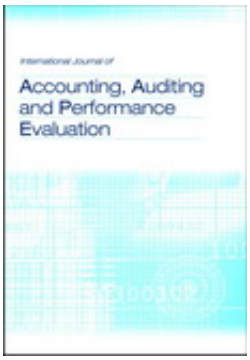

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Competition, stability and the efficiency channel in the Tunisian banking system

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Competition, stability and the efficiency channel in the Tunisian banking system

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Abstract: Tunisia has expanded foreign capital entry and introduced Basel-based reforms to bolster bank efficiency, competition and stability. Although notable progress has been made, the increase in non-performing loans (NPLs) and susceptibility to adverse economic conditions remain significant threats to bank stability. This study examines the *competition-stability* nexus in the Tunisian banking sector from 2005 to 2020 and establishes whether cost efficiency plays a role in this relationship. The results reveal that competition reduces stability, supporting the *competition–fragility* thesis with an insignificant *efficiency channel*. Fragility heightens as banks become larger, while liquidity and diversification have a neutral effect. Inflation, GDP growth and the rule of law influence bank stability. Interestingly, the stability of government-owned, foreign-owned, and private banks does not significantly differ. This suggests that non-government ownership may pursue objectives other than enhancing stability. Consequently, there is a case for reviewing reform programs and redefining their objectives and procedures.

Keywords: bank competition; cost efficiency; stability; Lerner index; market power; Tunisia; Covid-19; Arab spring.

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1 Introduction

Tunisia is a small economy whose financial system is predominately bank-based. During 2017–2021, the banking sector consisted of 23 banks, including 6 state, 3 private, 11 foreign, and 3 mixed banks. This structure has resulted from the several reform rounds implemented since 1987. Accordingly, Tunisia has introduced market-based measures abolishing price and non-price restrictions, expanding non-public ownership of banks, and adopting international norms of soundness (Jbili et al., 1997; Cook et al., 2005; CBT, 2013). These measures were recently supplemented by chartering 3 Islamic banks accounting for 5% of total sector assets, implementing Basel reforms, and integrating the latest technologies into operations (Elleuch and Taktak, 2015). These measures are expected to inject competition into the industry and enable higher cost efficiency (Williams, 2012) because more competition enhances banks' stability (Schaeck and Čihák, 2014). Despite the significant progress (IMF, 2006, 2012), the Tunisian experience, disrupted by internal trends and external shocks, may have shaped a system in which it is uncertain whether raising competition has enhanced or weakened bank stability (Khalfaoui and Guenichi, 2021) and whether efficiency has had a role in this competition-stability nexus (Schaeck and Čihák, 2014).

Against this doubt, three attributes of Tunisian banking that might have prevented the banks from thriving underscore the importance of understanding the financial resilience of Tunisian banks in terms of competition and efficiency. First, financial reforms brought about a rise in the number of banks to what can be viewed as too large for a small economy. As one may expect, a higher number of finance providers may imply a surge in competition. Nevertheless, the market concentration remains high, the average size of a bank is small (Khalfaoui and Guenichi, 2021), and banks operate under more monopolistic conditions (Ben Abdelkader and Mansouri, 2014). Second, although the State has reduced its stakes, its presence is still significant and visible. Third, banks have been operating under conditions that are vulnerable to changing political landscapes and difficult economic conditions (Khalfaoui and Guenichi, 2021). These phenomena might have re-formed the interconnectedness among efficiency, competition and stability, generating uncertainty on what to do next to enhance the sector.

From a theoretical standpoint, the intellectual framework on which studies of competition and stability are grounded comprises two opposing views: the traditional *competition-fragility* and the alternative *competition-stability*. Keeley (1990) advocates the *competition-fragility* view, which states that more competition increases risk-taking, reducing stability. It argues that they can earn higher profits through monopoly rents in a less competitive environment, enabling them to endure shocks and reduce risk-taking. By contrast, the *competition-stability* view maintained by Boyd and De Nicolo (2005) suggests that competition positively impacts stability, implying that more competition reduces risk-taking. Under less competition, banks charge higher rates, increasing the probability of default on loan repayments.

The uncertainty on the *competition-stability* nexus may motivate several stakeholders in Tunisia to establish whether competition affects stability and test the role of efficiency in this relationship. This work makes several contributions to the literature on the relationship between bank efficiency, competition and stability in Tunisian banking. First, it employs the latest dataset from 2005 to 2020, which deserves a fresh analysis. This period was eventful with adverse shocks: difficult macroeconomic conditions, challenging geological situation, the 2008–2008 global financial crisis (GFC), the

2011–2012 Arab spring and the 2019–2020 Covid-19 pandemic. Regulators and policymakers have subjected the banking sector to a few reforms, such as converting specialised banks into commercial banks, privatisation, and re-capitulation. Second, we investigate whether banks in Tunisia should heighten market power to attain more resilience and whether efficiency intervenes in this relationship. To address these objectives, this paper makes two research questions using data from Tunisia: What is the relationship between competition and stability in light of the two views surveyed above? And what is the role of efficiency in the *competition–stability* nexus?

The analysis considers bank-level data from a sample of 23 banks over 2005–2020, generating an unbalanced panel dataset of 343 observations. Bank-level data are extracted from the individual banks' balance sheets availed by the Tunisian Professional Banking Association. Macroeconomic and institutional data are obtained from the World Bank Economic database and Worldwide Governance databases. The ownership data are sourced from the reports of the statistical annals published by the Central Bank of Tunisia. Bank stability is proxied by the Z-score, while the Lerner index of market power measures bank competition. Efficiency values are estimated using the stochastic frontier approach (SFA). Endogeneity is treated using the two-step system GMM. For robustness checks, several specifications are estimated.

Our analysis reveals that more market power reduces the fragility of banking institutions in Tunisia. While cost efficiency generates a stabilising effect, it does not impact the *competition-stability* nexus. Furthermore, the results show that size, diversification and ownership types are not the transmission mechanisms through which market power channels its effects to bank stability. The results also demonstrate that external shocks experienced by Tunisia during 2005–2020 had a neutral effect on bank stability, while economic and institutional variables played a significant role in enhancing banks' resilience.

The remainder of this paper is structured as follows: Section 2 reviews several recent studies; Section 3 presents the methodology, the variables, and the data; Section 4 presents and discusses the results; Section 5 summarises; Section 6 recommends.

2 Literature review

A strand in the literature has emerged addressing the validity of the *competition-fragility* and *competition-stability* theses in different banking systems. The literature provides mixed results regarding the effect of competition on bank stability and the channels through which competition influences stability. For instance, Kasman and Carvallo (2014) study the effect of competition on bank stability using a sample of 272 commercial banks from 15 Latin American countries from 2001–2008. The results show that higher competition leads to greater financial stability, banks with higher stability enjoy higher market power, and banks with higher market power have higher efficiency. Beck et al. (2013) reveal results favouring the *competition-fragility* view and that the regulatory and institutional factors exercise a large moderating role. Greater competition rendered the banking system more fragile in countries with strict activity restrictions, lower systematic fragility, a well-developed stock exchange, an efficient credit information-sharing system, and substantial deposit insurance.

Albaity et al. (2019) investigate the relationship between competition and bank stability for 276 banks over the 2006–2015 period. The analysis uses two proxies of

competition, i.e., the *Lerner Index* and the *Boone indicator*, in the same regression equation, which also encompasses bank size, efficiency, diversification and leverage, profitability, financial inclusion, productivity, and macroeconomic instability. The results support the *competition-fragility* hypothesis for the banking systems in the MENA region. More competition is associated with lower bank stability (Z-score) and profitability (ROA and ROE), and high insolvency risk (NPLs). Competition reduces the portion of profitability generated through market power, which results in accepting more risk to offset the lost profitability, thus making banks less stable. The results emphasise that the *competition-fragility* relationship is stronger for Islamic banks than conventional banks.

Phan et al. (2019) examine the relationships between bank competition, efficiency and stability in China, Hong Kong, Malaysia and Vietnam between 2004 and 2014. The results support the *competition–fragility* view, suggesting that higher competition may lessen stability and that credit risk, bank size and market concentration positively affect bank stability. By contrast, banks with higher liquidity risk and revenue diversification may become less stable. Other results suggest that the 2008 GFC, inflation and GDP growth affect bank stability.

Dutta and Saha (2021) examine the impact of competition and efficiency on the financial stability of the banking system of Bangladesh. This study analyses whether the financial deregulation that followed financial repression during the 1980s and 1990s generated a stimulating effect on competition among banks. The results propose a nonlinear competition–stability relationship, suggesting that competition initially contributes to stability. However, the positive impact diminishes and becomes damaging at a higher degree of competition. Besides, the results show that efficiency fosters stability, but its impact is weakened in the presence of competition.

Shabir et al. (2021) examine the effects of Economic Policy Uncertainty (EPU) on bank stability and whether institutional quality and competition moderate this effect, using data from 2005 to 2019. The results show that EPU negatively influences bank stability regardless of a country's economic development and income level. The adverse effect is more pronounced during periods of unanticipated phenomena such as financial crises. Furthermore, the negative EPU-stability link loses strength in banking systems characterised by more competition and higher quality of institutional variables.

El Moussawi and Mansour (2022) analyse the relationship between competition, efficiency, and bank stability, using a sample of 222 MENA banks from 1999–2018. The results show that competition, measured by the *Panzar-Rosse H-statistic* and the *Lerner index*, positively affects both the efficiency and stability of the banks in the MENA region. These findings show that banks with market power are less efficient, supporting the *quiet life hypothesis* (Hicks, 1935). Besides, the ownership structure of banks influences bank stability.

Elfeituri (2022) analyses whether market concentration and competition contribute to shaping the performance and stability of the banking systems in MENA for the period 1999–1916. This study considers the context of the overall institutional quality, the adverse shocks of the recent 2008 GFC, and the political and security concerns following the *Arab Spring*. The results show that less competition and higher concentration lead to a deterioration in stability, supporting the *competition-stability* hypothesis. Furthermore, higher bank performance and stability are contingent upon a better quality of the institutional environment where banks operate.

However, Berger et al. (2009) demonstrate that concentration and competition could coexist and simultaneously induce stability or fragility. Fu et al. (2014) investigate *the competition-stability* nexus for 14 Asia Pacific banking systems from 2003 to 2010. The findings support the neutral view of the *competition-stability* nexus, indicating that the *competition-stability* and *competition-fragility* views can simultaneously apply to the Asia Pacific. The negative association between the competition and individual bank risk was accompanied by a positive relationship between the concentration ratio and bank fragility. The results show that stability is weakened by the larger size of banks and by an environment characterised by relaxed entry restrictions and stronger deposit insurance schemes.

Similarly, Saif-Alyousfi et al. (2020) support both *competition-fragility* and *competition-stability* hypotheses in the GCC banking market from 1998 to 2016. The findings indicate that more bank competition raises market concentration and loosens banks' financial resilience. However, the results also show that lower competition increases fragility by stimulating the risk-taking behaviour of smaller banks and banks with lower capitalisation and lower liquidity. Such results may indicate that using one measure of competition is not enough to evaluate the impact of competition on banking stability.

3 Methodology, variables and data

3.1 Estimation model

This work examines the impact of competition on bank stability and whether efficiency transmits this impact. To achieve this goal, we propose a model where bank stability is regressed upon a measure of competition and other bank-specific, macroeconomic and institutional variables. Following Phan et al. (2019) and Dutta and Saha (2021), the regression specification estimating the direct causal effect of competition and efficiency on bank stability takes the following form:

$$\begin{aligned} \text{STABILITY}_{i,t} = {} & \beta_0 + \beta_1\, \text{STABILITY}_{i,t-1} + \beta_2\, \text{COMPETITION}_{it-1} \\ & + \beta_3\, \text{EFFICIENCY}_{i,t-1} + \beta_4\, \text{COMPETITION}_{i,t-1} \\ & \times \text{EFFICIENCY}_{i,t-1} + \Sigma\gamma_j\, \text{X}_{i,t-1,j} + \Sigma\Phi_j\, \text{Z}_{t-1} \\ & + \Sigma\delta_j\, \text{DUMMIES} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where subscripts *i*, *t* and *t*–1 denote *bank, year* and one-year lagged term, respectively; *STABILITY* is the dependent variable proxied by the Z-score; *COMPETITION* is proxied by *Lerner values*; *EFFICIENCY* is the SFA-based cost efficiency. *X* is a vector of bank-specific variables of *SIZE*, *DIVERSIFICATION* and *LIQUIDITY*; *Z* is a vector of macroeconomic conditions and institutional quality controlling for *RULE_OF_ LAW*, *INFLATION*, and *GDPG*. *DUMMIES* is a vector of dummy variables that capture the effects of ownership, the 2008–2009 global financial crisis, the 2011–2012 *Arab Spring*, and the Covid-19 pandemic. β, γ, Φ, and δ are the parameter vectors, and ε is the unobserved disturbance. The interaction term (*COMPETITION x EFFICIENCY*) tests for the presence of an efficiency channel in the *competition-stability* nexus (Berger et al., 2009; Clark et al., 2018).

We take the one-period lag of all bank-level and country-level variables to reduce the endogeneity issues. Additionally, we apply the two-step system GMM for three reasons Phan et al. (2019):

i it generates consistent and efficient estimates

ii it overcomes endogeneity issues and the unobserved effects

iii it is a better fit for panel studies with fewer time observations.

We check the robustness of the validity of the instruments and any possible autocorrelation using the Sargan test and Hansen J statistic of over-identifying restrictions and Arellano–Bond (AR) test, respectively Phan et al. (2019). We incorporate instrumental variables that have the characteristics of contributing to shaping the stability of the banking system. We consider the second lag of the variables of the Lerner index of market power, the ratio of the total cost to total income, and the credit growth rate.

3.2 STABILITY

We gauge the stability of banks using the Z-score indicator, which captures a bank's distance from default (Beck et al., 2013; Kabir and Worthington, 2017). It is the inversed probability of bank failure (Wu et al., 2019). It is easy to calculate (Miah and Uddin, 2017) and identify distress events with less data (Chiaramonte et al., 2016). The Z-score is specified as:

$$Z-score_{it} = \frac{ROA_{it} + ETA_{it}}{\sigma ROA_i} \tag{2}$$

where ROA is the return on assets, ETA is the equity to total assets, and σROA is the standard deviation of ROA. σROA is a measure of volatility, estimated using a three-year rolling time window to allow for time variation in the *Z*-score (Čihák and Hesse, 2010; Kabir and Worthington, 2017).

The Z-score measures the number of standard deviations a bank's ROA has to fall before it exhausts its equity capital. In this sense, it indicates the multiple of a bank's equity buffer before it falls into default. A higher value of the Z-score implies higher bank stability and lesser insolvency risk (Miah and Uddin, 2017). The Z-score values are transformed into log values to account for skewness in the data (Chiaramonte et al., 2016).

3.3 Competition

We use the Lerner index of monopoly power to estimate competition (Clark et al., 2018). Lerner measures how a bank depends on its market pricing power to accumulate earnings (Calice et al., 2021). Lerner is calculated at the bank level as follows:

$$LERNER_{it} = \frac{P_{it} - MC_{it}}{P_{it}} \tag{3}$$

where *P* is the price of the output proxied by total interest and non-interest revenues to total assets ratio (Kabir and Worthington, 2017); *MC* is the marginal cost of producing one additional unit of output. Higher values of Lerner are associated with more market

power and less competitive conditions (Khan et al., 2017). It may range from less than zero to one, with the values of 'zero', 'one' and 'less than zero' implying perfect competition, monopoly, and a non-optimal state (where banks price their product below their marginal cost), respectively (Saif-Alyousfi et al., 2020).

Following Clark et al. (2018), *MC* is estimated from an SFA-based translog cost function, specifying one output variable and three input prices of purchased funds, labour and physical capital (W_{jit}).[1] The equation is as follows:

$$\ln\left(\frac{TC_{it}}{W_{3it}}\right) = \alpha_0 + \alpha_1 \ln Q_{it} + \frac{1}{2}\alpha_2 \ln Q_{it}^2 + \sum_{j=1}^{2}\beta_{jt} \ln\left(\frac{W_{jit}}{W_{3it}}\right) + \frac{1}{2}\sum_{k=1}^{2}\sum_{j=1}^{2}\gamma_{ij} \ln\left(\frac{W_{kit}}{W_{3it}}\right) ln\left(\frac{W_{jit}}{W_{3it}}\right) + \sum_{j=1}^{2}\Phi_i \ln Q_{it} \ln\left(\frac{W_{jit}}{W_{3it}}\right) + \ln\mu + \ln\nu \tag{4}$$

where TC and Q represent the total cost and output (total assets), respectively, W_1, W_2 and W_3 are the input prices of purchased funds, labour and physical capital. MC is the first derivative of the cost function with respect to the level of output as represented by equation (5):

$$MC_{it} = \frac{TC_{it}}{Q_{it}}\left[\alpha_1 + \alpha_2 lnQ_{it} + \sum_{j=1}^{2}\Phi_i ln\left(\frac{W_{jit}}{W_{3it}}\right)\right] \tag{5}$$

3.4 EFFICIENCY

EFFICIENCY captures banks' management quality and ability to control costs (Chiaramonte et al., 2016). Schaeck and Cihák (2014) claim that efficiency forms the channel through which competition influences banks' risk-taking. We use the SFA to measure cost efficiency (Aigner et al., 1977) and derive cost efficiency estimators from a model suggested by Battese and Coelli (1995). The following translog form of the stochastic cost frontier is specified:

$$\ln\left(\frac{TC_{it}}{W_{3it}}\right) = \alpha_0 + \sum_{k=1}^{2}\alpha_k \ln Y_{kit} + \sum_{j=1}^{2}\beta_j \ln\left(\frac{W_{jit}}{W_{3it}}\right) + \frac{1}{2}\sum_{k=1}^{2}\sum_{m=1}^{2}\delta_{km} \ln Y_{kit} \ln Y_{mit} + \frac{1}{2}\sum_{j=1}^{2}\sum_{n=1}^{2}\gamma_{jn} \ln\left(\frac{W_{jit}}{W_{3it}}\right) ln\left(\frac{W_{nit}}{W_{3it}}\right) + \sum_{k=1}^{2}\sum_{j=1}^{2}\Phi_{kj} \ln Y_{kit} \ln\left(\frac{W_{jit}}{W_{3it}}\right) + \ln\mu + \ln\nu \tag{6}$$

Where TC is total costs; Q denotes outputs (Q_1: total loans, and Q_2: total other earning assets); W is the input price vector (W_1: loanable fund, W_2; labour; W_3: physical capital). To impose the symmetry condition and linear homogeneity restrictions, we divide the total cost (TC) and the prices of funds and labour (W_1 and W_2) by the price of physical capital (W_3).[2]

Berger and DeYoung (1997) offer two hypotheses on the relationship between bank efficiency and risk-taking. First, the bad management hypothesis states that cost efficiency captures management quality. Lower cost efficiency is positively associated with increases in future NPLs, as long as bad management leads to poor skills in credit

scoring, appraisal of pledged collaterals and monitoring of borrowers. Second, the bad luck hypothesis argues that adverse external events cause problem loans (risk) rather than bank appetite for risk or management competencies. The higher risk raises organisational efforts and related costs. Hence, it is expected that a surge in risk is associated with a deterioration in bank efficiency.

3.5 Control variables

3.5.1 SIZE

SIZE is the natural logarithm of total assets (Fiordelisi et al., 2011; Yin, 2021). Abuzayed et al. (2018) confirm the positive and significant relationship between bank size and Z-score, implying that larger banks are more stable. However, AlKhouri and Arouri (2019) find that larger banks perform worse than smaller banks. Thus, there is no clear-cut relation between *SIZE* and *STABILITY* in Tunisian banking.

3.5.2 DIVERSIFICATION

Following Abuzayed et al. (2018), *DIVERSIFICATION* is proxied by the ratio of non-interest income to total operating income. The magnitude of non-interest income reveals the bank's participation in nontraditional activities such as securities trading, asset management services, and the ability to extract other non-interest revenues, which is more emphasised during economic upturns. Therefore, it captures the bank's business model and market risk (Chiaramonte et al., 2016). Azmi et al. (2019) argue that banks may skew towards nontraditional banking activities in competitive markets to compensate for the reductions in earnings from traditional activities exposed to higher competition.

3.5.3 LIQUIDITY

Berger and Bouwman (2013) show that improving liquidity helps banks reduce the probability of failure. Chiaramonte et al. (2016) show that banking problems such as increasing NPL, inadequate liquidity and closer distance to insolvency are correlated with the loans to total assets ratio. We use the ratio of loans to total assets as a proxy of *LIQUIDITY* (Bilgin et al., 2021). Accordingly, increases in liquidity risk should correspond to a weakening bank stability (Hassan et al., 2019).

3.6 Economic variables

3.6.1 INFLATION

The analysis of the *inflation-stability* nexus is consistent with the view that banks' costs and revenues and the market values of assets and liabilities are exposed to inflation risk. Staikouras and Wood (2004) suggest that inflation might influence bank profitability directly through a rise in the price of operating costs, such as labour costs or indirectly through changes in interest rates and asset prices. Borio and Lowe (2002) claim that low and stable inflation contributes to financial stability. Ghosh (2016) concludes that inflation is a factor accelerating the expansion of NPLs. Abuzayed et al. (2018) show a negative association between inflation and bank stability. Uhde and Heimeshoff (2009)

and Bilgin et al. (2021) imply that the impact of inflation depends on whether it coincides with general economic deterioration. As Tunisia witnessed an escalation of inflation with difficult economic conditions during the period under study, we expect a negative sign on the variable *INFLATION*.

3.6.2 GDPG

We include the real GDP growth rate (*GDPG*) as a business cycle indicator. The literature, however, has not yet established a clear-cut indication that bank risk escalates in periods of reduced GDP growth. Marcucci and Quagliariello (2008) observe that the default rates of Italian bank borrowers follow the business cycle. For instance, Abuzayed et al. (2018) show that GDP growth is positively associated with bank resilience, while Al-Shboul et al. (2020) find a significant and negative relationship between economic growth and bank stability. We conjecture that *GDPG* impacts bank stability positively.

3.7 Other control variables

3.7.1 RULE_OF_LAW

La Porta et al. (1997), Berger et al. (2009), and Shaddady and Moore (2019) analyse the association between the governance and institutional quality of the environment where banks operate and bank performance and stability. Accordingly, we use the *RULE_OF_LAW* to account for the institutional quality variable (Wu et al., 2019). Information is available through the annual dissemination of the World Bank's Worldwide Governance Indicators (WGI).[3] The *RULE_OF_LAW* gauges the quality of institutions by capturing perceptions of the extent to which individuals and organisations have confidence in and abide by the rules of society, such as the quality of contract enforcement, property rights, the police, the courts, as well as the likelihood of crime and violence. The index ranges from –2.5 to +2.5, with higher values denoting higher adherence and better perceptions about the law. We conjecture that an institutional environment overwhelmed by stronger adherence to the rule of law can enhance the degree of bank stability.

3.7.2 Ownership dummies: GOVERNMENT, PRIVATE, FOREIGN and MIXED

We test whether ownership contributes to shaping bank stability in Tunisia. Four types of ownership cohabitate in Tunisia: *GOVERNMENT*, *PRIVATE*, *FOREIGN* and *MIXED*. Each type enters into our equations individually by incorporating the corresponding dummy variables. The state controls *GOVERNMENT* banks; domestic private capital controls *PRIVATE* banks; foreign capital dominates *FOREIGN* banks; *MIXED* banks are banks equally owned by the Tunisian State, the governments of the GCC countries and Libya. The role of bank ownership has received attention in the literature, especially in countries reforming and transitioning from a government-controlled to a private banking system. Beck et al. (2005), Claessens and van Horen (2014), and Shaban and James (2017) find that foreign and private banks contribute to bank stability. Berger et al. (2000), Mian (2006), Chen et al. (2017) and Yin (2021) find a negative or neutral effect of foreign ownership on the domestic banking system.

3.7.3 Global financial crisis dummies: Y2008 and Y2009

In the aftermath of the GFC, banks worldwide faced many challenges related to credit quality, liquidity, costs, and profitability (Fang et al., 2014; AlKhouri and Arouri, 2019). Abuzayed et al. (2018) find that the GCC banking sector was less impacted by the 2008 GFC than sectors in other regions. Ibrahim and Rizvi (2018) consider the 2008–2009 period as the 2008 GFC period. Accordingly, we include the GFC in our specifications through two year dummies: *Y2008* and *Y2009*.

3.7.4 Arab spring dummies: Y2011 and Y2012

Tunisia's political risk has shifted due to the fundamental change in its political and institutional setting in 2011, driven by the *Arab Spring*, which swept over the MENA region (Schraeder, 2012; Matta et al., 2019). Malek and Awadallah (2013) argue that the *Arab Spring* reflects the failure of the State to establish a private sector, including the financial sector, that is independent of government, competitive, and integrated with global markets. In this context, the *Arab Spring* as a hazard for political risk might affect banks' attributes via government uncertainties, greater information asymmetries, the quality of legal institutions and bank competition, efficiency, stability, and risk (Al-Shboul et al., 2020).

Matta et al. (2019) estimate the output loss in Tunisia due to the *Arab Spring* to be 5.5%, 5.1% and 6.4% of GDP in 2011, 2012 and 2013, respectively. Matta et al. (2019) identify the *investment channel* as the primary conduit through which the *Arab Spring* adversely impacted the Tunisian economy. Ghosh (2016) shows that the *Arab Spring* was associated with an increase in the cost of borrowing, lowered bank profitability by roughly 0.2% and raised bank risk by 0.4% in the MENA region. Therefore, we expect a negative impact of the Arab spring on bank stability in Tunisia.

3.7.5 Covid-19 dummies: Y2019 and Y2020

The outbreak of the Covid-19 pandemic and the lockdown that followed have induced economic slowdowns and cancelled or postponed investment and consumption decisions. Businesses in many sectors shut down temporarily or permanently, generating turmoil in financial markets (Demirgüç-Kunt et al., 2021) and precipitating erosion of public confidence in the economic systems, and heightened uncertainty. Banks might face increased default risk due to cash problems and insolvency relating to servicing debt arising from business closures, lockdowns, and lower demand for goods and services during the pandemic (Elnahass et al.,2021). The extent of the effect of Covid-19 on banks may be measured by the size of public policy support and the other factors linked with the fragility traits of the individual banks (Berger et al., 2021; olak and Öztekin, 2021). Demir and Danisman (2021) reveal that banks with a larger size, more deposits, higher capitalisation, more diversification, and lower non-performing loans were more resilient to the pandemic.

We follow Hassan et al. (2022) by including a dummy variable, *Y2020*, taking a value of one for the pandemic year 2020 and zero otherwise. We also consider 2019 as a year connected to Covid. Consistent with Elnahass et al. (2021), we expect that *Covid-19* would have negatively affected bank stability and induced more moral hazards. However,

banks would have exploited this incident to increase their earnings by taking more risks under the expectation that they would receive public support in case of unwanted consequences, consistent with the *bailout-expectation hypothesis*.

3.8 Data

To achieve the goals of this paper, we compile a dataset comprising all Tunisian banks operating from 2005 to 2020. As of 2020, 7 banks are government-owned (BFT, BH BANK, BNA, BTK, BTS, STB, BFPME), 9 are foreign-owned (ATB, ATTIJ. BK, Bank ABC, BT, CITIBK, QNB, UIB, BZ, Baraka Bank), 4 are private (AMEN BK, BIAT, UBCI, Wifak), and 3 are mixed (BTE, BTL, TSB). Bank-level information is obtained from the individual banks' financial statements by the Tunisian Banking Association.[4] The final sample includes 343 year-observation. Ownership types are determined annually based on data from the Central Bank of Tunisia website. As for country-level variables, we collect *INFLATION* and *GDPG* from the World Bank's World Development Indicators (WDI). The data for *RULE_OF_LAW* come from the World Bank's Worldwide Governance Indicators database.

Table 1 shows the descriptive statistics of the bank-specific, institutional and macroeconomic variables for all banks for the study period, 2005–2020. We exclude the analysis of the Z-value, Lerner index of market power and efficiency from this section and place it in the empirical results section.

Table 1 Descriptive statistics of the bank-specific and environmental control variables during 2005–2020

Variable	*Proxy*	*Mean*	*Median*	*St. dev*	*Min*	*Max*
SIZE	Assets (millions of Tunisian dinar)	3099.02	1582.60	3393.22	30.59	17,874.42
DIVERSIFICATION	Non-interest revenues to total revenue	0.27	0.26	0.09	0.03	0.57
LIQUIDITY	Loans to assets	0.66	0.72	0.19	0.04	0.95
RULE_OF_LAW	–	0.01	0.04	0.10	–0.19	0.14
INFLATION	Inflation rate (annual %)	4.46	4.44	1.37	2.02	7.31
GDPG	Real GD growth rate (annual %)	1.91	2.51	3.49	–9.18	6.71

Table 1 shows that banks had average total assets of TD 3 billion (about USD 1 billion). The difference between the minimum and maximum values of bank-level variables shows that the banking sector in Tunisia incorporates: very large banks and very small banks, highly diversified banks and poorly diversified banks, and banks with higher loans to assets, and banks with lower loans to assets. Table 1 indicates an average of 1.91% for the real GDP growth rate, 4.46% for the inflation rate and 0.10 for the rule of law.

To further understand how the control variables evolved over the study period, the annual mean values for the variables are provided in Table 2.

Table 2 Annual mean values of bank-specific and environmental variables during 2005–2020

Variable	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
SIZE	1502.13	1558.88	1761.14	1996.38	2248.63	2406.75	2617.80	2903.26	3011.30	3148.24	3243.02	3604.52	4070.04	4557.80	4824.88	5,097.22
DIVERSIFICATION	0.29	0.28	0.27	0.26	0.27	0.27	0.27	0.27	0.26	0.27	0.27	0.28	0.30	0.27	0.25	0.25
LIQUIDITY:	0.67	0.63	0.61	0.65	0.64	0.66	0.71	0.70	0.68	0.67	0.67	0.67	0.67	0.66	0.65	0.67
RULE_OF_LAW	–0.01	0.11	0.09	0.07	0.13	0.06	–0.13	–0.13	–0.19	–0.11	–0.07	–0.00	0.06	0.04	0.06	0.14
INFLATION	2.02	3.23	2.97	4.35	3.66	3.34	3.24	4.61	5.32	4.63	4.44	3.63	5.31	7.31	6.72	5.63
GDPG	3.49	5.24	6.71	4.24	3.04	3.51	–1.66	3.91	2.14	2.71	1.00	1.12	2.24	2.51	1.40	–9.18

In Table 2, the average size of the bank increased by about 2.4 times between 2005 and 2020 compared to an increase in GDP by 1.8 times over the same period. Diversification stood at the mean of 0.27 between 2005 and 2016; it increased to 0.30 in 2017 and then decreased to 0.25 during 2019–2020. The loans to assets ratio increased from 0.61 in 2007 to 0.71 in 2011, then decreased to 0.65 in 2019. The inflation rate rose from 2.02% in 2005 to 7.31% in 2018. During the post-*Arab Spring* period, inflation escalated, particularly in 2010–2013 and 2016–2018. For the real GDP growth rate, Tunisia witnessed an increase during 2005–2007, then a decrease during 2008–2011 to reach –1.66% in 2011, possibly due to the 2008–2009 GFC. The growth rates did not exceed 3% during 2013–2020. In 2020, the rate fell to –9.18% due to the Covid-19 lockdown.

4 Estimation results

4.1 STABILITY, COMPETITION, and EFFICIENCY

Tables 3–6 report the average yearly values of the Z-score, Lerner index and cost efficiency for the full sample of banks in Tunisia between 2005 and 2020. Table 3 compares the yearly average values across ownership types, while Tables 4–6 report yearly values for each bank.

4.1.1 STABILITY

Panel 1 in Table 3 shows the average yearly values of the Z-score as a proxy of bank stability during 2005–2020. The mean Z-score is 11.49 with a standard deviation of 4.60 for the whole period, indicating that ROA has to fall by 11.5 times the standard deviation to deplete equity. In the literature, Pham et al. (2019) report a value of 12.66 for Vietnamese banks in 2010–2018; Guidi (2021) reports 3.49 for South-East European banking in 2003–2012; Saif-Alyousfi et al. (2020) report 53.08 for GCC banks during 1998–2016.

Table 4 presents the average Z-score for each bank over 2005–2020. Ignoring the outliner BFPME, the four small and foreign-owned banks of BTE (62.48), QNB (31.92), BTS (18.91) and BT (17.91) exhibit the highest averages. By contrast, the government-owned and small bank BFT was associated with a negative value of –0.51, reflecting *a state of bankruptcy*, followed by Citibank (2.43) and Attijari Bank (2.47). In fact, Table 4 shows that BFT witnessed a continuous degradation since 2008, and the value turned negative in 2010, which questions why bankruptcy was not actioned sooner than 2022.

Tables 3 and 4 indicate that, on average, Tunisian banks experienced a consistently volatile trend in bank stability during 2005–2020. The Z-score improved from 10.56 in 2005 to 19.40 in 2009, then decreased to 16.75 in 2010 and continued to hover around 6.50 between 2011 and 2015. The Z-score reached 17.13 in 2018. However, it declined to 13.66 in 2019 and 6.5 in 2020, possibly because of Covid-19. Additionally, Panel 1 in Table 3 shows that private and foreign banks experienced the lowest volatility in Z-score compared to government and mixed banks. Table 4 shows that the year 2011 marked the entry of the Z-value in the sub-unity territory. The worsening of bank stability seems to be caused by government banks. However, the results show that recapitalisation, implemented during 2015–18, lifted the Z-score to 17.13 in 2018.

Table 3 Z-score, Lerner and cost efficiency values per ownership type during 2005–2020

	Panel 1: Z-score					*Panel 2: Lerner*					*Panel 3: Efficiency*				
Year	*Foreign*	*Government*	*Mixed*	*Private*	*Mean*	*Foreign*	*Government*	*Mixed*	*Private*	*Mean*	*Foreign*	*Government*	*Mixed*	*Private*	*Mean*
2005	3.24	19.20	51.90	10.11	10.56	0.1556	0.2350	0.4149	0.2899	0.2589	0.7438	0.8374	0.8151	0.8338	0.7967
2006	3.47	328.73	48.29	10.64	13.33	0.2240	0.1962	0.3929	0.3238	0.2679	0.7311	0.8635	0.8316	0.8373	0.8066
2007	2.84	363.21	40.30	10.75	15.55	0.1684	0.2469	0.3717	0.3376	0.2597	0.7932	0.8112	0.8370	0.8443	0.8147
2008	5.69	356.82	34.35	5.68	16.35	0.2737	0.2384	0.3334	0.3878	0.2864	0.7250	0.7955	0.7964	0.8212	0.7700
2009	8.25	256.68	51.31	5.01	19.40	0.2277	0.1990	0.2755	0.3318	0.2391	0.8429	0.8254	0.8737	0.8884	0.8483
2010	6.03	22.36	70.48	4.85	16.75	0.2451	0.0843	0.3192	0.3551	0.2161	0.8501	0.8308	0.8963	0.8848	0.8558
2011	4.63	3.68	13.46	5.62	6.62	0.2141	–0.0396	0.2767	0.3187	0.1514	0.8287	0.8734	0.9006	0.9016	0.8642
2012	14.05	3.48	11.53	3.27	13.10	0.2842	0.0390	0.1986	0.3457	0.1920	0.8533	0.8735	0.9076	0.9080	0.8756
2013	5.52	1.54	28.89	2.58	6.46	0.2812	0.0643	0.1971	0.3628	0.2047	0.8695	0.8537	0.8724	0.8840	0.8660
2014	6.78	0.50	4.17	5.33	6.33	0.2563	–0.0128	0.1708	0.3416	0.1668	0.8711	0.8480	0.8591	0.8579	0.8609
2015	10.38	0.82	4.39	5.87	6.15	0.2628	–0.0604	0.1605	0.2942	0.1552	0.8783	0.8686	0.8607	0.7559	0.8571
2016	4.95	10.80	3.96	7.88	13.39	0.2118	–0.0290	0.1705	0.3870	0.1560	0.8957	0.8846	0.8867	0.8596	0.8864
2017	4.33	4.37	15.02	8.42	8.09	0.2558	–0.0199	0.1921	0.3312	0.1734	0.8867	0.8883	0.8802	0.8730	0.8846
2018	7.10	4.76	78.84	14.16	17.13	0.2930	0.0190	0.1691	0.2980	0.1941	0.8183	0.8343	0.7502	0.7800	0.8093
2019	5.56	2.53	4.87	16.07	13.66	0.2787	–0.0121	0.0977	0.2739	0.1786	0.7618	0.8393	0.7036	0.7174	0.7686
2020	5.62	1.12	0.84	5.76	6.35	0.2447	–0.0443	0.0207	0.3112	0.1391	0.7967	0.8334	0.7998	0.7990	0.8087
Mean	6.15	86.29	28.91	7.63	11.83	0.2423	0.0690	0.2351	0.3306	0.2025	0.8216	0.8476	0.8419	0.8404	0.8358
St. dev	2.84	144.94	25.46	3.82	4.60	0.0402	0.1145	0.1106	0.0330	0.0470	0.0569	0.0264	0.0572	0.0543	0.0392

Table 4 Annual values of Z-score for Tunisian banks during 2005–2020

Z-score	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*Mean*	*St. dev*
AMENBK	10.50	9.89	10.66	4.90	7.57	6.10	6.46	4.42	3.34	3.23	2.32	4.29	4.52	22.20	26.55	5.79	**8.30**	**6.8**
ATB	7.34	6.83	5.90	11.45	12.10	12.23	2.92	4.23	6.56	16.44	12.64	8.71	7.28	1.95	1.69	16.29	**8.41**	**4.7**
ATTIJ.BK	0.06	–0.04	0.04	0.06	0.40	1.62	1.48	1.88	1.53	2.42	1.41	1.29	2.26	10.06	11.91	3.05	**2.47**	**3.5**
BankABC	–0.04	0.10	0.09	2.50	1.51	1.59	1.67	1.74	3.20	16.38	7.67	9.41	8.12	9.26	4.26	12.61	**5.00**	**5.0**
Baraka										5.12	4.75	4.22	2.21	2.85	1.39	2.30	**3.26**	**1.4**
BFPME		1888.68	2106.56	2054.08	1487.12	97.36	13.30	9.25	9.07	1.11	0.89	0.22	0.20	0.11	0.03	–0.02	**511.20**	**867.1**
BFT	6.23	3.69	2.95	7.80	0.13	–1.62	–1.72	–2.84	–2.84	–2.84	–2.84	–2.84	–2.84	–2.84	–2.84	–2.84	**–0.51**	**3.6**
BHBANK	2.04	2.08	2.58	16.50	6.16	2.35	1.71	3.52	0.03	0.11	0.15	62.59	8.98	9.79	11.02	2.32	**8.25**	**15.2**
BIAT	9.71	11.40	10.85	6.46	2.45	3.60	4.79	2.12	1.83	7.42	1.55	1.57	3.12	9.34	18.68	4.43	**6.21**	**4.8**
BNA	3.46	3.41	3.29	4.50	20.74	40.97	8.29	10.40	3.12	2.70	2.70	1.32	1.23	4.41	1.98	2.64	**7.20**	**10.2**
BT	7.16	7.48	7.73	9.08	21.08	8.44	9.07	88.16	28.24	16.74	11.45	18.95	15.03	8.65	9.26	8.46	**17.19**	**19.9**
BTE	127.63	117.00	93.07	53.00	69.71	163.39	11.80	9.57	77.65	2.44	2.44	2.35	36.11	226.62	6.10	0.87	**62.48**	**68.1**
BTK	15.86	16.35	17.03	14.43	20.73	11.15	5.19	6.20	3.55	4.34	61.31	0.01	0.11	0.19	0.32	0.13	**11.05**	**15.2**
BTL	10.78	9.25	6.60	7.43	8.28	8.28	4.98	14.82	6.52	6.73	7.78	5.64	5.71	1.07	0.53	0.05	**6.53**	**3.8**
BTS	78.28	68.92	58.38	49.42	10.68	13.39	1.01	0.95	1.07	0.66	0.87	3.16	2.08	7.54	2.85	3.29	**18.91**	**27.6**
BZ						1.03	0.69	0.65	0.38	1.74	3.85	10.54	9.95	7.28	8.78	4.81	**4.52**	**4.0**
CITIBK	3.83	5.81	2.14	3.53	2.52	2.61	3.23	4.02	2.99	2.06	0.90	0.85	1.10	0.88	1.54	0.87	**2.43**	**1.4**
QNB	86.39	81.02	66.78	62.33	114.25	50.46	28.52	18.07	0.25	0.53	0.78	0.21	0.57	0.43	0.29	–0.03	**31.93**	**39.0**
STB	6.00	5.58	5.48	8.64	15.27	3.04	2.47	2.47	–0.06	–0.01	0.15	0.58	11.00	7.06	2.13	2.31	**4.51**	**4.3**
TSB	18.86	17.85	18.02	14.64	13.01	59.78	8.55	3.65	2.49	3.32	2.95	3.87	3.25	8.84	7.97	1.60	**11.79**	**14.2**
UBCI	4.27	4.09	3.99	4.45	7.64	10.11	12.69	2.71	3.27	3.48	2.39	3.37	3.94	6.87	15.36	10.12	**6.17**	**3.9**
UIB	0.02	0.02	–0.02	0.01	0.01	0.47	0.83	3.45	0.11	0.33	0.45	2.44	2.65	29.89	6.31	2.18	**3.07**	**7.4**
Wifak											13.72	17.77	17.63	10.95	2.99	2.71	**10.96**	**6.8**

Table 5 Lerner values for Tunisian banks during 2005–2020

Bank	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*Average*
AMEN BK	0.3315	0.3353	0.3631	0.3724	0.3512	0.3507	0.2943	0.3343	0.3379	0.2672	0.2489	0.2947	0.3434	0.3102	0.3402	0.3156	0.3244
ATB	0.2638	0.2504	0.2213	0.3006	0.2371	0.2675	0.2320	0.2542	0.2162	0.1869	0.2162	0.2094	0.2187	0.1442	0.1013	0.1331	0.2158
ATTIJ. BK	0.1726	0.2348	0.2645	0.3576	0.4014	0.3670	0.3432	0.3953	0.4227	0.3817	0.3826	0.3846	0.4106	0.4371	0.4514	0.4618	0.3668
Bank ABC	–0.4017	–0.0459	–0.0235	–0.1397	–0.3364	–0.1345	–0.0727	0.3926	0.0799	0.0924	0.1919	0.0914	0.0683	0.1975	0.2828	0.2605	0.0314
Baraka										0.1926	0.1299	0.0942	0.1303	0.2228	0.2887	0.2772	0.1908
BFPME		–0.0614	0.1134	0.2776	0.0004	–0.0970	–0.3447	–0.1906	–0.0300	–0.4164	–0.5702	–0.4201	–0.3511	–0.1004	–0.1770	–0.2766	–0.1763
BFT	0.2284	0.1200	0.1829	–0.0102	–0.0403	0.0659	–0.6762	–0.7542	–0.8026	–1.0876	–1.2040	–1.2040	–1.2040	–1.2040	–1.2040	–1.2040	–0.6249
BH BANK	0.3159	0.3633	0.3961	0.4115	0.4220	0.4014	0.3633	0.3930	0.3259	0.3070	0.2958	0.2939	0.3091	0.2814	0.2408	0.2564	0.3361
BIAT	0.2483	0.3123	0.3121	0.4032	0.3124	0.3596	0.3431	0.3571	0.3876	0.4160	0.4298	0.4164	0.4277	0.4154	0.4196	0.4224	0.3739
BNA	0.2059	0.2680	0.2613	0.2695	0.3383	0.3282	0.2863	0.3363	0.3026	0.2847	0.2528	0.2823	0.2860	0.2840	0.2978	0.2841	0.2855
BT	0.4103	0.4627	0.4611	0.4860	0.4719	0.4525	0.4169	0.4021	0.4122	0.3895	0.3955	0.4251	0.4131	0.3984	0.3771	0.4025	0.4236
BTE	0.3764	0.3737	0.3688	0.3018	0.2269	0.2592	0.2300	0.1869	0.1927	0.1445	0.0682	0.1678	0.1408	0.1704	0.1880	0.1488	0.2216
BTK	0.3388	0.4746	0.4067	0.3768	0.3878	0.3276	0.2514	0.1500	0.2102	0.1951	0.2225	0.0572	–0.0258	0.1235	–0.0042	–0.0487	0.2152
BTL	0.3197	0.1894	0.2079	0.1652	0.1636	0.2572	0.1934	0.1888	0.1869	0.2171	0.2048	0.0974	0.1691	0.0612	–0.1192	–0.2439	0.1412
BTS	0.1643	0.1815	0.1572	0.0976	0.0992	0.0605	–0.0041	0.0795	0.1384	0.2297	0.2144	0.2482	0.1962	0.2938	0.3726	0.3029	0.1770
BZ						–0.5282	–0.2034	0.0721	0.1824	0.2813	0.2507	0.2399	0.2632	0.2083	0.2137	0.3398	0.1200
CITIBK	0.1706	0.2199	0.0183	0.3575	0.1802	0.1364	0.0395	0.1771	0.4656	0.4878	0.4613	0.3853	0.6210	0.6115	0.6838	0.4960	0.3445
QNB	0.4640	0.4129	0.3491	0.3789	0.2730	0.3075	0.3380	0.1590	0.1485	0.0720	0.0812	–0.1116	0.0869	0.1503	0.0176	–0.4753	0.1658
STB	0.2607	0.3058	0.3702	0.3841	0.3741	0.3594	0.3016	0.3371	0.3336	0.3117	0.3378	0.3572	0.3616	0.3699	0.3972	0.3759	0.3461
TSB	0.5754	0.5136	0.5261	0.4876	0.4384	0.4528	0.3454	0.2598	0.2117	0.1508	0.2086	0.2461	0.2666	0.2756	0.2244	0.1573	0.3338
UBCI	0.2406	0.2380	0.2457	0.2966	0.2553	0.2695	0.2376	0.2160	0.2519	0.2528	0.2387	0.2334	0.2945	0.2929	0.3138	0.3243	0.2626
UIB	0.2332	0.2084	–0.0089	0.1541	0.2244	0.2750	0.2648	0.2861	0.3234	0.3122	0.3076	0.3494	0.3404	0.3516	0.3394	0.3069	0.2668
Wifak											0.2039	0.4498	0.2224	0.1684	0.0618	0.1825	0.2148

Table 6 Annual values of cost efficiency as a measure of management quality for Tunisian banks during 2005–2020

Bank	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*Average*
AMEN BK	0.7852	0.7785	0.7697	0.7403	0.8365	0.8319	0.8600	0.8683	0.8268	0.7961	0.7953	0.8397	0.8149	0.6920	0.6225	0.7072	0.7853
ATB	0.8299	0.8073	0.8291	0.7983	0.9269	0.9165	0.9207	0.9284	0.9021	0.8720	0.8912	0.8984	0.8986	0.8058	0.7740	0.7493	0.8593
ATTIJ. BK	0.8633	0.8449	0.8412	0.8417	0.8668	0.8539	0.8666	0.9019	0.8876	0.9033	0.9028	0.9165	0.8999	0.7824	0.7435	0.7752	0.8557
Bank ABC	0.4526	0.5940	0.6091	0.6133	0.5562	0.6426	0.7282	0.6008	0.9141	0.9450	0.8477	0.9215	0.9040	0.8347	0.7974	0.8040	0.7353
Baraka										0.9463	0.9437	0.9456	0.9349	0.9434	0.9219	0.9368	0.9389
BFPME		0.9288	0.8975	0.9088	0.9180	0.9242	0.9430	0.9220	0.8658	0.8401	0.8089	0.8620	0.8835	0.8977	0.9163	0.9406	0.8971
BFT	0.7194	0.7090	0.5484	0.3924	0.4410	0.3070	0.6571	0.7950	0.7768	0.7832	0.9126	0.9129	0.9131	0.9134	0.9136	0.9139	0.7256
BH BANK	0.8849	0.8782	0.8468	0.8344	0.9055	0.9058	0.9036	0.9115	0.9069	0.9050	0.9087	0.8728	0.9052	0.8086	0.7199	0.7619	0.8662
BIAT	0.8825	0.8960	0.9188	0.9021	0.9402	0.9377	0.9432	0.9477	0.9412	0.9196	0.9289	0.9331	0.9319	0.8791	0.8250	0.8754	0.9127
BNA	0.9102	0.9119	0.9114	0.9055	0.9120	0.9368	0.9369	0.9430	0.9179	0.9174	0.8999	0.9121	0.8960	0.8130	0.7424	0.7765	0.8902
BT	0.8641	0.8608	0.8295	0.7725	0.8859	0.9137	0.9230	0.9371	0.9130	0.9049	0.9044	0.9168	0.9197	0.8743	0.8335	0.8723	0.8828
BTE	0.7576	0.7964	0.8038	0.7299	0.8064	0.8426	0.8588	0.8918	0.8848	0.8672	0.8558	0.8841	0.8841	0.7779	0.7717	0.8119	0.8265
BTK	0.7228	0.8339	0.7562	0.8245	0.8544	0.7821	0.7904	0.8148	0.7403	0.7037	0.7476	0.7254	0.7019	0.6968	0.6243	0.6710	0.7494
BTL	0.8789	0.8009	0.8250	0.7493	0.9061	0.9488	0.9479	0.9381	0.9264	0.9336	0.9382	0.9297	0.8944	0.7256	0.6306	0.8628	0.8648
BTS	0.8390	0.8966	0.8421	0.9133	0.9253	0.9449	0.9543	0.9534	0.9528	0.9484	0.9497	0.9485	0.9461	0.9415	0.9379	0.9314	0.9266
BZ						0.9331	0.8363	0.6914	0.6856	0.6819	0.7162	0.7700	0.7695	0.6365	0.6369	0.7433	0.7364
CITIBK	0.4271	0.2544	0.7690	0.2128	0.8313	0.9002	0.5973	0.8380	0.8194	0.7754	0.9053	0.9617	0.9560	0.9138	0.7978	0.8457	0.7378
QNB	0.7687	0.7787	0.8518	0.7610	0.8534	0.8987	0.9072	0.9024	0.8767	0.8894	0.8355	0.8480	0.8490	0.6533	0.6036	0.6041	0.8051
STB	0.8338	0.8566	0.8214	0.8185	0.8503	0.8638	0.8827	0.8981	0.8699	0.8599	0.8846	0.9139	0.9047	0.8295	0.8054	0.8385	0.8582
TSB	0.9472	0.9482	0.9485	0.9452	0.9287	0.8951	0.8884	0.8983	0.8058	0.7764	0.7882	0.8463	0.8621	0.7471	0.7084	0.7246	0.8537
UBCI	0.8590	0.8493	0.8337	0.8327	0.9072	0.9101	0.9208	0.9199	0.9291	0.9190	0.9269	0.9217	0.9178	0.8712	0.8752	0.8943	0.8930
UIB	0.9108	0.9071	0.8407	0.9039	0.9148	0.8821	0.8827	0.8854	0.8431	0.8524	0.8778	0.9009	0.8857	0.8071	0.7720	0.8400	0.8692
Wifak											0.5436	0.8060	0.8721	0.7688	0.7046	0.7190	0.7357

4.1.2 Lerner index of market power

Panel 2 in Tables 3 and 5 show the results of the Lerner values of market power as a gauge of competition for 2005–2020. Over this period, the Lerner for banks averaged 0.2025 with a standard deviation of 0.047, indicating that Tunisian banks remained fairly competitive over the study period. A fall (strengthening) in Lerner implies improvements (weakening) in competitive conditions. This estimate is lower than those reported in the literature. For instance, Risfandy et al. (2020) report a mean of 0.35 for dual Conventional-Islamic banking systems during 2010–2018. Saif-Alyousfi et al. (2020) report 0.46 for GCC banks in 1998–2016.

Additionally, Panel 2 in Tables 3 and 5 show that the competitive behaviour of Tunisian banks was volatile. Lerner rose from 0.2589 in 2005 to 0.2864 in 2008; then it fell to 0.2391 in 2009 and 0.1514 in 2010. Although it increased to about 0.20 during 2012–2013, it went back to hover at about 0.15 in 2015–2016. This suggests that the liberalisation measures implemented in the 2000s may have positively affected monopoly power. In 2017, Lerner was 0.1941, but declined in 2019 (0.1786) and 2020 (0.1391). Panel 2 in Table 3 shows that Lerner witnessed higher volatility in the post-2011 period, reflecting vulnerability to the changing regulatory conditions and the political landscape due to the *Arab Spring*.

In addition, Table 3 shows that, on average, banks owned by domestic private capital enjoyed the highest market power with 0.218, followed by foreign-controlled banks with 0.150. By contrast, government-owned and mixed banks attained Lerner values of 0.077 and 0.126, respectively. These results show that *state* banks may find it difficult to compete with nongovernment-controlled banks. Rakshit and Bardhan (2021) find similar results for Indian banks. Table 5 shows that private and foreign banks gained more market power than government banks during 2016–2020. Mixed banks experienced a decline in market power from 0.173 in 2005 to 0.056 in 2011, then increased with higher volatility to reach 0.173 in 2020.

Table 5 identifies the banks with higher market power and those struggling with the competition over the study period. The banks with the highest Lerner are Citibank (0.316), Baraka Bank (0.299), Amen Bank (0.269), ATB (0.264), and TSB (0.235). Except for the private Amen Bank, the other four are foreign-owned banks. In contrast, the banks with the lowest Lerner values are BTS (–0.013), BFT (–0.012), UIB (0.004) and PFPME (0.008). The negative value of Lerner for these government banks reflects serious problems, preventing them from being able to face competition.

4.1.3 Cost efficiency

Panel 3 in Tables 3 and 6 show the cost efficiency results estimated using the SFA approach as a proxy of quality management for Tunisian banks during 2005–2020. Tunisian banks had a mean cost efficiency of 0.8358 with a standard deviation of 0.0393. This means that banks could have saved, on average, 16.42% of their resources and produced the same level of output. These results are similar to Rakshit and Bardhan (2021), who find a value of 0.83 for Indian banks during 1996–1916. The small standard deviation implies that the cost efficiency of Tunisian banks did not witness significant fluctuations. Efficiency was about 0.80 in 2005–2007, then decreased to 0.77 in 2008, possibly due to the 2008 GFC. It stayed around 0.86 during 2009–2017.

In Table 3, the average efficiency estimates are highest for government banks (0.8476), followed by private (0.8419), mixed (0.8404), and foreign (0.8216) banks.

Rakshit and Bardhan (2021) find that public banks are more efficient than private and foreign banks in India. Public banks prudently select the appropriate mix of inputs and avoid waste. However, Table 6 reveals widespread differences in average efficiency estimates for individual banks. On average, the banks with the highest efficiency are Baraka Bank (0.9389) and BTS (0.9266), followed by BNA, UBCI and BT with 0.89. The bank with the lowest score was BFT with 0.7256, followed by Bank ABC, BZ, Citibank, and BTK with about 0.74.

4.1.4 Regression results

Over the last two decades, Tunisian banks have been exposed to liberalisation to enhance competition, efficiency, and stability. Several variants of the dynamic panel-data model in equation (1) are estimated to examine the effect of competition on Tunisian bank stability and whether cost efficiency affects this relationship. The variants serve as robustness tests. The results are displayed in Tables 7–9. Table 7 presents the baseline results for the models incorporating bank-specific, macroeconomic and institutional variables. Table 8 displays the results for the influence of ownership type on stability. Table 9 shows the results for the impact of year dummies controlling for the *2008 GFC*, the *Arab Spring*, and *Covid-19* on bank stability. In all models, the number of observations is 297.

Table 7 Estimation results with the baseline model

	Model 1	*Model 2*
CONSTANT	0.2015 (0.15)	0.0115 (0.01)
$STABILITY_{t-1}$	0.6857 (6.3)***	0.6543 (5.82)***
$EFFICIENCY_{t-1}$	0.9475 (4.25)***	0.7393 (0.46)
$COMPETITION_{t-1}$	2.4858 (3.74)***	2.6493 (3.15)***
$EFFICIENCY_{t-1} \times COMPETITION_{t-1}$		0.1836 (0.10)
$SIZE_{t-1}$	–0.4112 (–4.47)***	–0.4301 (–4.57)***
$DIVERSIFICATION_{t-1}$	0.0433 (0.2)	0.0043 (0.02)
$LIQUIDITY_{t-1}$	–0.2457 (–0.45)	–0.0872 (–0.16)
$RULE\_OF\_LAW_{t-1}$	–2.0702 (–2.89)***	–1.8292 (–2.00)*
$INFLATION_{t-1}$	1.3859 (3.06)***	1.4643 (2.86)***
$GDPG_{t-1}$	0.7609 (3.35)***	0.8432 (3.03)***
F-statistic (p-value)	75.61 (0.000)***	115.97 (0.000)***
Arellano-Bond test for AR() in first differences		
AR(1): Z-value (p-value)	–3.07 (0.002)***	–3.16 (0.002)***
AR(2): Z-value (p-value)	–0.54 (0.592)	–0.56 (0.578)
Overidentification tests		
Sargan test: chi2 (p-value)	7.47 (0.825)	7.08 (0.793)
Hansen test: chi2 (p-value)	7.49 (0.824)	6.04 (0.871)
Endogeneity tests		
Hansen test excluding group: chi2 (p-value)	3.12 (0.794)	2.63 (0.756)
Difference (null H = exogenous): chi2 (p-value)	4.37 (0.627)	3.40 (0.757)

Table 8 Estimation results for the models with ownership type dummies and ownership channel

	Model 1 *GOV*	*Model 2* *PRIVATE*	*Model 3* *FOREIGN*	*Model 4* *MIXED*	*Model 5* *GOV*	*Model 6* *PRIVATE*	*Model 7* *FOREIGN*	*Model 8* *MIXED*
CONSTANT	0.5699 (0.4)	0.0193 (0.01)	0.0192 (0.01)	–0.176 (–0.09)	–2.9313 (–1.01)	–0.012 (–0.01)	–0.3076 (–0.17)	1.1197 (0.32)
$STABILITY_{t-1}$	0.6861 (5.1)***	0.6832 (5.95)***	0.6658 (6.64)***	0.6879 (6.22)***	0.5279 (4.11)***	0.6344 (5.4)***	0.6186 (4.45)***	0.685 (3.52)***
$EFFICIENCY_{t-1}$	1.0311 (4.64)***	0.9839 (4.47)***	1.0517 (3.47)***	0.9409 (3.64)***	0.5336 (1.4)	0.8243 (2.33)**	1.1477 (3.83)***	0.7291 (1.35)
$COMPETITION_{t-1}$	2.5499 (2.78)**	2.4779 (3.58)***	2.6256 (3.58)**	2.3116 (2.56)**	5.344 (2.61)**	2.6237 (5.28)***	2.7659 (4.06)***	2.4671 (2.83)**
OWNERSHIP_TYPE	0.0806 (0.2)	–0.3323 (–0.55)	–0.4215 (–0.75)	0.2012 (0.38)	2.6136 (1.57)	–0.6183 (–0.18)	–0.5612 (–0.42)	–1.8168 (–0.57)
$TYPE_{t-1} \times COMPETITION_{t-1}$					–2.8132 (–1.55)	0.2119 (0.05)	0.1414 (0.09)	1.9163 (0.58)
$SIZE_{t-1}$	–0.4221 (–4.22)***	–0.3895 (–3.62)***	–0.3902 (–3.14)***	–0.3786 (–2.9)***	–0.3904 (–3.12)***	–0.3605 (–3.44)***	–0.3894 (–2.59)**	–0.3274 (–2.35)**
$DIVERSIFICATION_{t-1}$	0.1299 (0.5)	0.0295 (0.11)	0.0552 (0.2)	0.01 (0.04)	0.0608 (0.4)	–0.0989 (–0.59)	0.0043 (0.02)	–0.0703 (–0.23)
$LIQUIDITY_{t-1}$	–0.4419 (–0.76)	–0.44 (–0.69)	–0.4848 (–0.67)	–0.3828 (–0.66)	0.5825 (1.01)	–0.1588 (–0.26)	–0.7285 (–0.76)	0.168 (0.19)
$RULE\_OF\_LAW_{t-1}$	–2.0116 (–2.3)**	–1.7545 (–1.69)*	–1.6858 (–2)*	–1.964 (–2.61)**	–1.7184 (–1.1)	–1.1848 (–0.88)	–0.795 (–0.39)	–1.2079 (–0.49)
$INFLATION_{t-1}$	0.7371 (2.43)**	0.7421 (3.02)***	0.7168 (2.61)**	0.7265 (3.05)***	0.7431 (1.78)*	0.6914 (2.69)**	0.7517 (3.4)***	0.5361 (1.55)
$GDPG_{t-1}$	1.3123 (2.34)**	1.3258 (2.63)**	1.3566 (2.82)**	1.3777 (2.44)**	1.6425 (2.32)**	1.1015 (1.91)*	1.3673 (2.27)**	0.6155 (0.54)

Table 8 Estimation results for the models with ownership type dummies and ownership channel (continued)

	Model 1 *GOV*	*Model 2* *PRIVATE*	*Model 3* *FOREIGN*	*Model 4* *MIXED*	*Model 5* *GOV*	*Model 6* *PRIVATE*	*Model 7* *FOREIGN*	*Model 8* *MIXED*
F–statistic (p–value)	74.53 (0.000)***	82.27 (0.000)***	65.83 (0.000)***	120.70 (0.000)***	47.04 (0.000)***	223.54 (0.000)***	9.36 (0.000)***	73.98 (0.000)***
Arellano-Bond test for AR () in first differences								
AR(1): Z-value (p-value)	–3.01 (0.003)***	–3.09 (0.002)***	–3.10 (0.002)***	–3.02 (0.003)***	–3.04 (0.002)***	–2.98 (0.003)***	–2.98 (0.003)***	–2.80 (0.005)***
AR(2): Z-value (p-value)	–0.52 (0.600)	–0.51 (0.611)	–0.49 (0.627)	–0.49 (0.627)	–0.36 (0.715)	–0.58 (0.560)	–0.40 (0.693)	–0.64 (0.521)
Overidentification tests								
Sargan test: chi2 (p-value)	7.37 (0.769)	7.15 (0.787)	7.02 (0.797)	7.19 (0.784)	6.86 (0.909)	6.51 (0.925)	7.26 (0.888)	9.10 (0.765)
Hansen test: chi2 (p-value)	8.58 (0.660)	7.30 (0.774)	9.03 (0.619)	7.68 (0.742)	7.60 (0.869)	7.86 (0.852)	9.71 (0.717)	13.39 (0.418)
Endogeneity tests								
Hansen test excluding group: chi2 (p-value)	3.09 (0.687)	2.21 (0.819)	2.95 (0.707)	2.97 (0.704)	5.93 (0.431)	3.42 (0.754)	5.41 (0.492)	3.04 (0.804)
Difference (null H = exogenous): chi2 (p-value)	5.49 (0.482)	5.09 (0.532)	6.08 (0.414)	4.71 (0.582)	1.66 (0.976)	4.44 (0.728)	4.30 (0.745)	10.35 (0.169)

Table 9 Estimation results for the models with year dummies

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
CONSTANT	0.2465 (0.13)	0.2983 (0.2)	0.2061 (0.11)	–1.1951 (–0.26)	0.4274 (0.24)	0.3084 (0.24)
$STABILITY_{t-1}$	0.6937 (5.82)***	0.6878 (6.6)***	0.708 (7.27)***	0.6697 (4.59)***	0.6893 (4.09)***	0.72 (5.9)***
$EFFICIENCY_{t-1}$	0.9758 (3.64)***	0.949 (4.44)***	0.9567 (2.69)**	1.0283 (4.74)***	0.9689 (3.28)***	0.973 (4.03)***
$COMPETITION_{t-1}$	2.5008 (3.08)***	2.5221 (3.43)***	2.5036 (3.49)**	2.5034 (3.71)**	2.4746 (2.7)**	2.4119 (2.93)***
$SIZE_{t-1}$	–0.4183 (–3.99)***	–0.4218 (–4.5)***	–0.4039 (–4.25)***	–0.4154 (–4.55)***	–0.4119 (–3.59)***	–0.4123 (–3.93)***
$DIVERSIFICATION_{t-1}$	0.0672 (0.27)	0.0604 (0.24)	0.021 (0.08)	0.0511 (0.19)	0.0626 (0.26)	0.1211 (0.42)
$LIQUIDITY_{t-1}$	–0.2821 (–0.46)	–0.2726 (–0.47)	–0.3603 (–0.49)	–0.3868 (–0.75)	–0.2915 (–0.53)	–0.3101 (–0.62)
$RULE\_OF\_LAW_{t-1}$	–2.2731 (–1.84)*	–2.0187 (–2.57)**	–2.405 (–1.73)*	–2.098 (–2.05)*	–2.1137 (–2.01)***	–2.7572 (–3.41)***
$INFLATION_{t-1}$	0.7811 (2.76)**	0.7894 (2.78)**	0.708 (2.74)**	0.9216 (1.62)	0.7309 (3.5)***	0.6707 (1.98)***
$GDGP_{t-1}$	1.4112 (2.11)**	1.3853 (2.89)***	1.3582 (2.04)**	1.8615 (1.22)**	1.3289 (2.71)**	1.4801 (3.58)***
Y2008	0.0159 (0.08)					
Y2009	–	–0.0479 (–0.26)				
Y2011			–0.2093 (–0.49)			
Y2012				0.3157 (0.28)		
Y2019					0.0158 (0.03)	
Y2020						0.1381 (0.57)
F–statistic (p-value)	110.95 (0.000)***	73.83 (0.000)***	109.68 (0.000)***	45.72 (0.000)***	90.85 (0.000)***	161.14 (0.000)***
Arellano-Bond test for AR() in first differences						
AR(1): Z-value (p-value)	–2.96 (0.003)***	–3.07 (0.002)***	–2.99 (0.003)***	–3.13 (0.002)***	–2.92 (0.003)***	–2.97 (0.003)***
AR(2): Z-value (p-value)	–0.56 (0.576)	–0.61 (0.541)	–0.88 (0.379)	–0.59 (0.556)	–0.53 (0.596)	–0.48 (0.633)

Table 9 Estimation results for the models with year dummies (continued)

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
Overidentification tests						
Sargan test: chi2 (p-value)	7.48 (0.759)	7.24 (0.779)	7.10 (0.791)	7.47 (0.760)	7.26 (0.778)	6.50 (0.838)
Hansen test: chi2 (p-value)	8.09 (0.705)	7.72 (0.738)	9.02 (0.620)	7.46 (0.761)	7.41 (0.765)	7.76 (0.734)
Endogeneity tests						
Hansen test excluding group: chi2 (p-value)	3.06 (0.690)	2.13 (0.831)	3.10 (0.684)	2.98 (0.704)	3.06 (0.691)	3.16 (0.676)
Difference (null H = exogenous): chi2 (p-value)	5.02 (0.541)	5.59 (0.471)	5.92 (0.432)	4.48 (0.612)	4.35 (0.629)	4.61 (0.595)

Following Phan et al. (2019), we employ the Sargan/Hansen, the Difference-in-Hansen and Arellano-Bond tests. First, the Sargan/Hansen tests of overidentifying restrictions cannot reject the null hypothesis that instruments are exogenous. The test statistic for the overidentification restriction is far from significant (the p-value is higher than 10%). Therefore, we cannot reject the null hypothesis of over-identification. This means that the likelihood of an error in the specification of the variants of equation (1) is small. Second, the 'Difference-in-Hansen' tests of the exogeneity of instrument subsets cannot reject the null hypothesis. Third, the Arellano-Bond technique tests for first and second-order serial correlation in the residuals with the null hypothesis that there is no serial correlation. The tests cannot reject the null hypotheses for second-order serial correlation.

Tables 7–9 show a positive relationship between *STABILITY* proxied by the Z-score and its one-period lagged variable, confirming the presence of persistence in bank risk-taking. The significance of the lagged variable at the 1% level for all the estimated specifications supports the use of the GMM method. This indicates that past information about bank stability influences its current level, consistent with El Moussawi and Mansour (2022).

4.1.5 Estimation results for the effect of efficiency and competition on stability

In Tables 7–9, the coefficient on the *EFFICIENCY* is positive and significant in almost all models. This result provides conclusive evidence that efficient banks are more stable, confirming the existence of *efficiency-stability* nexus in Tunisian banking. AlKhouri and Arouri (2019) and Dutta and Saha (2021) find a positive and significant impact of efficiency on bank stability.

The *bad management* and *bad luck hypotheses* (Berger and DeYoung, 1997) may explain the efficiency-stability link. First, because operating costs are captured by the Z-score through ROA, banks operating with low levels of efficiency incur higher costs resulting in lower profitability and stability. Deteriorations in cost efficiency because of inadequate credit monitoring and inefficient control of operating expenses will temporally precede increases in banks' risk due to credit, operational, market and reputational problems (Fiordelisi et al., 2011). Second, bank managers may find it difficult to monitor and control operating expenses and better manage the loan portfolio when the external environment is overwhelmed by adverse shocks such as poor macroeconomic conditions.

Table 10 Results for the models which interaction terms testing the size, diversification and ownership channels

	PANEL A	*PANEL B*	*PANEL C*			
	SIZE × *LERNER*	*DIVERSIFICATION* × *LERNER*	*GOVERNMENT* × *LERNER*	*PRIVATE* × *LERNER*	*FOREIGN* × *LERNER*	*MIXED* × *LERNER*
CONSTANT	4.3409 (0.41)	–1.1737 (–0.57)	–2.9313 (–1.01)	–0.012 (–0.01)	–0.3076 (–0.17)	1.1197 (0.32)
$STABILITY_{t-1}$	0.7115 (6.89)***	0.5862 (4.89)***	0.5279 (4.11)***	0.6344 (5.4)***	0.6186 (4.45)***	0.685 (3.52)***
$EFFICIENCY_{t-1}$	0.7829 (2.64)**	0.9563 (3.2)***	0.5336 (1.4)	0.8243 (2.33)**	1.1477 (3.83)***	0.7291 (1.35)
$COMPETITION_{t-1}$	–1.7537 (–0.16)	5.101 (1.74)*	5.344 (2.61)**	2.6237 (5.28)***	2.7659 (4.06)***	2.4671 (2.83)**
$INTERACTION\ TERM_{t-1}$	0.3497 (0.38)	1.0383 (0.8)	–2.8132 (–1.55)	0.2119 (0.05)	0.1414 (0.09)	1.9163 (0.58)
$SIZE_{t-1}$	–0.6827 (–0.81)	–0.4748 (–3.99)***	–0.3904 (–3.12)***	–0.3605 (–3.44)***	–0.3894 (–2.59)**	–0.3274 (–2.35)**
$DIVERSIFICATION_{t-1}$	0.132 (0.72)	–0.7807 (–0.73)	0.0608 (0.4)	–0.0989 (–0.59)	0.0043 (0.02)	–0.0703 (–0.23)
$LIQIDUITY_{t-1}$	0.0424 (0.05)	0.2783 (0.3)	0.5825 (1.01)	–0.1588 (–0.26)	–0.7285 (–0.76)	0.168 (0.19)
$RULE\_OF\_LAW_{t-1}$	–2.7918 (–1.4)	–2.005 (–1.75)*	–1.7184 (–1.1)	–1.1848 (–0.88)	–0.795 (–0.39)	–1.2079 (–0.49)
$INFLATION_{t-1}$	0.6021 (2.03)*	0.9057 (2.94)***	0.7431 (1.78)*	0.6914 (2.69)**	0.7517 (3.4)***	0.5361 (1.55)
$GDPG_{t-1}$	1.1953 (2)*	1.4768 (2.86)***	1.6425 (2.32)**	1.1015 (1.91)*	1.3673 (2.27)**	0.6155 (0.54)
GOVERNMENT			2.6136 (1.57)			

Table 10 Results for the models which interaction terms testing the size, diversification and ownership channels (continued)

	PANEL A	*PANEL B*	*PANEL C*			
	SIZE × LERNER	*DIVERSIFICATION × LERNER*	*GOVERNMENT × LERNER*	*PRIVATE × LERNER*	*FOREIGN × LERNER*	*MIXED × LERNER*
PRIVATE				–0.6183 (–0.18)		
FOREIGN					–0.5612 (–0.42)	
MIXED						–1.8168 (–0.57)
F-statistic **(p-value)**	161.84 (0.000)***	176.73 (0.000)***	47.04 (0.000)***	223.54 (0.000)***	9.36 (0.000)***	73.98 (0.000)***
Arellano-Bond test for AR() in first differences						
AR(1): Z-value (p-value)	9.35 (0.808)	z = –2.82 (0.005)***	–3.04 (0.002)***	–2.98 (0.003)***	–2.98 (0.003)***	–2.80 (0.005)***
AR(2): Z-value (p-value)	7.56 (0.911)	z = –0.56 (0.573)	–0.36 (0.715)	–0.58 (0.560)	–0.40 (0.693)	–0.64 (0.521)
Overidentification tests						
Sargan test: chi2 (p-value)	12.04 (0.603)	12.04 (0.603)	6.86 (0.909)	6.51 (0.925)	7.26 (0.888)	9.10 (0.765)
Hansen test: chi2 (p-value)	9.65 (0.787)	9.65 (0.787)	7.60 (0.869)	7.86 (0.852)	9.71 (0.717)	13.39 (0.418)
Endogeneity tests						
Hansen test excluding group: chi2 (p-value)	7.18 (0.411)	12.64 (0.081)*	5.93 (0.431)	3.42 (0.754)	5.41 (0.492)	3.04 (0.804)
Difference (null H = exogenous): chi2 (p-value)	0.38 (1.000)	–2.98 (1.000)	1.66 (0.976)	4.44 (0.728)	4.30 (0.745)	10.35 (0.169)

4.1.6 Estimation results for the effect of competition on stability

In Tables 7–9, the coefficient for *LERNER* is positive, significant and relatively large for all specifications, indicating a negative nexus between bank competition and stability through the *risk-shifting channel* (Boyd and De Nicolo, 2005). This result corroborates the findings of Al-Shboul et al. (2020) and Zoghlami and Bouchemia (2021), but it is in valence with the findings of Albaity et al. (2019) and El Moussawi and Mansour (2022). Our result implies that more competition may weaken bank stability, supporting the traditional *competition–fragility view* (Keeley, 1990). An escalation of bank competition through the weakening of monopoly power tends to squeeze profit margins, leads to an erosion of the banks' *franchise value*, and consequently, spurs lending, induces *risk-taking behaviour* and increases the fragility of banks (Hellmann et al., 2000).

Fu et al. (2014) argue that the positive *LERNER-STABILITY* link is not surprising for developing countries that pursued '*finance for growth*' policies for long periods. The protected, larger and state-owned banks in these countries transferred resources to enterprises owned or favoured by the government. These banks may exhibit attributes of *Quiet Life* by lacking the incentives to impose an appropriate credit culture and may face high levels of non-performing loans. On the other hand, banks are the main source of savings and finance in Tunisia, making them '*too-big-to-fail*' or '*too-systemically-important-to-fail*', possibly leading to moral hazard problems (Hmissi and Snoussi, 2017).

4.1.7 Estimation results for the effect of efficiency on the competition-stability nexus

Model 2 in Table 7 shows that the coefficient on the '*Efficiency X Competition*' term is insignificant, suggesting a *neutral* role of efficiency in the transmission of competition to stability. This agrees with Phan et al. (2019) but contrasts with Schaeck and Čihák (2014). Vives (2010) shows that competition diffuses its effects on stability through three channels: the *efficiency channel*, the *risk-shifting channel* and the *information asymmetry channel*. Our result indicates that the *efficiency channel* for *competition-stability* nexus does not apply in Tunisian banking, leaving room to test the other two channels.

4.1.8 Estimation results for the effect of size on stability

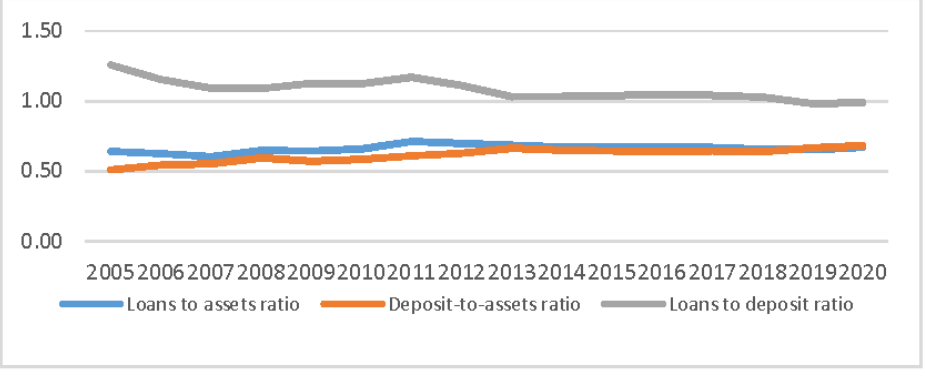
Most estimations in Tables 7–9 show a negative and significant impact of *SIZE* on STABILITY. This result is similar to Al-Shboul et al. (2020) and implies that stability deteriorates as the bank becomes bigger. Liu and Nguyen (2012) point out that larger banks indulge in greater risk-taking behaviour leading to less stability while relying on the government to intervene and bail them out when they fail. Hence, the negative *SIZE-STABILITY* nexus may come from explicit or implicit public protection mechanisms related to government ownership and perhaps the '*too big to fail*' doctrine.

4.1.9 Estimation results for the effect of liquidity on stability

Tables 7–9 show that the coefficient on *LIQUIDITY* is insignificant, suggesting that liquidity may be neutral to bank stability in line with the *bad management hypothesis* (Fang et al., 2014). This finding corroborates the results of Phan (2019) and Saif-Alyousfi et al. (2020) on GCC banks. Figure 1 shows that Tunisian banks experienced a

diminishing trend in the loan-to-deposit ratio from 1.26 in 2005 to less than 1.00 in 2019–2020. This has reinforced banks' balance sheet immunity to adverse shocks, leading to an improvement in banking stability. Thus, banks can earn higher income while avoiding excessive liquidity risk when granting more loans. However, it is to stress that, in theory, when banks hold more loans in their assets than deposit, they may earn more income, but they tend to face liquidity risk and borrowers' moral hazard, which can accelerate into a confidence crisis (Phan et al., 2019).

Figure 1 Trend in loans to deposit ratio of Tunisian banks between 2005 and 2020 (see online version for colours)



4.1.10 Estimation results of the effect of ownership on stability

The models in Table 8 yield insignificant coefficients on all ownership dummies, implying a *neural* effect of ownership on stability. On the one hand, the coefficients on *GOVERNMENT* and *MIXED* are positive, whereas those on *FOREIGN* and *PRIVATE* are negative. Although insignificant, the estimates show that the presence of public banks does not impair the stability of the banking system and that foreign banks contribute to financial stability. In the literature, Elfeituri and Vergos (2019) find an insignificant relationship between foreign bank presence and competition in the MENA region; Alouane et al. (2022) find an insignificant relationship between risk and public and private banks.

4.1.11 Estimation results for the effect of diversification on stability

In almost all specifications in Tables 7–9, the results reveal a positive but insignificant influence of *DIVERSIFICATION* on bank stability, implying that banks not engaged in nontraditional activities will not necessarily see their stability deteriorate. Many studies (e.g., Stiroh and Strahan, 2003; DeYoung and Torna, 2013; Calice et al., 2021) show that diversification contributes to bank fragility. Azmi et al. (2019) indicate that diversifying away from traditional lending activities would not affect financial stability. Maudos (2017) argues that improved bank performance that stems from greater diversification does not necessarily apply to all banks – some institutions may be better than others in diversifying their activities. This may be the reason for the undecided findings in the literature on the impact of diversification on bank stability (Abuzayed et al., 2018).

4.1.12 Estimation results for the effect of inflation, GDP growth and the rule of law on stability

Tables 7–10 show that the environmental conditions are significant factors in influencing the stability of Tunisian banks. First, the effect of *INFLATION* on *STABILITY* is positive, suggesting that inflation heightens stability. Phan et al. (2019) find a positive impact, but Saif-Alyousfi et al. (2020) find a negative effect on bank stability. Our result implies that Tunisia did not experience a level of economic uncertainty that would make inflation impair banks' stability. However, the inflation rate rose from 3.3% during 2005–2011 to 5.3% during 2012–2020. Rising inflation should trigger an adjustment in the cost of borrowing with consequences on bank profitability. Tunisian borrowers may not have alternative sources of borrowing, and this has contributed to the ROA component of the Z-score of stability.

Second, the results show that higher *GDPG* contributes to *STABILITY*. The coefficient for *GDPG* is positive for almost all models. This finding suggests that banks are more stable under macroeconomic conditions characterised by higher GDP growth, consistent with many past studies. For instance, Clark et al. (2018) find that bank stability positively correlates with GDP growth. Improved economic conditions contribute to the availability of feasible investment projects for banks to fund as well as enhance the solvency of potential borrowers. Nevertheless, the result contrasts with Phan et al. (2019), who suggest that banks become less stable in conditions of higher GDP growth. Azmi et al. (2019) find the insignificant impact of GDP growth on stability.

Third, the coefficient on the *RULE_OF_LAW* shows a positive and significant impact of institutional variables on bank stability. This result is consistent with Elfeituri (2022) that the quality of institutional variables helps shape bank performance. Bank stability may be further improved if policymakers enhance the environment with higher institutional quality.

4.1.13 Estimation results for the effect of external shocks on bank stability

Table 9 shows the impact of dummies controlling for several external shocks on bank stability. First, the two proxies of the 2008 GFC, *Y2008* and *Y2009*, are negatively but insignificantly related to bank stability. This suggests that banks in Tunisia were adversely impacted by the global financial tumult but were able to wither its bad effects. This is consistent with Fu et al. (2014) and Phan et al. (2019), who find that banks showed fragility during financial turmoil. Second, the coefficients on the two dummies proxying the *Arab Spring*, *Y2011* and *Y2012*, are insignificant. For *Y2011*, the coefficient is negative, but for *Y2012*, the coefficient is positive. This inconclusive result may suggest that the onset of the *Arab Spring* harmed bank stability, but banks managed to benefit from an improvement in the quality of the environment.

Third, the coefficients on the two dummies controlling for the outbreak of *Covid-19*, *Y2019* and *Y2020*, are negative but insignificant. This suggests that *Covid-19* may not have affected bank stability and government measures may have alleviated any undesirable impact. Additionally, the various rounds of recapitalisation and improvement of loan loss provisioning may have also helped banks resist the shocks in the post-*Arab Spring* period.

4.2 Alternative channels for the competition-stability nexus in Tunisian banking

The result that the *efficiency channel* is inoperative in the *competition-stability* nexus extends this work in an effort to test for the existence of alternative channels. We exploit the available bank-level traits to test three channels: the *size channel*, the *diversification channel*, and the *ownership channel*.

Table 10 provides the estimation results for testing these channels by adding the corresponding interaction terms to the baseline equation (1). In Table 10, Panel A shows the estimation results for the *size channel* by including an interaction term between *SIZE* and *COMPETITION*; Panel B tests the *diversification channel* by adding an interaction term between *DIVERSIFICATION* and *COMPETITION*; Panel C presents the regression results for the ownership channel by adding the interaction terms between each type of ownership and *COMPETITION*.

The results show that the coefficients on the interaction terms are insignificant, implying that size, diversification and ownership are not the conduits transmitting the effects of market power to bank stability. Tunisian banks may not depend on these three traits to enhance the *competition-stability* relationship. This suggests that the role of bank-level variables in the association between competition and stability in Tunisian banking is *neutral*.

5 Summary

Since the 1990s, Tunisia has implemented a wide spectrum of policy measures consistent with Basel reforms to surge competition, enhance efficiency, and reinforce banks' financial resilience. This work empirically analyses the relationship between competition and stability in Tunisian banking from 2005 to 2020 and seeks to identify whether there is a role for efficiency to play in this relationship. This period controls for the 2008 GFC, the 2011–2012 *Arab Spring*, and the 2019–2020 Covid outbreak. We apply the dynamic panel system-GMM framework to an unbalanced dataset of 23 banks with 343 observations. Several regressions of the baseline model are specified to establish a relationship between competition and stability and whether there is an *efficiency channel* in this relationship.

This paper provides the following findings. First, the results support the *competition-fragility* view for Tunisian banking, implying that higher competition reduces banks' stability. More competition may give banks the incentive for excessive risk-taking, which may exacerbate moral hazard problems and adverse selection between banks and borrowers, leading to a rise in bad loans. Second, cost efficiency positively impacts bank stability in Tunisia, consistent with the bad management hypothesis. Third, competition does not rely on efficiency to propagate its effects, denying the existence of an *efficiency channel*. Fourth, bank size harms stability, suggesting that larger banks in Tunisia are risk-takers, in line with the *risk-shifting channel* and the *too-big-to-fail* policies. Fifth, diversification, liquidity, ownership and external shocks do not influence bank stability in Tunisia. Sixth, bank resilience is enhanced in an environment characterised by higher GDP, moderate inflation, and more respect for the law. Finally, the results do not support the existence of a *size channel*, a *diversification channel* and an *ownership channel* in the *competition-stability* nexus in Tunisian banking.

6 Policy implications

This work has several policy implications.

To begin, this paper disputes the reform policies that have escalated competition to a level detrimental to the stability of banks. The *insignificance* of the ownership calls into question the goals behind privatising public banks, especially in favour of foreign ownership. Equally, it leads to consider that there may appear a need to revise the privatisation program and elucidate its goals, procedures and steps more transparently. Foreign or private banks may be operating pursuing goals divergent from enhancing the system's stability. In simpler terms, excessive and imprudent liberalisation to foster competition could render banks more vulnerable. Supervisors may need to review the process, closely examine potential buyers to bolster stability, and reassess the intentions of foreign banks entering the Tunisian banking market.

Second, policymakers may consider that an increase in bank size harms stability. Increasing size implies increased complexity, which is conducive to more agency problems with implications for risk-taking and stability. Prudence shall be exerted in approving a further expansion of the existing banks to avoid swamping the system with systemically important banks (Albaity et al., 2019). The negative *size-stability* link suggests that larger banks have fallen into the trappings of *Quiet Life*.

Finally, policymakers should promote sound economic policies that result in better growth and moderate inflation (Shabir et al., 2021). The government should continue injecting domestic institutions with better governance because it positively influences bank stability.

Primarily, this paper examines the existence of the *efficiency channel* for the impact of competition on stability in Tunisian banking during 2005–2020. The analysis leaves some scope for further research on Tunisian banking in two areas. First, the study confirms that competition influences stability but could not establish whether competition employs bank-level channels such as efficiency, size, diversification, and ownership to influence stability. Therefore, further research shall explore the channels through which competition diffuses its effects. Second, future research shall analyse the validity of the *Quiet Life hypothesis* in Tunisia and its role in making larger banks contribute negatively to stability. Other variables and theoretical frameworks shall be considered in this undertaking, such as concentration ratios, *Boone* indicator and other bank-level variables.

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Notes

[1]The summary statistics of the output, input and input prices are available upon request.

[2]The summary statistics of the output, input and input prices are available upon request.

[3]www.govindicators.org

[4]https://www.apbt.org.tn/rapports-annuels/