus (1983) and Keeley (1988), other studies found that the incentive constraint related to capital requirements induces banks to reduce risk-taking capital increases (Cannata & Quagliariello, 2006; El-Khoury, 2020; Nguyen et al., 2019; Saadaoui., 2014). In contrast, other contributions found that capital standards induce a positive reaction of bank capital to excessive risk-taking (Cannata & Quagliariello, 2006; Rime, 2001; Shrieves & Dahl, 1992). However, there is also a great deal of evidence that risk-taking is associated with a decrease rather than an increase of capital, suggesting the existence of a bank moral hazard (Coffinet, Coudert, Pop, & Pouvelle, 2012; El-Khoury, 2020; Nguyen et al., 2019; Saadaoui., 2014; Zheng et al., 2017).

One strand of empirical studies, using different measures of regulatory pressure, found that undercapitalized banks are more inclined to increase capital and/or reduce risk-taking in order to improve their conformity with capital rules (Aggarwal & Jacques, 2001; Godlewski, 2005; Guidara, Soumaré, & Tchana, 2013; Saadaoui, 2011; Shrieves & Dahl, 1992). However, other findings provide puzzling results on the reaction of banks to regulatory pressure. In fact, for various samples of banks operating in different countries and with different income levels, banks are found to increase risk-taking and/or to reduce capital in the presence of stronger regulatory pressure, suggesting the existence of a moral hazard or gambling for resurrection problems (El-Khoury, 2020; Nguyen et al., 2019). Similarly, findings concerning the procyclicality of bank behaviour also remain inconclusive. Although the procyclicality of capital buffers has been verified for many developed countries, this behaviour is less evident in emerging countries' banking systems (Coffinet et al., 2012; Jokipii & Milne, 2008; Saadaoui, 2015; Shim, 2013).

3. Empirical Methodology and Data

3.1. Variables and Hypotheses

In contrast with previous empirical studies, but building on their theoretical frameworks, the following model assumes that the relationship between dependent and independent variables is not only constrained by short-term dynamics but also by an adjustment to a long-term equilibrium. To investigate the long-term determinants of the capital and risk-taking decisions of Tunisian banks, two separate equations are estimated by regressing bank capital and risk-taking on a set of bank-specific and macroeconomic variables.

3.1.1. Capita Buffer Equation

For the first equation, capital buffers (BUF) are more interesting to use as a dependent variable than total capital ratio because it is rare for the capital ratio to fall below the required minimum. Rather, banks often hold a total capital ratio higher than the minimum for strategic purposes. Indeed, capital buffers may serve as a cushion against regulatory sanctions caused by unanticipated endogenous or exogenous shocks. Capital buffers also serve as a signalling tool about bank robustness to investors and market actors. By signalling a good situation, higher capital buffers ease the access to capital markets and decrease the cost of wholesale funds. In addition, capital buffers are expected to make banks more able to seize unexpected investment opportunities (Lindquist, 2004; Marcus, 1983).

The non-performing loans (RISK) ratio is used as a proxy for bank risk-taking. The expected impact of risktaking on capital buffers is ambiguous. By definition, the total regulatory capital ratio should increase when banks pursue risky investment strategies. Also, risk-taking often increases as a consequence of excessive leverage; in this case, as each unit of assets should be financed by a minimum level of regulatory capital, an improvement of the total capital ratio is expected when leverage is increased. However, in the presence of market imperfection and asymmetric information between banks and regulatory authorities, a moral hazard problem comes into play, as banks' shareholders may prefer increased leverage and risk-taking in order to maximize shareholders' value in the presence of implicit or explicit deposit insurance subsidies.

The importance of loans in the assets structure is captured by the variable LTA. This is introduced to check whether an upward adjustment of capital buffers is done on the assets side through a reduction of lending supply and a deleveraging process aimed at reducing assets' risk-weights or vice-versa. In this case a negative relationship is expected between LTA and BUF.

In addition, bank size (SIZE) is also expected to influence capital buffers in the long-term. Large banks benefit from better market reputation, an easier access to capital markets, and can issue shares at lower costs. Also, as demonstrated by Bikker, Spierdijk, and Finnie (2006), large banks often benefit from a higher charter value that provides them with additional revenues through wider interest margins, which makes recapitalization easier. For these two reasons, large banks are expected to operate with lower capital buffer levels. However, from another point of view, the tight relationship between bank size and market power invites the opposite hypothesis, a positive relationship between SIZE and BUF, which is also plausible. According to the competition-fragility hypothesis, small banks operating with lower market power are more inclined to engage in riskier investments in order to increase profitability and preserve their charter value (Keeley, 1988). This could translate into a positive relationship between bank size and capital buffers in the long term.

Furthermore, the relationship between business cycle (CYCLE) and capital buffers is tested. As explained above, the long-term equilibrium may indicate that business cycle triggers a downward adjustment of capital buffers, illustrating a countercyclical behaviour of banks. Cognitive biases and the existence of capital adjustment costs are two theoretical arguments explaining this kind of destabilizing behaviour. But it is also possible to observe a positive relationship between CYCLE and BUF when forward-looking banks are more aware of loan loss accumulation during periods of expansion, urging them to build adequate capital buffers during this phase.

We also introduce an indicator of regulatory pressure (REG). This indicator expresses the probability of a bank being in a situation of non-conformity with capital requirements and hence exposed to regulatory sanctions, while taking into account the volatility of its total capital ratio. This variable is of primary importance to Tunisian banks because after 2011 the minimum required capital level was revised upward twice, from 8% to 9% with a transitory period between January and December 2013, and from 9% to 10% between January and December 2014. We expect a positive impact of REG on BUF, since increased regulatory pressure exerts a positive influence on capital buffers by inducing undercapitalized banks to increase capital buffers and reduce capital volatility to avoid regulatory sanctions.

3.1.2. Risk-Taking Equation

In the second equation, RISK is taken as the dependent variable. The first explanatory variable BUF is thought to impact RISK in different ways. On the one hand, an increase of capital buffers is expected to enhance shareholders' awareness by inducing them to avoid excessive leverage and risk-taking. On the other hand, due to market imperfections, banks could be more prone to risk-taking after capital increase, as explained earlier.

Loan loss provisions (LLP) are introduced as a potential long-term determinant of bank risk-taking. A negative relationship could arise between LLP and RISK since the higher provisioning, indicating an accumulation of loan losses and a deterioration of the quality of assets, impedes banks from engaging in risky investments in the future (Aggarwal & Jacques, 2001). We might also observe a positive long-term impact of LLP on bank risk-taking. This impact is channelled through bank earnings, as a higher LLP ratio may signal lower expected earnings due to a poor management of loans, translating into more loan losses in the future (Louzis, Vouldis, & Metaxas, 2012). Also, as suggested by Rajan (1994), bank credit policy could rely not only on the objective of value maximization, but on short-term market concerns about the reputation of the bank's management. Accordingly, when banks hold a high level of loan loss provisions, this gives them more latitude to invest in risky NPV projects in order to inflate current earnings and signal a good profitability to the market. In turn, more investments in risky NPV projects should give rise to an increase in future loan losses, suggesting a positive relationship between LLP and RISK.

The long-term relationship between SIZE and RISK could be either positive or negative. A positive relationship could be explained by the fact that large banks are more able to diversify their investments and funding sources and are then more able to improve risk and income diversification (Louzis et al., 2012; Salas & Saurina, 2002). A negative relationship is related to the too-big-to-fail moral hazard problem, emanating from large banks that benefit from Government subsidies and less effective market discipline (Schaeck, Cihak, & Wolfe, 2009; Stern & Feldman, 2004).

In addition, a negative long-term relationship between CYCLE and RISK indicates that risk measurement biases keep banks from accurately assessing default risks during expansion phases, giving rise to a materialization of loan losses during economic downturns. Finally, the impact of REG on bank risk-taking is estimated. A negative impact of REG on RISK is expected, meaning that when the distance between the regulatory capital ratio and the minimum requirement decrease, banks will avoid risk-taking under pressure of regulatory sanctions.

3.2. Model Specification

To test the long-term determinants of capital and risk decisions, the Panel Autoregressive Distributed Lag (Panel ARDL) technique is used, which incorporates heterogeneous panel regression into the error correction model (Pesaran, Shin, & Smith, 1999). Building on several empirical models of capital buffers and risk-taking adjustment (Equations 1 and 2 respectively) and based on the above analysis, the following specifications are estimated:

$$BUF_{it} = \theta_{ot} + \theta_{1t} RISK_{it} + \theta_{2t} LTA_{it} + \theta_{3t} SIZE_{it} + \theta_{4t} CYCLE_{t} + \theta_{5t} REG_{it} + \mu_i + \epsilon_{it} \quad (1)$$

$$RISK_{it} = \pi_{ot} + \pi_{1t} BUF_{it} + \pi_{2t} LLP_{it} + \pi_{3t} SIZE_{it} + \pi_{4t} CYCLE_{t} + \pi_{5t} REG_{it} + \alpha_i + \omega_{it} \quad (2)$$

The indexes i and t indicate banks and periods, respectively. Coefficients θ_{ot} and π_{ot} are the intercepts for the two equations, μ_i and α_i the fixed bank effects, ϵ_{it} and ω_{it} the error terms, which are assumed to be independently and normally distributed. These two equations are estimated separately. In fact, this study does not focus on the short-term simultaneous relationship between capital and risk-taking; rather its main purpose is to estimate the long-term determinants of capital and risk-taking adjustment. Moreover, by including lags of both endogenous and exogenous variables, Panel ARDL is able to mitigate the endogeneity problem which may eventually be caused by, among others, simultaneous relationships (Samargandi, Fidrmuc, & Ghosh, 2015). Later in this paper, an additional estimation step will be run, substituting the two dependent variables (BUF and RISK) by other proxies of capital and risk-taking while keeping the same explanatory variables.

All variables are observed at a semi-annual frequency. BUF_{it} is computed as the difference between observed total capital ratio and the minimum requirement, $RISK_{it}$ is the ratio of non-performing loans to total gross loans, LLP_{it} is the ratio of loan loss provisions to total gross loans, while LTA_{it} is the ratio of net loans to total assets and $SIZE_{it}$ is the logarithm of total assets. The business cycle indicator $CYCLE_t$ is computed by a trend elimination method, using *Hodrick–Prescott* data filtering *to isolate the cyclical component of the semi-annual real GDP growth rate. REG is a dummy variable. If the observed Total Capital Ratio (TCR) exceeds the minimum required level, REG is equal to* the difference between the TCR minus the sum of the minimum required level and the standard deviation of TCR computed using a five-year rolling window on the data going back to 2004. If TCR is lower than the minimum required level, then REG is equal to zero. For the two equations, the optimal lag orders on the first-differenced variables are selected according to the Schwarz information criterion (SIC) or the Akaike information criterion (AIC). The ARDL dynamic panel specifications of Equations 1 and 2 are as follows:

$$BUF_{it} = \lambda_i BUF_{i,t-1} + \mu_i + \delta_{10i} RISK_{it} + \delta_{11i} RISK_{it-1} + \delta_{20i} LTA_{it} + \delta_{21i} LTA_{it-1} + \delta_{30i} SIZE_{it} + \delta_{31i} SIZE_{it-1} + \delta_{40i} CYCLE_t + \delta_{41i} CYCLE_{t-1} + \delta_{50i} REG_{it} + \delta_{51i} REG_{it-1} + \epsilon \quad (3)$$

$$RISK_{it} = \gamma_i RISK_{i,t-1} + \alpha_i + \rho_{10i} BUF_{it} + \rho_{11i} BUF_{it-1} + \rho_{20i} LLP_{it} + \rho_{21i} LLP_{it-1} + \rho_{30i} SIZE_{it} + \rho_{31i} SIZE_{it-1} + \rho_{40i} CYCLE_t + \rho_{41i} CYCLE_{t-1} + \rho_{50i} REG_{it} + \rho_{51i} REG_{it-1} + \omega \quad (4)$$

Then, Equations 3 and 4 are reparametrized to include an error correction term as follows:

$$\Delta BUF_{it} = (BUF_{i,t-1} - \theta_{0i} - \theta_{1i} RISK_{it} - \theta_{2i} LTA_{it} - \theta_{3i} SIZE_{it} - \theta_{4i} CYCLE_t - \theta_{5i} REG_{it}) + \theta_{11i} \Delta RISK_{it} + \theta_{21i} \Delta LTA_{it} + \theta_{31i} \Delta SIZE_{it} + \theta_{41i} \Delta CYCLE_t + \theta_{51i} \Delta REG_{it-1} + \epsilon_{it} \quad (5)$$

Where $\varphi_i = -(1-\lambda_i)$, $\theta_{0i} = \frac{\mu_i}{1-\lambda_i}$, $\theta_{1i} = \frac{\delta_{10i}+\delta_{11i}}{1-\lambda_i}$, $\theta_{2i} = \frac{\delta_{20i}+\delta_{21i}}{1-\lambda_i}$, $\theta_{3i} = \frac{\delta_{30i}+\delta_{31i}}{1-\lambda_i}$, $\theta_{4i} = \frac{\delta_{40i}+\delta_{41i}}{1-\lambda_i}$, $\theta_{5i} = \frac{\delta_{50i}+\delta_{51i}}{1-\lambda_i}$

$$\Delta RISK_{it} = \tau_i (RISK_{i,t-1} - \pi_{0i} - \pi_{1i} dBUF_{it} - \pi_{2i} LLP_{it} - \pi_{3i} SIZE_{it} - \pi_{4i} CYCLE_t - \pi_{5i} REG_{it}) + \pi_{11i} \Delta BUF_{it} + \pi_{21i} \Delta LLP_{it} + \pi_{31i} \Delta SIZE_{it} + \pi_{41i} \Delta CYCLE_t + \pi_{51i} \Delta REG_{it-1} + \omega_{it} \quad (6)$$

Where $\tau_i = -(1-\gamma_i)$, $\pi_{0i} = \frac{\alpha_i}{1-\gamma_i}$, $\pi_{1i} = \frac{\rho_{10i}+\rho_{11i}}{1-\gamma_i}$, $\pi_{2i} = \frac{\rho_{20i}+\rho_{21i}}{1-\gamma_i}$, $\pi_{3i} = \frac{\rho_{30i}+\rho_{31i}}{1-\gamma_i}$, $\pi_{4i} = \frac{\rho_{40i}+\rho_{41i}}{1-\gamma_i}$, $\pi_{5i} = \frac{\rho_{50i}+\rho_{51i}}{1-\gamma_i}$

The parameters φ_i and τ_i indicate the error-correcting speeds of adjustment to equilibrium for each unit. These two parameters must take negative values, meaning that the variables exhibit a return to long-run equilibrium.

The Pooled Mean Group (PMG) estimator developed by Pesaran et al. (1999) is used to estimate the parameters of Equations 5 and 6 and to take into consideration the long-term equilibrium and the heterogeneity of the dynamic adjustment process. This choice has three main advantages:

First, the dynamic nature of the adjustment of capital buffers should be captured to take into consideration the capital and risk-taking speed of adjustment. Static panel techniques using random or fixed individual effects do not consider the dynamic nature of these variables. They are also unable to assume a variation of the slope coefficient across individuals (banks in our case) by imposing a homogeneity restriction and control only for the structural heterogeneity between cross-sections.

Second, when using dynamic panel data, the PMG estimators are more appropriate for small size samples than the General Method of Moment (GMM) estimator, which is more efficient for large N (individual dimension) small T (time dimension) samples. Small N samples, like the one used in this paper, may affect the reliability of the tests for the validity of instruments and autocorrelation used under the GMM estimator, leading to inefficient results. Also, as the study period is relatively large, the non-stationarity problem makes the GMM estimator biased, since it is only efficient under short-run dynamics. In addition, GMM estimation requires the slope coefficient of lagged dependent variables to be homogenous, which may lead to spurious long-run estimates (Pesaran et al., 1999; Samargandi et al., 2015).

Finally, the PMG estimator is considered more consistent and efficient among panel error-correction estimators, assuming short-run cross-section heterogeneity and long-run homogeneity restrictions. This estimator combines pooled and averaged coefficients, leading to heterogeneous estimators for the short-run and requiring the long-run slope coefficient to be homogenous across individuals (banks in this case).

3.3. Sample and Data

We assume that the determinants of capital and risk-taking exert a homogenous impact in the long run. This could be an appropriate restriction in the case of Tunisian banks, at least the ten largest ones. Indeed, these banks largely dominate the loan and deposit markets, share similar market and business model orientations, and are closely and homogenously supervised by the CBT. Also, there are few apparent disparities between the risk management mechanisms and governance modes of these banks. Hence, we expect the long-term capital and risktaking decisions of the listed Tunisian banks to be homogenous in response to the endogenous risks, macroeconomic volatility and regulatory measures.

Accordingly, this paper focuses on a sample of listed Tunisian commercial banks. This sample is representative since more than 90% of the banking system's total assets are held by this group of banks. Data are observed with a semi-annual frequency from June 2009 to June 2018. Balance-sheet data were hand-collected from banks' annual reports and semi-annual financial statements published by the Financial Market Council (the financial market authority). Regulatory and macroeconomic data are provided by the CBT.

4. Empirical Results

4.1. Unit Root Tests and Descriptive Statistics

The Im, Perasan and Shin (IPS), Levin, Lin and Chu (LLC), and Breitung and Hadri LM unit root tests, including intercept and time trend, were used to capture the unit root processes followed by the variables included in the model. These four unit root tests were employed to determine the order of integration of each variable, which must not exceed I(1) order under the ARDL model (Pesaran et al., 1999).

As indicated in Table 1, none of the variables included in the two specifications is found to have an order of integration higher than one. The variable Size is found to be I(1) by all unit root tests, while BUF and LTA are found to be I(1) by IPS and Breitung tests and I(0) by the remaining unit root tests.

Table 1. Unit root tests.

	L	**LC**	**IPS**		**Breitung**		**Hadri LM test**	
	Level	**First diff**	**Level**	**First diff**	**Level**	**First diff**	**Level**	**First diff**
BUF	-3.56**	-6.01**	0.46	-3.93**	0.7735	-6.84**	0.8207	0.4617**
RISK	-6.37**	-5.95**	-2.60**	-4.51**	1.44	-2.90**	0.73**	0.23**
SIZE	1.09	-2.62**	3.49	-6.86**	7.17	-5.49**	0.96	-0.22**
LLP	-2.93**	-8.00**	-4.73**	-8.61**	-5.74**	-6.94**	0.13**	-0.47**
LTA	-2.61**	-4.75**	-1.01	-7.41**	-0.78	-5.17**	0.73**	-0.24**
CYCLE	-17.39**	-14.59**	-2.53**	-4.14**	-5.70**	-5.03**	0.51**	0.31**
REG	-2.87**	-4.23**			-1.59*	-6.58**	0.82	0.44**

Notes: H_0: the variable follows a unit root process. *: H_0 is rejected with a confidence level higher than 99%. **: H_0 is rejected with a confidence level higher than 95%. IPS unit root test is not possible for REG because it contains zero values.

The order of integration of RISK is found to be I(0) by all unit root tests except the Breitung test, which indicates an order of integration for this variable of I(1). Also, the regulatory pressure variable REG is found to have an order of integration of I(1) by the Hadri LM Test only; all the other tests indicate a I(0) process for this variable. In short, unit root tests suggest that the panel ARDL technique is suitable for the estimation of the two model specifications.

Table 2 presents the descriptive statistics of the variables. Despite the persitence of macroeconomic and financial turmoil since the revolution, the average level of BUF continues to be positive and reach almost 2.1% while the median level of BUF is slightly lower at 1.9%. However, the level of non-performing loans (RISK) is quite high, with a median of almost 10% and a much higher average standing at 13.8% of total gross loans. The standard deviation of RISK is relatively high, indicating a strong disparity of asset quality between state and private banks that increased further after the revolution. Table 2 also shows that LTA stands at 74.2% of total assets, indicating that traditional intermediation strongly dominates the business model of Tunisian banks, whereas semi-annual loan loss provisions represent on average of 5.7% of total gross loans.

The correlation matrix shows that BUF is negatively correlated with RISK, LLP, and SIZE and positively correlated with REG. In turn, RISK is positvely correlated with LTA, SIZE, LLP and REG with a relative strong correlation with the latter variable. REG shows a positive correlation with SIZE and LLP, while CYCLE is not significantly correlated with any of the other variables.

Table 2. Statistical properties and correlation matrix.

	BUF	**RISK**	**SIZE**	**LLP**	**LTA**	**CYCLE**	**REG**
Mean	0.021	0.138	15.486	0.006	0.742	0.000	0.013
Median	0.019	0.097	15.513	0.005	0.755	0.001	0
St. dev	0.037	0.104	0.429	0.005	0.091	0.015	0.034
Min	-0.156	0.033	14.346	-0.006	0.434	-0.035	0
Max	0.137	0.469	16.453	0.051	0.987	0.027	0.232
			Correlation matrix				
BUF	1						
RISK	-0.402	1					
SIZE	-0.327	0.310	1				
LLP	-0.429	0.400	0.213	1			
LTA	-0.119	0.208	-0.133	0.099	1		
CYCLE	0.0044	0.011	-0.002	-0.043	-0.089	1	
REG	-0.420	0.532	0.149	0.209	0.060	-0.036	1

Moreover, Figure 1 illustrates some interesting elements concerning the co-evolution of the average values of BUF, RISK and REG. Starting from the revolution year, the ratio of non-performing loans (RISK) began a significant increase, going from an average of almost 12% in June 2011 to 16% in December 2015.

State banks, which bore the major responsibility of this quick rise of credit risk, benefited from an extensive recapitalization plan funded entirely by the government. Before receiving these funds, they were forced to consume a large part of their accumulated retained earnings (a component of Tier 1 capital ratio) in order to absorb loan losses and improve the provisioning of assets risk. This explains why average capital buffers dropped sharply from almost 4% in December 2012 to -1% in June 2013. After the recapitalization of the state banks, the Tunisian banking system began to restore its capital cushion, reaching an average value of 2% in December 2015 and remaining more or less stable until 2018. Figure 1 shows that after the capital regulatory reform, which extended from December 2012 to December 2014, REG stood at a level slightly higher that its level before the reform and that, paradoxically, the average value of the capital buffers ratio decreased significantly (see Figure 1).

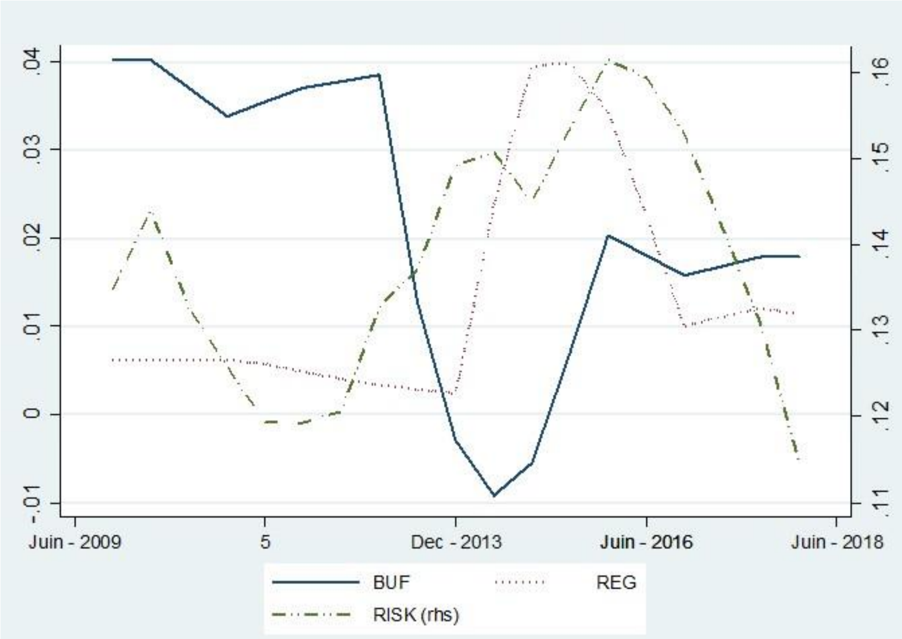

Figure 1. Co-evolution of capital buffers, risk-taking and regulatory pressure.

4.2. Estimation Results

Table 3 presents the estimation results of the capital buffer equation using the panel ARDL-PMG estimator as the main econometric estimation method (Column 1). Estimation outputs using fixed and random specific effects (generalized least squares – GLS method) are also provided for comparison purposes to check for the relevance of the dynamic nature of the dependent variables. In fact, these static panel estimators, contrary to the panel ARDLPMG estimator, do not take into consideration the adjustment dynamics of bank capital and risk-taking (Columns 2 and 3, respectively). The two-stage instrumental variable regression with fixed effects is used as an additional way to gauge the robustness of the panel ARDL-PMG estimator and to minimize biases related to the limited number of observed cross-sections (Column 4). The interpretation of the results is mainly based on the panel ARDL-PMG outputs. The comparison with the other estimation methods is only mentioned when relevant.

4.2.1. First Results

As mentioned, in the first Column of Table 3, the existence of a long-term relationship is confirmed only if the error correction term (φ_i) is negative and not lower than -1. Indeed, the parameter φ_i takes a negative sign and reaches almost -10%, proving the existence of a mean reversion to a long-run equilibrium and that BUF is cointegrated with its determinants. The low value of φ_i also indicates that the cost of the adjustment of capital buffers is relatively high. Concerning the long-term adjustment of capital buffers, the estimation in Equation 5 indicates that all explanatory variables exert a significant long-term impact on capital buffers adjustment. An increase of RISK (ratio of non-performing loans) by one percentage point (p.p.) results in a long-term decrease of BUF by 0.33 p.p. This coefficient is quite similar to that produced by the panel IV method and more significant than those provided by the fixed and random effect estimators.

Table 3. Long-term determinants of capital buffers.

	(1)	**(2)**	**(3)**	**(4)**
	PMG	**Fixed**	**Random**	**IV**
RISK	-0.3347 (0.010)	-0.1540 (0.000)	-0.1250 (0.001)	-0.3336 (0.000)
LTA	-0.3236 (0.012)	-0.1976 (0.000)	-0.1595 (0.000)	-0.2379 (0.005)

SIZE	0.0111 (0.594)	-0.0269 (0.001)	-0.0271 (0.000)	-0.0300 (0.007)
CYCLE	-0.4395 (0.083)	-0.0974 (0.407)	-0.0803 (0.493)	-0.0774 (0.597)
REG	2.7525 (0.010)	-0.1566 (0.024)	-0.1697 (0.013)	0.2752 (0.012)
Intercept		0.6087 (0.000)	0.5793 (0.000)	0.7048 (0.000)
Err. Correction	-0.10 (0.007)			
#Observations		190	190	180
R^2 Within/Overall		0.24	0.22	
Hausmann statistic		22.16		
Hansen-Sargan p-value				0.88
F-statistic				15.24

Note: The dependent variable is capital buffers (BUF). The sample of listed Tunisian banks is observed between 2009 and 2018 using half-year observations. Hausman statistic: Hausman specification test. HansenSargan p-value: Hansen-Sargan test for over-identifying restrictions. F-statistic: Fisher Statistic test. P-values are in parentheses.

This result confirms that Tunisian banks react to a deterioration of their assets quality by adjusting their capital buffers downward, which may be due to different reasons. It may indicate a kind of moral hazard behaviour from banks at a long-term horizon in order to preserve or increase their shareholders' value. This finding was observed in other banking systems, albeit at short-term horizons (El-Khoury, 2020; Heid, Porath, & Stolz, 2003; Jacques & Nigro, 1997; Zheng et al., 2017). The insufficient level of loan loss provisions could also explain the incapacity of Tunisian banks to cover future losses by adequately increasing their capital buffers. Also, the negative long-term impact of RISK on BUF might simply be explained by a change in the capital investment strategy when banks target lower capital buffers.

The estimation of parameter θ_{2i} in Equation 5 suggests a long-term downward adjustment of capital buffers in response to an increase of LTA. Reciprocally, a 1 p.p. decrease in LTA induces a long-term increase of BUF by 0.32 p.p., demonstrating that deleveraging is a main channel through which banks could adjust their capital buffers upward. This result was also found in the case of other emerging countries' banking systems (Fonseca & González, 2010; García-Suaza, Gómez-Gonzales, Pabón, & Tenjo-Galarza, 2012).

The long-term relationship between CYCLE and BUF is negative and significant, demonstrating that capital buffers are countercyclical. When compared with the other estimation methods, only the panel ARDL-PMG estimator is significant among the four, demonstrating that this countercyclical reaction of capital buffers to business cycle is mainly observed in the long run [about five years, or 1/0.1017 (=10) half-years if we base our interpretation on the estimated error correction term]. This result is congruent with the results found for other developed and emerging countries' banking systems (Ayuso, Pérez, & Saurina, 2004; Jokipii & Milne, 2008; Nguyen et al., 2019; Saadaoui., 2014; Shim, 2013; Stolz & Wedow, 2011). This risky behaviour could be theoretically explained by the existence of cognitive biases that cause excessive deleveraging during crisis periods or by the existence of capital adjustment costs. The latter assumption is more appropriate in the case of Tunisian banks because they operate in a shallow capital market characterized by important information asymmetries. Moreover, these banks faced a persistent need for liquidity over the last decade, making the opportunity cost of holding capital very important.

Finally, the estimated parameter θ_{5i} related to REG stands at 2.75 and is highly significant, demonstrating that regulatory pressure exerts a very important long-term positive impact on capital adjustment. The panel ARDLPMG estimator indicates a much more important impact (in absolute value) of regulatory pressure in the long run than the other estimation methods. The fixed and random effects methods indicate the opposite effect, while the panel IV method corroborates the positive impact of REG on BUF found using the panel ARDL-PMG technique. This highlights the pertinence of using an estimation method that takes into consideration the dynamic adjustment of bank capital and risk-taking and also deals with the problem of endogeneity. This result corroborates, among others, the findings of Rime (2001) and Godlewski (2005), revealing that despite the risky behaviour of Tunisian banks, the adoption and the revision of the minimum required capital imposed by the CBT motivated the banks to preserve their capital buffers.

Concerning Equation 6, we can see in the first column of Table 4 (panel ARDL-PMG estimates) that the error correction term is negative and stands within the unit circle, proving that the dynamics of the explanatory variables adjust from a short-term situation to a long-term equilibrium path. The value of -33% indicates that Tunisian banks adjust their risk-taking behaviours more quickly than their capital buffers.

Regarding the impact of bank capital buffers on the risk-taking adjustment, we note that only the panel ARDLPMG estimator is significant, demonstrating that the link between the two variables is mainly established in the long run. The long-term relationship between BUF and RISK is negative and significant, as demonstrated by the panel ARDL-PMG estimations.

An increase of capital buffers by 1 p.p. causes a decrease of RISK by 0.21 p.p. in the long run, indicating that higher capital cushions prove to be efficient in improving assets quality and reducing moral hazard by restricting bank leverage and inducing bank shareholders to avoid excessive risk-taking. Previous empirical studies focusing on the short-term dynamics of bank risk-taking have reported the same result (Cannata & Quagliariello, 2006; ElKhoury, 2020; Hussain & Hassan, 2004; Nguyen et al., 2019).

There is no evidence for a long-standing impact of loan loss provisioning on bank risk-taking, as shown by the non-significant parameter linking LLP to RISK in Column (5). The static fixed and random specific effect estimations demonstrate a positive impact of LLP on RISK. However, this result is challenged when we take into account the endogeneity of the explanatory variables using the panel IV method.

In contrast to Equation 5, bank size is found to exert a very significant long-term impact on bank risk-taking. In accordance with our expectations, larger banks achieve better assets quality in the long run through better diversification. This significant relationship is only found by the panel ARDL-PMG estimator, proving that the diversification and scale economies mechanisms related to bank size mostly take place in the long run [if we assume a readjustment to the long-run equilibrium after 1/0.33 = three half-years (≈1.5 years)]. Additionally, the positive relationship between CYCLE and RISK confirms the hypothesis of a procyclical risk-taking behaviour of Tunisian banks.

Finally, the regulatory pressure variable exerts a positive and significant long-term effect on RISK. A 1 p.p. increase of REG induces a long-term increase in the non-performing loans ratio of 0.74 p.p. This is an unexpected effect of capital requirements and indicates that Tunisian banks tend to increase risk-taking in response to greater regulatory pressure. This result may be explained by various theoretical arguments such as those outlined earlier in this paper. It also confirms previous empirical findings, like those of Cannata and Quagliariello (2006) and Saadaoui (2011).

To sum up, capital requirements lead to ambiguous outcomes. Capital standards seem to be harmful for banking system stability since there is evidence of a moral hazard problem in the long-term, as demonstrated by the negative relationship between RISK and BUF in Equation 5.

Table 4. Long-term determinants of risk-taking.

	(5)	**(6)**	**(7)**	**(8)**
	PMG	**Fixed**	**Random**	**IV**
BUF	-0.2097 (0.029)	-0.1830 (0.224)	-0.1742 (0.242)	0.1875 (0.419)

LLP	0.0304 (0.933)	1.6338 (0.044)	1.8013 (0.024)	2.6891 (0.168)
SIZE	-0.0268 (0.000)	-0.0182 (0.252)	-0.0133 (0.392)	0.0106 (0.640)
CYCLE	(0.1765) (0.008)	0.1631 (0.443)	0.1674 (0.431)	0.1232 (0.531)
REG	0.7463 (0.000)	0.7150 (0.000)	0.7330 (0.000)	0.7741 (0.000)
Intercept		0.4053 (0.105)	0.3271 (0.180)	-0.0561 (0.877)
Err. Correction	-0.3318 (0.000)			
#Observations	180	190	190	180
R^2 Within/Overall		0.2452	0.3292	
Hausmann statistic		20.13		
Hansen-Sargan p-value				0.29
F-statistic				62.01

Note: The dependent variable is the non-performing loans ratio (RISK). The sample of listed Tunisian banks is observed between 2009 and 2018 using half-year observations. Hausman statistic: Hausman specification test. Hansen-Sargan p-value: Hansen-Sargan test for over-identifying restrictions. Fstatistic: Fisher Statistic test. P-values are in parentheses.

There is also evidence for countercyclical capital buffers and an unexpected long-term impact of regulatory pressure on bank risk-taking, since REG is positively related to RISK. However, some results show that capital requirements have helped to improve the stability of the Tunisian banking system. Indeed, higher capital buffers lead to a significant decrease of bank risk-taking in the long run. There is also evidence of procyclical bank risktaking. Moreover, regulatory pressure is associated with a long-term improvement of capital cushion. The findings also show that Tunisian banks mainly adjust their capital buffers in the long run through leverage adjustment. In addition, larger banks behave more cautiously at a long-run horizon than small ones, as evidenced by the positive impact of SIZE on BUF and its negative impact on RISK. In order to bring further details to these results, the following section provides new estimations after changing the two dependent variables in order to refine the previous results and develop our understanding of the long-term determinants of capital and bank risk-taking adjustments by Tunisian banks during the last decade.

4.2.2. Additional Estimations

As explained earlier, the capital buffers ratio includes in its denominator the volume of risk-weighted assets that could also vary depending on risk-taking and regulatory pressure. The long-term impact of these variables on bank capital is isolated as much as possible using the equity ratio (EQUITY) as the dependent variable of Equation 5 instead of capital buffers. In fact, EQUITY, computed as the volume of equity capital on total assets, does not include risk-weights in its denominator like the ratio of capital buffers does. Moreover, bank risk-taking should not only be captured through actual and future loan losses but also through other losses that cumulate over time, which may be caused by bad management, under-provisioning, agency conflicts, etc. Hence, it is also appropriate to assume that excessive risk-taking is tightly related to the probability of failure. In consequence, in Equation 6, we substitute RISK with the standard deviation of return on assets (SD_ROA) measured by a six-period rolling window (3 years) standard deviation of pre-tax income on total assets. This step may contribute additional interesting results concerning the influence exerted by capital requirements and regulatory pressure on the volatility of return on assets, particularly through the banks' risk-taking behaviour. As shown in Column (9) of Table 5, the error correction term (ECT) is negative and significant when EQUITY is used as the dependent variable, proving the convergence toward a long-term equilibrium. The ECT stands at -30%, meaning that for Tunisian banks the cost of equity adjustment is almost equal to the cost of capital buffers adjustment. In addition, the coefficient related to RISK is not significantly different from zero in the long run. However, the static panel, as well as the instrumental variable estimator, reveals a negative and significant impact of risk-taking on equity capital, confirming the negative and significant effect of RISK on capital buffers demonstrated in Table 4. This result confirms the hypothesis of bank moral hazard, since it suggests that an increase in risk-taking is mainly caused by an increase in the volume of risk-weighted assets without an equivalent and sufficient increase of regulatory capital, leading to an overall decrease of the capital buffers ratio. Column (9) also shows that the longterm impact of LTA on EQUITY contrasts sharply with its impact on BUF. Indeed, LTA has a positive and significant impact on EQUITY, demonstrating that the business model of Tunisian banks, which is mainly based on traditional intermediation, is likely to help them consolidate their revenues and capital positions. The opposite impact exerted by LTA on BUF in Table 3 proves, however, that Tunisian banks essentially adjust their leverage through the adjustment of risk weights. In other words, the adjustment of capital buffers through the change of targeted lending growth induces Tunisian banks to operate a trade-off between earnings and capital on the one side, and conformity with capital rules on the other. When banks target higher capital buffers they reduce lending and leverage to cut down on risk-weighted assets. Reciprocally, a higher leverage increases risk-weighted assets and exerts a downward pressure on BUF, despite its positive impact and bank revenues. In addition, the estimated parameter related to CYCLE is positive and significantly different from zero. This result suggests that Tunisian banks do not adjust equity capital in a countercyclical way, as they do in the case of capital buffers.

Table 5. Long-term determinants of capital equity.

	(1)	**(2)**	**(3)**	**(4)**
	PMG	**Fixed**	**Random**	**IV**
RISK	0.0546 (0.472)	-0.0791 (0.003)	-0.0788 (0.002)	-0.1654 (0.001)
LTA	0.0614 (0.029)	-0.0220 (0.450)	-0.0184 (0.506)	-0.0823 (0.115)
SIZE	0.0016 (0.716)	0.0064 (0.200)	0.0056 (0.252)	0.0105 (0.124)
CYCLE	0.2107 (0.000)	-0.0323 (0.663)	-0.0305 (0.678)	-0.0818 (0.364)
REG	0.3863 (0.035)	-0.1584 (0.000)	-0.1594 (0.000)	0.0620 (0.357)
Intercept		0.0134 (0.861)	0.0242 (0.746)	0.0034 (0.976)
Err. Correction	-0.3083 (0.000)			
#Observations	180	190	190	170
R^2 Within/Overall		0.18	0.17	
Hausmann statistic		0.72		
Hansen-Sargan p-value				0.27
F-statistic				34.90

Note: The dependent variable is the ratio of equity capital (EQUITY). The sample of listed Tunisian banks is observed between 2009 and 2018 using half-year observations. Hausman statistic: Hausman specification test.

Hansen-Sargan p-value: Hansen-Sargan test for over-identifying restrictions. F-statistic: Fisher Statistic test. P-values are in parentheses.

In consequence, the countercyclicality of BUF seems to be mainly caused by a procyclicality of lending and risk-weight adjustments (the denominator of BUF) rather than by a countercyclicality of equity capital (the numerator of BUF). Finally, regulatory pressure has a positive and significant impact on EQUITY in the long run. The same relationship was found in Table 3 between REG and BUF, albeit with a lower magnitude. The dynamic feature of bank capital adjustment and the accompanying endogeneity issues are once again raised by these results, as the panel ARDL-PMG estimator contradicts the results of the static panel estimators. Accordingly, regulatory sanctions related to capital requirements exert an important long-term influence on the conformity of banks to capital standards. Table 6 presents the estimation outputs when SD_ROA is used as the dependent variable instead of RISK. The results in Column (13) show that the ECT related to the PMG estimator is negative and significant, confirming the existence of a mean reversion to a long-run equilibrium and the cointegration of SD_ROA with the selected explanatory variables. The long-term estimator indicates a negative and significant impact of BUF on assets return volatility that is in line with the previous result relating BUF to RISK. This shows that capital buffers induce Tunisian banks to improve the quality of their assets in the long run. We also note that the longterm relationship between LLP and SD_ROA is positive and significant, an effect which was not observed for the relationship between LLP and RISK. This finding is confirmed by the static panel estimators, although bank provisioning seems to be more impactful in the long term. This positive impact may be explained by the theoretical arguments of Louzis et al. (2012), who stipulated that loan loss provisions are created in expectation of poor earning outcomes and higher assets volatility. Also, as suggested by Rajan (1994), higher loan loss provisions, by providing more latitude for banks to invest in risky assets, may lead to a higher probability of failure in the long run. Table 6 provides another interesting result related to the procyclicality of bank risk-taking. In fact, in contrast to the previous results, assets volatility is countercyclical, being lower during expansion phases and higher during downturns. The different cyclical behaviour exhibited by RISK (which was found to be countercyclical in Table 5) may be explained by the ex-post nature of non-performing loans, which may be accounted for with a time-lag of a half year or more. Hence, the countercyclicality of assets return volatility, when combined with the procyclicality of capital buffers, may produce harmful effects on the real economy during periods of recession.

Concerning the impact of regulatory pressure on return volatility, the four estimation methods indicate a positive and significant impact of REG, which is in accordance with the results found earlier when RISK was taken as the dependent variable. This result confirms the fact that Tunisian banks respond to stronger regulatory pressure by increasing risk-taking, which may lead to higher return volatility in the long run.

Some interesting deductions follow from these results. Indeed, RISK has a negative long-term impact on capital buffers, whereas its impact on EQUITY is not significant in the long run. The static panel estimators even report a negative impact of RISK on EQUITY. Accordingly, it seems that capital requirements create a moral hazard problem, since an increase in the volume of risk-weighted assets is not adequately covered by a sufficient increase in capital buffers. In addition, regulatory pressure has an ambiguous effect on banking system stability. This variable is found to exert an expected positive long-term influence on banks' capital buffers and equity capital but also leads to more risk-taking and higher assets volatility in the long run. On the other hand, the results also show that capital requirements are beneficial for banking stability, since higher capital buffers significantly improve the quality of assets in the long run. The results also show that regulatory pressure has an important long-term and positive impact on EQUITY and BUF.

In addition, the long-term positive impact of leverage on EQUITY and its negative impact on BUF confirm that Tunisian banks operate a trade-off when targeting higher capital buffers by reducing leverage and risk-taking between their conformity to regulatory rules and higher revenues (major source of recapitalization) which depend on leverage. Moreover, the countercyclicality of capital buffers is mainly related to procyclical lending behaviour and volatility of return on assets.

Table 6. Long-term determinants of return on assets volatility.

	(13)	**(14)**	**(15)**	**(16)**
	PMG	**Fixed**	**Random**	**IV**
BUF	-0.0186 (0.007)	-0.0084 (0.226)	-0.0068 (0.286)	-0.0069 (0.586)

LLP	0.4826 (0.000)	0.1160 (0.002)	0.1151 (0.001)	0.0778 (0.467)
SIZE	0.0001 (0.834)	0.0009 (0.276)	0.0006 (0.337)	0.0001 (0.924)
CYCLE	-0.0064 (0.067)	-0.0051 (0.602)	-0.0050 (0.608)	0.0021 (0.848)
REG	0.1942 (0.000)	0.0379 (0.000)	0.0363 (0.000)	0.0426 (0.000)
Intercept		-0.0119 (0.339)	-0.0080 (0.424)	-0.0001 (0.996)
Err. Correction	-0.2727 (0.006)			
#Observations	180	190	190	170
R^2 Within/Overall		0.32	0.30	
Hausmann statistic		11.83		
Hansen-Sargan p-value				0.53
F-statistic				7.04

Note: The dependent variable is the ratio of equity capital (EQUITY). The sample of listed Tunisian banks is observed between 2009 and 2018 using half-year observations. Hausman statistic: Hausman specification test. Hansen-Sargan p-value: Hansen-Sargan test for over-identifying restrictions. F-statistic: Fisher Statistic test. P-values are in parentheses.

5. Conclusion and Policy Implications

The macroeconomic, institutional and regulatory context in which Tunisian banks are operating has changed considerably since the revolution. The joint effects of a more volatile macroeconomic environment and more restrictive monetary policies are exerting stronger liquidity constraints and market pressures on banks. In addition, the CBT introduced a package of regulatory reforms within a short time interval that included an increase of the minimum required capital ratio and the redefinition of regulatory capital instruments. Despite these facts, only few studies have been conducted that help to provide a clear picture of the reaction of Tunisian banks to this tumultuous economic and regulatory environment.This study investigates the long-term determinants of capital buffers and risk-taking adjustment by focusing on a sample of the listed Tunisian commercial banks observed between June 2009 and June 2018. A panel ARDL is estimated using the PMG technique in order to take into consideration the long-term equilibrium and the heterogeneity of the dynamic adjustment process.

The estimation of the Panel ARDL demonstrates the existence of a long-term dynamic that relates capital buffers and risk-taking to a vector of bank-specific and macroeconomic variables. The reaction of Tunisian banks to capital requirements shows conflicting results. Capital requirements prove to be an important prudential tool for the robustness of Tunisian banks, as higher capital buffers improve the quality of assets in the long run through a reduction of non-performing loans and a reduced volatility of returns on assets. Regulatory sanctions also induce undercapitalised banks to significantly increase their capital buffers and equity capital in the long run. However, more stringent capital requirements could be harmful to banking stability, as they are expected to give rise to a moral hazard problem. Moreover, regulatory pressure may also induce undercapitalized banks to increase risktaking. Another interesting finding is that the long-term adjustment of capital buffers is mostly channelled through lending growth and leverage. Thus, in the long run, Tunisian banks seem to be confronted with a trade-off between their level of conformity to capital rules and their profitability, since more leverage leads to more revenue and eases recapitalization. In consequence, when Tunisian banks target higher capital buffers by reducing leverage and risk-taking, they are likely to reduce revenues which are a major source of recapitalization. In addition, the capital behaviour of Tunisian banks is found to be countercyclical, mainly due to procyclical lending and risktaking behaviour, which is confirmed by the negative relationship between asset return volatility and business cycle. These results have some micro- and macro-prudential policy implications. First, the upward revision of the minimum capital requirements between 2012 and 2014 seems to have had a positive effect on banking stability since Tunisian banks operating under higher regulatory pressure are improving their capital position in the long run. The CBT should consolidate this regulatory measure and proceed to enlarge the scope of their capital standards by including additional technical requirements that allow for more convergence toward international standards, like the standardized approach and the internal-rating-based approach to risk assessment. Second, the CBT should improve its supervisory mechanisms to enforce better risk monitoring practices in conjunction with the latest capital regulatory reform in order to avoid bank moral hazard. On the other hand, however, Tunisian banks need to overcome their dependence on lending and leverage as major channels for capital buffers adjustment. Other channels should be improved, such as equity issuance, which remains tightly related to the liquidity level of the domestic capital market. In the same vein, Tunisian banks should diversify their sources of revenues and thoroughly revise their business models to become less dependent on revenues from traditional intermediation activities and to reduce the procyclicality of the banking system.

References

Aggarwal, R., & Jacques, K. (2001). The impact of FDICIA and prompt corrective action on bank.capital and risk: Estimates using simultaneous equations model. *Journal of Banking and Finance, 25*(6), 1139-1160.

Ayuso, J., Pérez, D., & Saurina, J. (2004). Are capital buffers pro-cyclical?: Evidence from Spanish panel data. *Journal of Financial Intermediation, 13*(2), 249-264.

Besanko, D., & Kanatas, G. (1996). The regulation of bank capital: Do capital standards promote bank safety? *Journal of Financial Intermediation, 5*(2), 160-183. Available at: https://doi.org/10.1006/jfin.1996.0009.

Bikker, J., Spierdijk, L., & Finnie, P. (2006). Impact of bank size on market power. DNB Working Papers No. 120, Netherlands Central Bank.

Blum, J. (1999). Do capital adequacy requirements reduce risks in banking? *Journal of Banking & Finance, 23*(5), 755-771.

Borio, C., Furfine, C., & Lowe, P. (2001). Procyclicality of the financial System and thefinancial Stability: Issues and Policy Options',BIS Paper No. 1.

Cannata, F., & Quagliariello, M. (2006). Capital and risk in Italian banks: A simultaneous equation approach. *Journal of Banking Regulation, 7*(3), 283-297. Available at: https://doi.org/10.1057/palgrave.jbr.2350029.

Coffinet, J., Coudert, V., Pop, A., & Pouvelle, C. (2012). Two-way interplays between capital buffers and credit growth: Evidence from French banks. *Journal of International FinancialMarkets, Institutions and Money, 22*(5), 1110-1125.

Curry, T. J., Fissel, G. S., & Hanweck, G. A. (2008). Is there cyclical bias in bank holding company risk ratings? *Journal of Banking & Finance, 32*(7), 1297-1309. Available at: https://doi.org/10.2139/ssrn.964520.

El-Khoury, R. (2020). Regulation, bank capital, and bank risk: evidence from the Lebanese banking industry. *Journal of Banking Regulation, 21*(3), 241-255. Available at: https://doi.org/10.1057/s41261-019-00111-2.

Estrella, A. (2004). The cyclical behavior of optimal bank capital. *Journal of Banking & Finance, 28*(6), 1469-1498. Available at: https://doi.org/10.1016/s0378-4266(03)00130-4.

Fonseca, A. R., & González, F. (2010). How bank capital buffers vary across countries: The influence of cost of deposits, market power and bank regulation. *Journal of Banking & Finance, 34*(4), 892-902.

García-Suaza, A. F., Gómez-Gonzales, J. E., Pabón, A. M., & Tenjo-Galarza, F. (2012). The cyclical behavior of bank capital buffers in an emerging economy: Size Does Matter. *Economic Modelling, 29*(5), 1612–1617.

Godlewski, C. J. (2005). Bank capital and credit risk taking in emerging market economies. *Journal of Banking Regulation, 6*(2), 128-145. Available at: https://doi.org/10.1057/palgrave.jbr.2340187.

Guidara, A., Soumaré, I., & Tchana, F. T. (2013). Banks' capital buffer, risk and performance in the Canadian banking system: Impact of business cycles and regulatory changes. *Journal of Banking & Finance, 37*(9), 3373-3387. Available at: https://doi.org/10.1016/j.jbankfin.2013.05.012.

Hakenes, H., & Schnabel, I. (2011). Capital regulation, bank competition, and financial stability. *Economics Letters, 113*(3), 256-258.

Hansen, L. (1982). Large sample properties of generalized method of moments estimators. *Econometrica, 50*(3), 1029–1054.

Heid, F., Porath, D., & Stolz, S. (2003). Does capital regulation matter for bank behavior? Evidence for German savings banks. Working Papers No. 1192, Kiel Institute for World Economics.

Hellmann, T. F., 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. Available at: https://doi.org/10.1257/aer.90.1.147.

Hussain, M. E., & Hassan, M. K. (2004). Basel capital requirements and bank credit risktaking in developing countries. Working Papers No. 2005-01, Department of Economics and Finance, University of New Orleans.

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. Available at: https://doi.org/10.1016/s0148-6195(97)00038-6.

Jeitschko, T. D., & Jeung, S. D. (2005). Incentives for risk-taking in banking–A unified approach. *Journal of Banking & Finance, 29*(3), 759777. Available at: https://doi.org/10.1016/s0378-4266(04)00057-3.

Jokipii, T., & Milne, A. (2008). The cyclical behaviour of European bank capital buffers. *Journal of Banking & Finance, 32*(8), 1440-1451.

Keeley, M. C. (1988). Bank capital regulation in 1980s : Effective or ineffective? *Economic Review, Winter*(1), 3-20.

Kopecky, K. J., & VanHoose, D. (2006). Capital regulation, heterogeneous monitoring costs, and aggregate loan quality. *Journal of Banking & Finance, 30*(8), 2235-2255. Available at: https://doi.org/10.1016/j.jbankfin.2005.07.018.

Lindquist, K.-G. (2004). Banks' buffer capital: how important is risk. *Journal of International Money and Finance, 23*(3), 493-513.

Louzis, D. P., Vouldis, A. T., & Metaxas, V. L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business and consumer loan portfolios. *Journal of Banking & Finance, 36*(4), 1012-1027.

Lowe, P. (2002). Credit risk measurement and procyclicality. Working Paper No. 116, Bank for International Settlements (BIS).

Marcus, A. J. (1983). The bank capital decision: A time series—Cross section analysis. *The Journal of Finance, 38*(4), 1217-1232. Available at: https://doi.org/10.2307/2328021.

Merton, R. C. (1977). An analytic derivation of the cost of deposit insurance and loan guarantees an application of modern option pricing theory. *Journal of Banking & Finance, 1*(1), 3-11. Available at: https://doi.org/10.1016/0378-4266(77)90015-2.

Mingo, J. J. (1975). Regulatory influence on bank capital investment. *The Journal of Finance, 30*(4), 1111-1121. Available at: https://doi.org/10.1111/j.1540-6261.1975.tb01026.x.

Nguyen, Q. T. T., Gan, C., & Li, Z. (2019). Bank capital regulation: How do Asian banks respond? *Pacific-Basin Finance Journal, 57*, 101196. Available at: https://doi.org/10.1016/j.pacfin.2019.101196.

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of American Statistics Association, 94*(446), 621–634. Available at: https://doi.org/10.1080/01621459.1999.10474156.

Rajan, R. G. (1994). Why bank credit policies fluctuate: A theory and some evidence. *the Quarterly Journal of Economics, 109*(2), 399-441.

Rime, B. (2001). Capital requirements and bank behaviour: Empirical evidence for Switzerland. *Journal of Banking & Finance, 25*(4), 789-805.

Saadaoui, Z. (2011). Risk-based capital standards and bank behaviour in emerging and developed countries. *Journal of Banking Regulation, 12*(2), 180-191.

Saadaoui, Z. (2014). Business cycle, market power and bank behaviour in emerging countries. *International Economics, 139*, 109-132. Available at: https://doi.org/10.1016/j.inteco.2014.04.001.

Saadaoui, Z. (2015). The cyclical behaviour of bank capital buffers: An empirical evidence for MENA banking systems. *Review of Middle East Economics and Finance, 11*(2), 145-182.

Salas, V., & Saurina, J. (2002). Credit risk in two institutional regimes: Spanish commercial and savings banks. *Journal of Financial Services Research, 22*(3), 203-224.

Samargandi, N., Fidrmuc, J., & Ghosh, S. (2015). Is the relationship between financial development and economic growth monotonic? Evidence from a sample of middle-income countries. *World Development, 68*, 66-81. Available at: https://doi.org/10.1016/j.worlddev.2014.11.010.

Schaeck, K., Cihak, M., & Wolfe, S. (2009). Are more competitive banking systems more stable? *Journal of Money, Credit and Banking, 41*(4), 711–734.

Shim, J. (2013). Bank capital buffer and portfolio risk: The influence of business cycle and revenue diversification. *Journal of Banking & Finance, 37*(3), 761-772. Available at: https://doi.org/10.1016/j.jbankfin.2012.10.002.

Shrieves, R. E., & Dahl, D. (1992). The relationship between risk and capital in commercial banks. *Journal of Banking & Finance, 16*(2), 439457.

Staiger, D., & Stock, J. H. (1997). Instrumental variables regression with weakinstruments. *Econometrica, 65*(3), 557–586.

Stern, G., & Feldman, R. (2004). *Too big to fail: the hazards of bank bailouts*. Washington, DC: The Brookings Institution.

Stolz, S., & Wedow, M. (2011). Banks' regulatory capital buffer and the business cycle: Evidence for Germany. *Journal of Financial Stability, 7*(2), 98-110. Available at: https://doi.org/10.1016/j.jfs.2009.09.001.

Zheng, C., Moudud-Ul-Huq, S., Rahman, M. M., & Ashraf, B. N. (2017). Does the ownership structure matter for banks' capital regulation and risk-taking behavior? Empirical evidence from a developing country. *Research in International Business and Finance, 42*, 404-421. Available at: https://doi.org/10.1016/j.ribaf.2017.07.035.