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The impact of regulatory capital pressure on profitability and risk: Evidence from Tunisian banks

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Abstract

This paper analyses the effect of regulatory pressure on bank behaviour, using a sample of Tunisian banks covering the period 2005-2020. Firstly, the paper examines the impact of regulatory capital on bank profitability and risk. Secondly, it contributes to the literature which has received scant attention from researchers investigating the nonlinear impact of regulatory pressure on bank behaviour. Thirdly, we consider different determinants of bank profitability and risk. Finally, we use both static and dynamic models to test for the persistence of bank profitability and risk, as well as to make sure that the results are not biased by endogeneity. The results suggest that regulatory capital pressure improves bank profitability and stability. This effect is, however, conditioned by the existence of a certain threshold, after which stringent capital regulation may have adverse effects. Our results have important policy implications on optimal bank capital regulation.

JEL classification: G21, C23, G29 .

Keywords : Banking, Regulatory capital, Basel Accord, Profitability, Risk, 2SLS.

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1 Introduction

The debate between bank managers and regulators about regulatory intervention casts doubt on the impact of regulatory capital on bank behaviour (Corcoran, 2010; Jakovljevi et al., 2015; Manlagnit, 2015). The questions are still being investigated as to whether capital should be regulated and whether the current regulation is effective in mitigating bank risk (Persaud, 2009; Gopinath, 2010; Hanson et al., 2011) or whether banks should be able to freely set their optimal capital level (Miller, 1995; Calomiris and Berry, 2004; Aiyar et al., 2015).

Regulatory authorities are torn over the costs and benefits of bank capital. On the one hand, stringent capital requirements protect depositors' interest, provide banks with a cushion to absorb unexpected losses and inspire confidence in the banking sector. On the other hand, capital requirements impose social costs in terms of the availability and the cost of lending which, if not taken seriously, can jeopardise economic growth. Indeed, bank managers are not incentivised to raise capital over debt, due mainly to three reasons eloquently summarised by Aiyar et al. (2015): First, if managers act against the interest of shareholders and are able to extract personal gains from keeping a high default risk, they are more likely to opt for leverage, since the probability of default rises when the bank is increasingly leveraged. Second, the social costs of a banking crisis (e.g., tightening of the credit supply, disruption of the payment system) are not internalised by the bank's stakeholders. Hence, bank managers receive no incentives to maintain a prudent management of risk. Third, the presence of safety nets that protect creditors' interests creates incentives for bank managers and shareholders, whose interests are now aligned with the managers to "game these safety nets" by keeping a high default risk. This situation is more dangerous when depositors are not able to monitor the risk portfolio of banks, due to the asymmetry of information and high costs of monitoring. This is the reason why some countries have given explicit deposit insurance schemes to protect the interest of depositors, since bank depositors are not protected by the standard covenants of debt contracts.

Banks that choose to raise new equity to comply with regulatory capital may see their profits deplete, due to the costly nature of equity financing compared to leverage (Myers, 1977; Myers and Majluf, 1984). Banks can offset high equity costs by passing on this cost to borrowers through charging higher interest rates (King, 2010). However, higher interest rates affect the ability of borrowers to pay back the amounts borrowed and, in turn, increase borrower defaults and ultimately bank instability (Martynova, 2015). Hence, the effect of capital requirements on bank risk and profitability remains ambiguous. In addition, empirical studies investigating the effect of regulatory capital often focus on developed economies. Scant attention has been paid to developing countries in Africa and Asia. Given these disparities between developing and developed countries, we are uncertain if the impact of regulatory requirements on bank behaviour has been the same for both. We chose the Tunisian banking sector because scant attention has been paid to the Tunisian context and since banks remain at the heart of the financial system. In addition, the Tunisian banking industry provides an interesting context to explore, since it has never witnessed a banking crisis and banking is thought to be the most profitable sector in the country.

There are several novel elements in our study. First, unlike most empirical studies, we do use the capital ratio to account for capital requirements. We use the risk-weighted ratio, taking into account the bank's risky portfolio. Moreover, we focus on the linear impact of bank capital regulation, but also take into account the possibility that the impact may shift after a certain threshold. This aspect of capital regulation has long been disregarded by earlier works, but we believe it is essential to gauge the real effect of capital regulation.

Second, our analysis builds on previous studies on the effects of specific and macroeconomic variables on bank profitability and risk. However, we turn the spotlight on a rather neglected variable that we believe is driving the relationship - and that is political instability. The variable may seem evident in the Tunisian context and in most countries yet, to our knowledge, we are the first to consider political stability as a driving force of bank profitability and stability.

Third, we use both static and dynamic models to test for the persistence of bank profitability and risk, as well as to make sure that the results are not biased by endogeneity.

Finally, this analysis allows insightful suggestions for future regulatory policies, whilst also taking inspiration from different countries' regulatory systems.

The results indicate that regulatory capital pressure improves bank profitability and stability. This effect is, however, conditioned by the existence of a certain threshold after which stringent capital regulation may have adverse effects. Our results have important policy implications on optimal bank capital regulation.

The remainder of the paper is structured in the following manner: The next section reviews theoretical and empirical literature. Section two describes the methodology, whilst section three presents the results and findings. Section four presents the results of the robustness check, whilst section five concludes the study.

2 Capital pressure and bank behaviour: Theoretical and Empirical review

Several theoretical and empirical studies have examined the impact of regulatory capital pressure on bank behaviour. Theoretically, Kahane (1977), Koehn and Santomero (1980), and Kim and Santomero (1988) have used the mean-variance framework to model bank portfolio selection, in order to understand the dynamics between the introduction of more stringent capital requirements and bank risk-taking incentives. They show that, when banks are faced with more stringent capital requirements, they expect a reduction in their profits. This is commonly referred to as the "expected income effect". Under this theory, banks engage in excessive risk-taking, in order to remain profitable. Hence, this theory challenges the ability of capital requirements to curb bank excessive risk-taking (Koehn and Santomero, 1980; Kim and Santomero, 1988; Rochet, 1992). Indeed, when banks are pressured to raise capital they do so by substituting leverage with risky assets. This means that banks would have incentives to raise their portfolio risk exposure when confronted with involuntary, regulatory induced increases in capital (Merton, 1972; Kahane, 1977; Koehn and Santomero, 1980; Kim and Santomero, 1988).

Several theories tend to explain the role of capital requirements in bank risk-taking. The option pricing theory posits that banks can maximise shareholder equity value by maximising the option value of the deposit insurance through greater risky assets and leverage. The problem that arises from this particular type of bank behaviour is that banks can increase shareholder value at the expense of their depositors, by exploiting the deposit insurance subsidy induced by the flat-rate deposit insurance pricing. This situation is referred to as the "moral hazard" hypothesis. Capital requirements can restrict this bank behaviour by forcing shareholders to increase their "skin in the game", thus diminishing the value of the deposit insurance put option. Notwithstanding the contribution of the theory of options valuation applied by Merton (1977) to the conventional wisdom, this framework was criticised for overlooking the presence of market frictions. In particular, information asymmetry was not taken into account in the option pricing theory (Dewatripont and Tirole, 1994).

On the other hand, the theory of bankruptcy cost avoidance, introduced by Orgler and Taggart (1983), sought to explain the reason why the optimal level of capital that banks hold will be in excess of the regulatory minimum. This relationship depends on the trade-off between tax rewards from deposit financing and costs of leverage, in terms of bankruptcy costs, higher reserve requirements and diseconomies of scale that stem from the production of deposit services. Similar to the aforementioned theory, the buffer theory predicts that a bank, which is holding capital levels just above the regulatory minimum, may reduce its risk exposure or increase its capital level as a protection against the violation of the regulatory minimum capital requirements (Marcus and Shaked, 1984; Milne and Whalley, 2001; Milne, 2004). This allows them to avoid costs arising from a supervisory intervention, in case of a breach of the capital requirements. This theory is challenged, however, by the "gambling for resurrection" hypothesis under which banks holding capital levels below the minimum required, may increase the risk of their asset portfolio in the hope of garnering higher returns, in order to increase their capital and comply with the regulation in force.

The theory of the disciplinary role of debt offers another view to the nexus. This theory postulates that equity-capital does not confer the same control rights as those of creditors. Debt holders are informed about the real outcomes of bank investment, otherwise only known by bank managers (Diamond, 1984; Ramakrishnan and Thakor, 1984; Calomiris and Kahn, 1991). These control rights make it harder for bank managers to serve their own interests in keeping a high default rate, by taking excessive risk and creating incentives for them to improve their job performance. Under this theory, capital requirements weaken the disciplinary role of debt, since it decreases the level of leverage.

A large body of theoretical literature also sought to shed light on the relationship between capital regulation and bank profitability. This is explained by the important effect of profitability on the willingness of bank owners and managers to comply with regulation.

The theory of irrelevancy of Modigliani and Miller (1958) was the starting point for research relative to bank capital structure and profitability. Under this theory, capital has a neutral effect on bank cash flows and, in turn, profits. This theory was later challenged by many others over the simplicity of its assumptions. Myers and Majluf (1984) introduced the signalling theory to describe the reaction of the market after a firm announces equity offerings. They document that, when banks or any other firm resort to external equity, outside investors will not be able to accurately value the bank's future earnings prospects due to information asymmetry. This information asymmetry causes adverse selection. This phenomenon can be witnessed in the stock market after a firm announces equity offerings, which are generally followed by a drop in its share price, forcing them to raise capital at prices well below fair value. Capital requirements impose adverse selection costs, not just when banks are below the minimum requirements, but also to include adjustment costs to a new minimum.

The trade-off theory posits that regulatory capital reduces bank profitability due to higher costs of capital, compared to leverage. However, this effect is coupled with a decrease in risks which, in turn, would lower the costs of insolvency demanded by shareholders, to compensate for higher default risk. The trade-off theory argues that, in equilibrium, banks will choose an optimal level of capital which allows them to offset costs and benefits which, in turn, would imply a neutral effect at the margin. However, the aforementioned theory was criticised due to the fact that banks are, generally, pressured to hold a capital level in excess of their optimal level, as required by the 37 binding capital requirements imposed by regulators. This, in turn, would result in additional costs imposed on banks (Miller, 1995; Buser et al, 1981).

Empirically, the relationship between capital and risk has been widely discussed. No consensus has been reached yet on the matter. Hovakimian and Kane (2000) analysed the effect of an increase in capital requirements on the risk behaviour of U.S. commercial banks. They find that regulatory capital ratios do not curb bank risk-taking incentives. On the contrary, they find that capital requirements increase the risk-taking incentives of poorly capitalised banks more than well-capitalised banks. Similarly, Bhattacharya (2013) attempted to compare the change in the risk-taking behaviour of U.S. banks before and after the implementation of capital requirements in 1980. The author argues that, contrary to what the regulatory and supervisory authorities would expect, capital requirements increased bank risk-taking. He explains that since binding capital requirements reduced the lending activity of banks by more than a half, banks had no other way than to increase their risky asset portfolio to generate income, in order to keep shareholders happy.

Other studies documented the success of capital requirement in limiting bank excessive risk-taking. Rime (2001), using a sample of Swiss banks during the period 1989 to 1995, found that regulatory pressure has a positive impact on bank capital, due to harsh consequences if banks fail to comply with the Swiss capital requirement, which may lead to bank closure and takeover. Hendrickson and Nichols (2001) argue that we cannot lump financial regulation into one basket. They claim that certain types of regulations (e.g., deposit insurance schemes) increased bank risk-taking, whereas other types of regulation (e.g., capital requirements, lending and deposit rate regulations) decreased bank risk-taking incentives and improved bank stability. Barth et al. (2004) find that the impact of regulation differs across countries, regions and income groups.

Another strand of literature has shown that capital stringency is less effective when certain aspects of markets are present. Agoraki et al. (2011) and Lee and Lu (2015) argue that regulatory capital only reduces bank risk for banks with relatively small market power. For banks with strong market power, the effectiveness of such regulation can be minimal or, in extreme cases, reversed (Agoraki et al., 2011). On a similar note, Behr et al. (2010) argue that to be able to achieve the desired effect of regulatory capital, markets concentration has to be low. Similarly, Laeven and Levine (2009) reveal that the effectiveness of capital requirements depends on bank ownership concentration. They explain that the more concentrated ownership is, the greater are bank incentives to take on higher risks to offset utility losses imposed by capital requirements. Camara et al. (2013) argue that the different responses to higher capital requirements are ascribed to the differences in capital levels amongst banks. Well-capitalised banks, with capital ratios above the minimum required, adjust their risk and capital in the same direction, whereas poorly capitalised banks (below the minimum required) reduce their risky assets portfolio to comply with regulatory capital ratios.

Furthermore, empirical evidence on the effect of regulatory capital on bank profitability finds no conclusive evidence on the matter. Several studies show that regulatory compliance seemed to improve bank profits (Coccorese and Girardone 2017; Berger and Bouwman, 2013; Bitar et al., 2016; Kundid and Pavic, 2021; Swamy, 2018), whilst other studies find that, on the contrary, regulatory capital diminishes bank profitability (Goddard et al., 2010; Chishty 2011). Other studies find that regulatory pressure has no effective impact on bank profitability (Ngo, 2006).

Berger and Bouwman (2013) analysed the implications of higher capital on bank performance, using a sample of U.S. based banks during the financial crises. They document a positive relationship between capital and bank profitability. In Europe, Goddard et al. (2004) investigated the determinants of European banks' profitability, using cross sectional data during 1990s. The results showed that capital requirements improved bank profitability. Along the same line, Kundid and Pavic (2021) investigated the relationship between our key variables, using a sample of 24 commercial banks from the Croatian banking sector between 2011 and 2016. They document a positive and strong association between regulatory capital and profitability, consistent with the capital buffer theory when using Return on Assets and net interest margin as bank profitability indicators. However, the relationship does not hold with Return on Equity as a profitability indicator. In Asia, Swamy (2018), using a sample of Indian commercial banks between 2002 and 2011, examined the effect of new capital regulations under Basel III proposals on Indian banks' profitability. They find that an increase in the ratio of capital to risk- weighted assets has a positive impact on banks' profitability. Similarly, Le and Nguyen (2020) examined the relationship between capital and bank profitability, using a sample of 30 Vietnamese banks between 2007–2019 and found a positive association between capital and profitability. Notably, they documented an inverted U-shaped relationship with the bank capital ratio. The relationship is more significant for highly profitable banks than for less profitable ones. In Africa, Madugu et al. (2019) argue that capital requirements reduced bank profitability in Ghana. Ajayi et al. (2019) find a strong and positive association between capital and the profitability of Deposit Money Banks (DMBs) of Nigeria. They recommend that policymakers should focus on capital adequacy, as well as monitoring and evaluating its implications on the banking industry in Nigeria.

Notwithstanding, several other studies have reported that regulatory requirement had no significant impact on bank profitability. Ngo (2006) showed no significant relationship between capital and profitability. Similarly, De Bandt et al. (2018) used a sample of 25 French banks for the period 2007-2014 to investigate the effect of higher capital requirements on bank profitability. They report that French banks were unfazed by higher capital restrictions.

Thus, we develop the following three hypotheses below:

- Hypothesis 1: Regulatory capital has a negative impact on bank profitability
- Hypothesis 2: Regulatory capital follows a "U-shape" form
- Hypothesis 3: Regulatory capital has a positive impact on bank stability (negative impact on bank risk)

3 Empirical Investigation

3.1 Sample selection and data sources

We start with a sample encompassing the 11 banks listed on the Tunisian stock exchange. However, we decided to exclude one bank due to extreme underperformance, which may cause a problem of outliers. We use a final sample of 10 Tunisian banks, relevant to the period 2005-2020. The rationale behind our sample choice is that these 10 banks provide 80% of financing to the economy. Thus, the type of data used for this study is a balanced panel dataset. Our study period covers periods of boom and bust in the Tunisian economy and growth in bank balance sheets. Our data is hand-collected from different but complementary sources from bank annual reports; statistics provided by the Financial Market Council (CMF); and the annual reports of Association Professionnelle Tunisienne des Banques et des Etablissements Financiers (APTBEF). We also used data provided by the CBT and the World Bank to further enhance the quality of our data.

3.2 Dependent variables

- **Return on Average Assets (ROAA)**

Following Chen et al. (2018), we use the return on average assets (ROAA) to proxy for bank profitability. Hence, we compute ROAA as the ratio of net income to average total assets. This ratio indicates the asset intensity of each bank. A high ROAA signifies that the bank has a higher asset intensity and vice versa.

$$ROAA = \frac{Net\ income}{Average\ Total\ Assets}$$

- **Z-score**

Z-score is a measure of bank stability and an inverse measure of bank risk-taking. The value given after computing our Z-score for each bank can be highly skewed. Therefore, we use the natural logarithm of Z-score. We will refer to the natural logarithm of banking z-score as a Z-score in the remaining of this thesis. We also compute the standard deviation of ROA using 3-year rolling windows. By using the 3-year rolling window scale, instead of the full sample period, we allow time variation of the standard deviation and give a more accurate estimation of bank risk in each year (Beck et at., 2013). Several papers multiply Z-score by minus 1 to get an appropriate measure of the banks risk-taking (Ashraf, 2017; Mourouzidou-Damtsa et al., 2017). We keep the value given by the Z-score measure but provide the inverse interpretation for the relationship between regulatory capital and bank risk. A high level of Z-score indicates that the bank is considered to be a low-risk bank, meaning that it has to go through several drops in its profits to fall into insolvency. Likewise, a low level of Z-score indicates that bank risk is high. Z-score is computed as follows:

$$Z - score = \frac{ROA + CAR}{\sigma ROA}$$

3.3 Independent variables

We use the Basel minimum capital adequacy ratio as a proxy for regulatory requirements. The ratio is calculated by summing Tier 1 and Tier 2 capital and dividing by the risk-weighted assets (RWA). Several empirical studies have also used the ratio of capital to the risk-weighted to account for regulatory imposed capital (Adjeitsey, 2015; Afriyie and Akotey, 2013). We follow the methodology of Le and Nguyen (2020)), whereby they use the square value of bank regulatory capital to test if the relationship is non-linear and increases profits up to a threshold, before dropping afterwards. This is commonly referred to as a “U-shape” form. If regulatory capital is, indeed, non-linear and follows a “U-shape” form, this reveals serious implications of regulatory decisions on bank behaviour. Bank managers claim that capital regulation reduces bank profitability due to social costs.

3.4 Control variables

Bank specific characteristics

- **Size:** we use the number of operating branches to account for bank size. The rationale for using this proxy for bank size is that by using the natural logarithm of total assets, we fall into multi-collinearity problems when two or more explanatory variables are highly correlated and render our estimation spurious. Large banks, at least in the Tunisian context, tend to open more branches.
- **Net interest margin:** we use the ratio of net interest margin to total loans to measure the interest-based activity of Tunisian banks.
- **Liquidity Risk:** to proxy for bank liquidity risk, we follow Carsemar et al. (2021) and use the ratio of Loan to Deposits (LTD). This ratio measures how much loans are being financed by depositors’ funds and can predict the potential liquidity risk a bank can face in a situation of a bank-run.
- **Credit risk:** we use the ratio of Loan Loss Reserves (LLR) in model 1, since loan loss reserves are deducted from bank profits and directly impact bank profitability. We use the ratio of NPLs to total loans (NPL) in model 2 to account for asset quality, because we believe that NPLs have a stronger impact on the overall risk and stability of a bank.
- **Cost efficiency:** We use the ratio of operating costs, which consists mainly of labour costs to total operating income, to account for bank inefficiency.
- **Lending policy:** Lending policy refers to the bank’s strategic choices when it comes to their growth and development. In our models, we use asset growth to proxy for bank lending policy.
- **Diversification:** we use the ratio of non-interest income to total operating income (DIVER) in model 1. This ratio provides information about the bank’s income structure but also showcases the weight of non-traditional income. We use the ratio of net commissions to payroll and benefits expenditure (COMOP) to account for diversification in model 2. This is because banks are more likely to sustain their normal activity if they are able to meet their short-term financial obligations, including payroll and benefits.

Macroeconomic conditions

- **Political instability:** We use the score of political stability provided by the World Bank multiplied by (-1) to assess the impact of political instability on bank profitability and stability.
- **Business Cycle:** We use real GDP per capita growth rate to account for the business cycle. Real GDP growth is generally used to measure economic growth and to assess the business cycle.
- **Inflation**: We use the yearly inflation rate to account for inflation.

Because we believe that the effect of liquidity and credit can take some time to affect bank stability and profitability, we use the one-period lagged of each proxy. Using lagged values of independent variables is also empirically justified because it can reduce the possible impact of reverse causality in our empirical models.

3.5 Model specification

We construct two models to investigate the relationship between regulatory capital and ROAA and Z-score, along with other control variables. Since this study uses panel data, we will present two statistical methods: Fixed effect OLS and GLS. First off, model 1 will be written as follows:

We also include the regulatory capital variable squared, to test whether the relationship is non-linear. Therefore, our first model will be written as follows:

$$ROAA_{it} = \alpha + \beta_1 CAP_{it} + \beta_2 CAP_{it}{}^2 + \beta_3 CTI_{it} + \beta_4 SIZE_{it} + \beta_5 AG_{it} + \beta_6 LLR_{it-1} + \beta_7 LTD_{it-1} + \beta_8 RENDC_{it} + \beta_9 DIVER_{it} + \beta_{10} POL_t + \beta_{11} INF_t + \beta_{12} GDP_t + \epsilon_{it} \quad (1)$$

Our second model will be written as follows:

$$Z-score_{it} = \alpha + \beta_1 CAP_{it} + \beta_2 GCP_{it} + \beta_3 CTI_{it} + \beta_4 SIZE_{it} + \beta_5 AG_{it} + \beta_6 NPL_{it-1} + \beta_7 LTD_{it-1} + \beta_8 ROAA_{it} + \beta_9 COMOP_{it} + \beta_{10} POL_t + \beta_{11} INF_t + \beta_{12} GDP_t + \epsilon_{it} \quad (2)$$

Where a Z-scoreit is our stability proxy, CAPit is the regulatory capital, GCPit is the growth rate of bank capital, LTDit-1 is the lagged value of loan to deposit ratio, NPL it-1 is the lagged value of NPLs to total loans, ROAAit is Return on Average Assets, SIZEit is the number of operating branches, CTIit is the cost to income ratio, AGit is the asset growth rate, COMOPit is the ratio of net commissions over operating income, POLt is the political instability score, INFt is the inflation ratio and GDPt is the real growth rate.

4 Results and discussion

First, we test the presence of multicollinearity by following the same method recommended by Wooldridge (2015), in which he considers the existence of multicollinearity if the correlation coefficient between two variables is greater than 0.7. All the correlation coefficients are less than 0.7, suggesting a low chance of multicollinearity bias in our estimations.

4.1 Descriptive statistics

There are 160 observations from 10 Tunisian commercial banks listed on the stock exchange over a 16- year period. Table 2 below displays the descriptive statistics of the key variables included in the two models. As noted by several other studies, we witness some variations in the mean and standard deviation of the variables (Ashraf, 2017; Chen et al., 2018).

(Insert table 2 here)

In particular, we notice that the mean values presented in table 2, characterising banks are generally larger than their median, which indicates that in our sample, smaller and medium sized banks outnumber large banks.

The financial stability of the Tunisian banking industry, measured by the Z-score, has an average value of 3.51, with a standard deviation of 3.43 and quite a significant gap between the minimum value of -16.12 and the maximum value of 10.08.

For our profitability variable, Tunisian bank performance does not stray from the trend witnessed worldwide. Bank ROAA is positive but not very high. The average value of ROA is 1%, with a maximum value of 4.4% and a minimum value of –4.5%. This is in line with the average 1% ROA recorded for the banking industry worldwide (Borio et al., 2017). The overall performance of the Tunisian banking industry is attributed to the interest margin charged on loans granted, with an average value of 6.83%.

Tunisian banks in our sample have an average regulatory capital ratio of 11.32%, much higher than the 10% minimum requirement of the CBT and the 8% minimum requirement of the Basel committee. The median regulatory capital sits at 11.05%. Tunisian banks keep regulatory capital ratios in the range of 10.75% to 20.70%, except for the years 2013 and 2014, in which a systemically important bank saw its equity drop to negative levels. This implies that Tunisian banks tend to keep a considerable buffer, in order to absorb unexpected losses.

4.2 The impact of regulatory capital on bank profitability

Table 3 displays our results for Model 1, in which ROAA is the dependent variable. The fixed effect regressions are presented as a baseline specification, from which we depart by examining the Generalized Least Squares (GLS) estimates which controls for heteroskedasticity and autocorrelation.

(Insert Table 3 here)

For the first specification, we evidence a positive impact of regulatory capital on bank profitability. This means that regulatory pressure did not curb bank profits. Interestingly, regulatory capital improves Tunisian banks' profitability. Our result confirms the findings of Baker and Wurgler (2013), who interpret these higher realised returns as proxying for higher expected returns ex ante and concluded that shareholders in well-capitalised banks require higher returns. This can also be ascribed to the fact that since banks are constrained to increase capital commensurately with their risk-weighted assets, they increase the monitoring and screening of their borrowers, in order to select the most solvent borrowers who are able to pay back the principle borrowed with interest (Altunbas et al., 2007). Our result is in contrast to the expected income theory, in which capital requirements are thought to reduce bank profitability.

Furthermore, the coefficient of regulatory capital squared (CAP2) in regression (4) is negative and statistically significant. This finding confirms the view that stringent capital requirements help improve bank profitability, up to a certain threshold. After that, an increase in capital is more likely to reduce bank profitability. This is commonly referred to as a "U-shape" form relationship. Le and Nguyen (2020) have also documented a U-shaped relationship between bank capital requirements and bank profitability.

Moreover, the coefficient of cost inefficiency is negative and significant. This finding is consistent with the view that efficient management provides banks with the opportunity to improve their profitability. Hence, as the conventional wisdom posits, efficient use of labour can only positively affect bank profits (Bourke, 1989; Khediri and Ben-Khedhiri, 2011). We also find that size is positively correlated with profitability. Our findings are in line with the size-profitability hypothesis, whereby larger banks benefit from economies of scale and scope, which in turn lead to higher profits (Le and Nguyen, 2020; Zhang et al., 2008). The positive association between size and bank profitability in the Tunisian context can also be explained by the "stewardship theory", which suggests that managers' interest aligns with that of the bank owners. Based on this argument, bank profitability will benefit managers as well as bank owners (Donaldson and Davis 1991; Davis et al., 1997). We use asset growth to proxy for bank growth strategy and lending policy. We document a positive relationship between asset growth and bank profits. This can be explained by the fact that growth in assets translates to higher interest income, which in turn leads to improved profitability.

We find the coefficient of the net interest margin ratio (RENDC) to be positive and significant. This result is expected, since Tunisian banks' profitability generally stems from their traditional interest-based activities. In addition, the coefficient for our diversification variable is positive and statistically significant. This means that higher diversification entails higher return. This finding is in line with the findings of Ahamed (2017), Kohler (2015) and Li (2021), who documented a positive association between diversification and bank profitability.

Interestingly, credit risk has a positive and significant coefficient. This can be explained by the risk-return hypothesis, under which bank shareholders expect to be compensated with higher returns for the increases in risk. The coefficient of the liquidity risk variable is negative and significant. This implies that liquidity risk negatively affects bank profitability. This can be explained by the fact that illiquid banks face higher funding costs, which in turn reduce their profitability. Our findings are in line with the findings of Bassey and Moses (2015), who also document a negative impact of liquidity risk on bank profitability.

For macroeconomic conditions, political instability negatively affects economic growth and foreign direct investment, which in turn would lead to less lending and lower profits.

Moreover, we observe that the coefficient of real GDP per capita is positive and significant for our first model. This implies that economic growth stimulates bank profitability. We also document a non-significant relationship between inflation and bank profitability. Our findings are in line with that of Jokipii and Monnin (2013), who also found no clear evidence of inflation on profitability.

4.3 The impact of regulatory capital on bank risk (stability)

Table 4 displays the results for Model 2, in which Z-score is the dependent variable. The fixed effect regressions are presented as a baseline specification, from which we depart by examining the Generalized Least Squares (GLS) estimates which controls for heteroskedasticity and autocorrelation.

(Insert table 4 here)

We find a positive and significant relationship between regulatory capital and bank stability. This implies that regulatory capital boosts Tunisian banks' solvency. This result may be ascribed to the constant effort of Tunisia's regulatory bodies, headed by the CBT, to ensure the resilience of the Tunisian banking industry through recapitalisation. Another explanation is that higher regulatory capital increases shareholders' "skin in the game", in turn improving bank efficiency in terms of screening and monitoring of borrowers. Another possible explanation is that managers tend to work harder to offset the negative impact of the social costs of capital-financing, by generating more profits through the expansion of their income sources and asset growth. The coefficient of the capital growth rate (GCP) is negative and significant. This implies that regulatory capital can also take a "U-shape" form and increase bank risk-taking and instability. This can also signal that regulatory capital is close to the threshold which would inverse the relationship between capital requirements and bank risk. We test the non-linearity hypothesis later in our robustness tests.

Moreover, the results show a positive and significant coefficient of the Cost to Income ratio (CTI). This implies that cost inefficiency has a negative effect on bank risk and a positive effect on bank stability. One possible explanation for this is that Tunisian banks are investing in skilled staff who would potentially improve their stability and decrease their risk exposure through better screening and monitoring of borrowers in the long run. Our finding is in contrast with the result documented by Alber (2017) and Dutta and Saha (2021) whose findings show a positive and significant association between efficiency and stability, as well as with that of Yakubu and Bunyaminu (2021) who does not find any significant association between efficiency and bank stability.

We report a positive effect of size on bank stability, hence a negative effect on bank risk. This can be justified by the fact that larger banks tend to benefit from greater investment opportunities, greater negotiating powers and economies of scale and scope, which reduces their probability of default. Le Nguyen (2020) explains that large banks tend to be more profitable and have lower bankruptcy costs, which generally foster bank stability and reduce their default risk. Our finding is consistent with those of De Haan and Poghosyan (2012), who also document a positive association between size and bank stability. However, it is in contrast to past literature documenting a negative relationship between size and stability (Altaee et al., 2013; Laeven et al., 2014; Kohler, 2015; Ali and Puah, 2018).

We find that credit risk is negatively associated with bank stability. This finding is in line with economic logic, since an accumulation of NPLs can deplete a bank's capital and render a bank insolvent. This finding is in line with Ghenimi et al., (2017), who find that credit risk is positively correlated to bank instability because it is associated with higher probabilities of default. Interestingly, the coefficient of our liquidity risk variable is positive and significant. This can be explained by the fact that our ratio also takes accounts of the lending activity of the bank financed by the cheapest form of liability, which is depositors' funds. This finding is in contrast with that of Ghenimi et al. (2017) and Ali and Puah (2019).

We find that profitability is positive and significant. This finding is to be expected, because profitability increases bank capital via retained earnings, which boosts bank stability and reduces bank insolvency risk. This result contradicts the one obtained by Srairi (2013) and Imbierowicz and Rauch (2014), who found a negative effect of ROA on banking stability. In addition, we find that diversification is positively associated with bank stability. This implies that diversification has helped Tunisian banks mitigate their risk of insolvency. Our findings are in line with past literature that documented a positive relationship between diversification and bank stability (Litan, 1985; Wall and Eisenbeis, 1984; De Jonghe, 2010), although in contrast to literature that documented the adverse effect of diversification (Lepetit et al., 2008; Abedifar et al., 2013).

Furthermore, we document a negative (positive) relationship between asset growth and stability (risk). This confirms empirical wisdom, that associated rapid asset growth with increase in risk. Our findings are in line with those of Abedifar et al. (2013), which show that asset growth is associated with higher risks and reduced bank stability.

For macroeconomic conditions, we find that the coefficient of the political instability variable is negative and significant. This implies that political instability increased bank risk of insolvency, since it negatively affects the banks' main source of income, which is heavily influenced by market conditions. The coefficient of real GDP per capita is positive and significant in the risk model. This implies that economic growth boosts bank stability. Contrary to model 1, we document a positive (negative) relationship between inflation and bank stability (risk) for model 2. This finding is in line with that of Yakubu and Bunyaminu (2021), who also document a positive relationship between inflation and bank stability.

5 Robustness check

For robustness, we re-estimate models 1 and 2 using a dynamic approach. Studies have shown that most economic and financial relationships are dynamic. Dynamic models differ from static models, in respect of the presence of lagged dependent variables amongst the other independent variables.

Bank profitability tends to persist, due to the influence of long-lasting economic shocks and market conditions (Berger et al., 2000). Based on these grounds, it is reasonable to expect the relationship to be dynamic and adopt a model in which lagged profitability variables are included. We also test whether bank stability can showcase a persistence effect. We also test if regulatory capital can have a "U-shape" form relationship with stability (risk taking), like that reported in our profitability model.

The least squares estimation technique produces biased and inconsistent coefficients when lagged dependent variables are present and dynamic relationships need to be modelled using dynamic appropriate techniques, such as the Generalised Method of Moments (GMM) and Two-Stage Least Squares (2SLS) Regression Analysis. However, Judson and Owen (1999) performed Monte Carlo simulation to test the bias in the coefficient in least squares estimation and found that the bias tends to approach zero when T increases. For the sake of caution, however, we perform our robustness test using the Two-Stage Least Squares (2SLS) regression analysis. We chose this estimation technique instead of the GMM estimation, since the latter requires "small T, large N" panels, meaning few time periods and many individuals (Arellano and Bond, 1991; Arellano and Bover 1995; Blundell and Bond 1998).

Tables 7 and 8 display the regression results after testing for endogeneity[3] and overidentifying[4] restrictions. Table 7 displays regression results for the 2SLS estimation, in which ROAA is the dependent variable.

(Insert table7 here)

(Insert table 8 here)

The coefficient of the one-period lagged value of ROAA is positive and significant. This implies that Tunisian banks' profitability showcases a persistence effect, meaning that banks that performed well in the past year tend to perform well the following year.

Even though the magnitude of coefficients generated by the 2SLS regression varies from the GLS to some extent, the impact of our independent variables is basically consistent. All our independent variables have economically reasonable signs. Regulatory capital remains positive and significant. However, the coefficient of the ratio squared is negative. This further confirms the non-linearity of the capital-profitability hypothesis and in line with the "U-shape" nature of the relationship documented in the GLS regression. Table 8 displays regression results of the 2SLS estimation, in which Z-score is the dependent variable. The coefficient of the one-period lagged value of Z-score is not significant. This implies that bank stability or risk-taking does not tend to persist. We find that the coefficient of the regulatory capital ratio is positively correlated with bank stability (negatively correlated with bank risk), which confirms the results of the static model. However, the coefficient of CAP2 is negative and significant, which further showcases the non-linearity of the capital-risk hypothesis and in line with the "U-shape" nature of the relationship documented in the GLS regression.

6 Conclusion

Bank capital is considered to be the centre of micro- and macro prudential regulation in banking all over the world. The Basel Accords view capital as the most important target to ensure the resilience and the stability of the financial system. Capital regulation can be considered as the effective medicine to prevent future illness within the financial system. Yet, it is legitimate to ask if the medicine can kill the patient?

[3] We performed the Hausman endogeniety test to determine whether our regulatory capital ratio variable is endogenous. We use the second and third lag of regulatory capital (CAP) and NPLs' ratio as instruments. We fail to reject the null hypothesis (Table 5), meaning that our regulatory capital variable is exogeneous.

[4] Table 6 reports our over-identifying restrictions test result. We fail to reject the null hypothesis for both of our models. Hence, we can confirm that our instruments are valid.

Our empirical investigation reveals very interesting findings. First, we find that regulatory capital ratios at first improve bank profitability and reduce bank risk. However, when regulatory pressure reaches a certain threshold, the positive effect of regulatory capital is diminished and regulatory capital may reduce bank profitability and increase risk-taking incentives. This means that the profitability and risk- taking behaviour of Tunisian banks is not linear and follows a "U-shape" form. This implies that bank managers retain some truth in their claims about the social costs of regulatory capital. In addition, we also find that Tunisian banks' performance tend to persist over time. This may insinuate that banks increase their capital by means of retained earnings. However, we do not find evidence of the persistence of bank risk. In addition, we find that diversification has helped mitigate bank risk and that political instability reduced bank profits and increased bank fragility.

Regulators should be able re-design capital standards in line with the optimal social capital, whereby bank profitability is not compromised and regulators are ensured of the soundness and solvency of banks. However, the optimal social capital is very difficult to determine, due to the complexity of the banking activity and the divergence of interests between regulators and banks. We propose that regulatory authorities include the leverage ratio — Equity to total assets ratio — proposed by Basel III and set at 3% as a complement to the regulatory risk-weighted requirements, in order to improve the resilience of the Tunisian banking sector and to curb banks' incentives to engage in regulatory arbitrage. Indeed, since risk-weighted capital ratios are prone to errors and since regulators cannot have full information about the risk portfolio, banks can meet capital requirements without having to raise equity capital considered to have the best loss-absorbing capacity. This behaviour has been documented by Jackson (1999), whose findings show that banks, in response to capital requirements, increase their average risk-weighted asset ratio, whereas the leverage ratio kept declining. The U.S, for instance, have kept the minimum leverage ratio — which existed prior to the implementation of the Basel framework — set at 3% for "strong" banks and 4% for other banks. Regulators in the U.S claim that the leverage ratio is the more binding constraint on bank activities.

We also propose the introduction of contingent capital, otherwise known as "CoCos". Contingent capital is a form of hybrid debt, which converts automatically into equity capital when a trigger event is met. The advantage brought by CoCos is that bank capital increases automatically in situations of distress, providing banks with additional loss-absorbing capacities. Contingent capital provides banks with additional capital in times of need, whilst also preserving the disciplinary role of debt, since subscribers to CoCos will closely monitor bank compliance. Another advantage of contingent capital is that the Central Bank of Tunisia can set the trigger conditions of contingent capital, for example when the leverage ratio reaches a pre-specified limit or when Tier 1 capital requirements are no longer met.

A number of limitations in this study can be identified. First, more evidence is needed on the impact of regulatory capital on bank profitability and risk, before any generalisation of our results can be made. Second, due to data availability, our empirical investigation was only conducted on the ten major listed Tunisian banks covering the period 1999-2005, hence the results of the study cannot be assumed to extend beyond this group of banks, or to different study periods. The use of only quantitative data —accounting data, to be exact — in itself can also be seen as a limitation to some extent, since bank risk and profitability may also depend on other qualitative variables that we did not take into account, which may affect the richness of our research data. Moreover, the study focuses on the banking sector and not the overall financial system, which can be considered both a delimitation and limitation. Another limitation of our study is that we do not consider insurance deposit schemes when determining the relationship between bank risk and regulatory capital. However, the Tunisian Bank Deposit Guarantee Fund started operating in 2018, which is considered too recent to influence bank behaviour. We propose, for future research, investigating the impact of an alternative "regulatory capital" Z-score as an indicator for the likelihood that a bank's regulatory capital drops below a given threshold.

7 APPENDIX

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) CAP	1.000													
(2) GCP	-0.012	1.000												
(3) LTD	0.113	-0.012	1.000											
(4) NPL	-0.457	0.097	-0.014	1.000										
(5) BRANCH	0.060	-0.050	-0.272	-0.158	1.000									
(6) CTI	-0.544	-0.036	-0.197	0.347	-0.100	1.000								
(7) AG	0.102	0.046	0.178	-0.056	0.087	-0.214	1.000							
(8) COMOP	0.353	0.062	0.008	-0.253	0.066	-0.562	0.220	1.000						
(9) POL	-0.107	0.060	-0.102	0.250	-0.520	0.099	0.162	-0.143	1.000					
(10) LLR	0.349	-0.032	0.080	-0.706	-0.038	-0.218	-0.063	0.184	-0.363	1.000				
(11) RENDC	0.350	-0.042	-0.062	-0.217	0.258	-0.333	-0.051	0.064	-0.081	0.064	1.000			
(12) DIVER	0.078	0.003	-0.424	-0.236	0.164	0.071	-0.250	0.209	-0.356	0.197	-0.034	1.000		
(13) GDPC	-0.240	0.147	0.072	0.229	-0.349	0.098	0.187	-0.029	0.367	-0.199	-0.305	-0.132	1.000	
(14) INFGDP	0.184	-0.030	0.060	-0.189	0.310	-0.113	-0.032	0.064	-0.401	0.120	0.553	0.115	-0.234	1.000

Table 1: Correlation matrix

Table 2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	.25	Median	.75	Max
Z-score	160	3.51	3.43	- 16.12	3.44	3.93	4.67	10.08
ROAA	160	0.01	.011	-0.05	0.00	0.01	0.02	0.04
CAP	160	0.11	0.04	-0.06	0.10	0.11	0.13	0.22
GCP	159	0.11	0.17	-0.32	0.01	0.08	0.17	0.99
CTI	160	0.47	0.11	0.25	0.39	0.47	0.53	0.84
SIZE	160	130.55	35.42	39	103.50	125.50	150	207
AG	150	0.08	0.07	-0.08	0.03	0.08	0.13	0.25
LLR	160	0.51	0.17	0.06	0.43	0.53	0.61	0.95
LTD	160	1.10	0.15	0.65	0.97	1.12	1.20	1.45
COMOP	160	0.51	0.15	0.24	0.40	0.49	0.61	0.91
RENDC	160	0.07	0.01	0.05	0.06	0.07	0.08	0.10
NPL	160	0.17	0.11	0.06	0.09	0.13	0.20	0.57
DIVER	160	0.46	0.12	0.22	0.37	0.44	0.51	0.77
INF	160	0.05	0.01	0.01	0.04	.044	0.06	0.08
GDP	160	0.01	0.03	-0.09	0.00	0.02	0.03	0.06
POL	160	0.49	.48	-0.21	-0.04	0.68	0.89	1.14

Abbreviations: Z-score: bank stability; ROAA: Return On Average Assets; CAP: Regulatory capital ratio; GCP: Growth rate of capital; CTI: Cost to income ratio; SIZE: The number of operating branches banking; AG: Asset growth ratio; LLR: Loan loss reserves; LTD: Loan to Deposit ratio; COMOP: Net commissions to operation costs ratio; RENDC: Net interest margin ratio; NPL: Non-performing loans ratio; DIVER: Non-interest income to total operating income; INF: Inflation rate; GDP: Real GDP per capita growth rate; POL: political instability.

Table 3:

	(1) Fixed effects ROAA	(2) GLS ROAA	(3) Random effects ROAA	(4) GLS ROAA
CAP	.067***	.066***	.113***	.119***
	(.017)	(.013)	(.027)	(.023)
CAP^2			-.304**	-.308***
			(.128)	(.111)
CTI	-.038***	-.032***	-.032***	-.033***
	(.01)	(.003)	(.006)	(.003)
SIZE	.032***	.013***	.013***	.012***
	(.005)	(.002)	(.003)	(.002)
AG	.019**	.009***	.024***	.008**
	(.009)	(.003)	(.008)	(.003)
LLLR	.002	.013***	.01***	.011***
	(.005)	(.003)	(.004)	(.003)
LLTD	-.024***	-.009***	-.012***	-.008***
	(.007)	(.002)	(.004)	(.002)
RENDC	.252***	.079**	.23***	.085**
	(.077)	(.036)	(.063)	(.036)
DIVER	-.058	.168***	.143**	.158***
	(.165)	(.042)	(.072)	(.042)
POL	-.001	-.002**	-.004***	-.002**
	(.002)	(.001)	(.002)	(.001)
INF	.028	.029	.037	.027
	(.041)	(.02)	(.042)	(.02)
GDP	.046***	.027***	.022	.023***
	(.016)	(.008)	(.016)	(.008)
cons	-.128***	-.057***	-.067***	-.055***
	(.026)	(.011)	(.016)	(.011)
Observations	150	150	150	150

Estimation using OLS and GLS for ROAA

Table 4: Estimation using OLS and GLS for Z-score

	(1) Fixed effects Z-score	(2) GLS Z-score
CAP	.546***	.045***
	(.069)	(.001)
GCP	-.023**	-.001***
	(.01)	(0)
CTI	.039	.074***
	(.043)	(0)
SIZE	-.117***	.008***
	(.029)	(0)
AG	.087***	-.009***
	(.031)	(0)
LNPL	-.089***	-.071***
	(.027)	(0)
LLTD	.035*	.019***
	(.02)	(0)
ROAA	1.545***	.676***
	(.317)	(.002)
COMOP	-.02	.05***
	(.027)	(0)
POL	.011	-.009***
	(.007)	(0)
INF	.074	.012***
	(.151)	(0)
GDP	-.064	.057***
	(.077)	(0)
cons	.701***	-.085***
	(.181)	(.001)
Observations	160	160

Standard errors are inparentheses

*** p<.01, ** p<.05, * p<.1

Table 5: Durbin–Wu–Hausman test for endogeneity

	ROAA	Z-score
Durbin (score) chi2(1)	1.7818	2.2896
P-value	0.6189	0.5145
Wu-Hausman F(1,114)	1.58421	2.0079
P-value	0.6630	0.5708

Table 6: Test of overidentifying restrictions

	ROAA	Z-score
Sargan (score) chi2(3)	1.7818	2.2896
P-value	0.6189	0.5145
Basmann chi2(3)	1.58421	2.0079
P-value	0.6630	0.5708

Table 7: Instrumental variable (2SLS) regression using ROAA

ROAA	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
LROAA	.205	.066	3.11	.002	.076	.335	***
CAP	.086	.026	3.28	.001	.034	.137	***
CAP²	-.239	.121	-1.98	.048	-.475	-.002	**
CTI	-.026	.006	-4.28	0	-.038	-.014	***
SIZE	.01	.003	3.86	0	.005	.016	***
AG	.029	.007	4.01	0	.015	.043	***
LLLR	.01	.004	2.82	.005	.003	.017	***
LLTD	-.012	.003	-3.42	.001	-.018	-.005	***
RENDC	.19	.06	3.18	.001	.073	.307	***
DIVER	.116	.067	1.72	.085	-.016	.248	*
POL	-.004	.001	-2.67	.008	-.007	-.001	***
INF	.041	.039	1.04	.298	-.036	.117	
GDP	.03	.015	2.07	.038	.002	.059	**
Constant	-.054	.016	-3.43	.001	-.084	-.023	***
Mean dependent var		0.011	SD dependent var			0.011	

R-squared	0.800	Number of obs	150
Chi-square	599.776	Prob > chi2	0.000

**** p<.01, ** p<.05, * p<.1*

Table 8: Instrumental variable (2SLS) regression using Z-score

Zscore	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
LZscore	-.029	.044	-0.66	.508	-.116	.057	
CAP	1.409	.083	16.92	.000	1.246	1.572	***
CAP2	-4.824	.368	-13.11	.000	-5.545	-4.103	***
GCP	-.029	.007	-3.94	.000	-.044	-.015	***
CTI	-.027	.021	-1.28	.200	-.068	.014	
SIZE	.002	.009	0.24	.807	-.016	.021	
AG	.04	.021	1.94	.052	0	.08	*
LNPL	-.042	.015	-2.76	.006	-.072	-.012	***
LLTD	.005	.01	0.50	.616	-.014	.023	
ROAA	.317	.193	1.64	.101	-.061	.696	
COMOP	-.022	.012	-1.86	.063	-.045	.001	*
POL	-.002	.004	-0.51	.609	-.01	.006	
INF	-.041	.097	-0.42	.671	-.232	.15	
GDP	.097	.043	2.27	.023	.013	.181	**
Constant	-.047	.073	-0.64	.523	-.191	.097	

Mean dependent var	0.034	SD dependent var	0.035
R-squared	0.831	Number of obs	150
Chi-square	736.145	Prob > chi2	0.000

**** p<.01, ** p<.05, * p<.1*

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