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Capital requirements, banking supervision and lending behavior: evidence from Tunisia

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This paper represents a contribution to the very meager literature on the impact of the prudential regulations on Tunisian bank behavior. It attempts to examine the effect of the capital requirements on bank credits during the period from 1999 to 2010 and assess the effectiveness of the banking supervision policy in containing the financial system's risk. On the basis of a theoretical dynamic model, the results show that the capital requirement ratio was binding bank credits during the period of study; well-capitalized banks have been lending more than less-capitalized ones. Despite this apparent stringency of the Tunisian bank regulator, our paper reveals that the supervision policy was weakly effective in restraining systemic risk. This research recommends further reinforcement of the supervision policy and initiating the assessment of its current design in order to improve its effectiveness.

Keywords: capital requirements; Basel Accords; dynamic model; banking supervision; nonperforming loans

JEL classification: C63; D92; G21; G28

1. Introduction

Since they were officially adopted by the authorities in 1991, there have been few research papers on prudential regulation (such as the capital requirements framework) and banks' behavior in Tunisia. This paper contributes to this meager literature by investigating the impact of Basel I implementation on the Tunisian banking system. We will examine the effect of the regulatory capital ratio on bank risk-taking during the period from 1999 to 2010 and assess the effectiveness of the banking supervision in containing this risk.

Throughout the 2000s, the Tunisian economy has been under an expanding monetary policy (see Figure 1) that was attempting to boost its weak growth rate. Notwithstanding, this period, in which two important reforms in banking regulation have been implemented by the government,[1] represents a very suitable time span to study the effect of the regulatory capital ratio on banks behavior than anytime else, because it is conjectured that during the 2000s Tunisian banks have become more accustomed with this internationally inspired regulatory framework.[2] Therefore, the examination of the supervision policy conducted by the bank regulator, that is, the central bank of Tunisia, is expected to provide more interesting implications for policy-makers,

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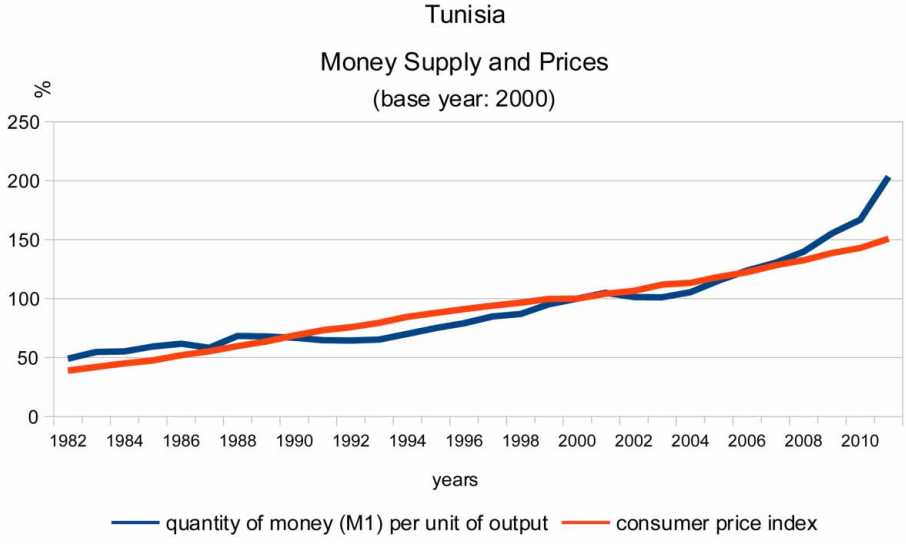

Figure 1. Monetary policy and prices (quantity of money M1 and CPI) in Tunisia (1982–2010). Source: National Institute of Statistics (the INS).

especially at the dawn of the newly internationally introduced Basel III. One of these policy issues might be institutional in relation to the design of the banking regulator with respect to the monetary policy function, namely, the combination of both functions by the same institution, that is, the central bank of Tunisia.

Outwardly, unlike in numerous countries, no sign of a credit crunch seems to appear in Tunisia during the period between 1999 and 2010 after the adoption of the capital adequacy ratio regulation.[3] Indeed, throughout this decade, bank credits have not ceased to increase steadily (see Figure 2).

Hence the questions about which this paper attempts to find some insights are the following: Did the capital regulatory framework have any binding effect on bank credits? In other words, why did the credit crunch not occur in Tunisia like in many other countries in the aftermath of the prudential regulations tightening of the 2000s? How effective was the bank regulator in containing the financial system's risk?

The rest of the paper is organized as follows. The next section presents a literature review on capital regulation and bank behavior in several countries including Tunisia. Section 3 presents the theoretical model. This model is based on a micro-foundation analysis. Section 4 discusses the assumptions on which the empirical regression is determined. Section 5 presents the data. The results and the contribution of the paper are reported in Section 6, together with several robustness tests. Section 7 concludes the paper and discusses some policy implications.

2. Literature review

Since the commencement of the implementation of the capital measurement system – commonly referred to as the *Basel Capital Accords* – by developed countries in the early 1990s, many economists were interested in investigating the impact of the *Risk-Based Capital Requirement* on banking behavior, particularly lending (Bernanke,

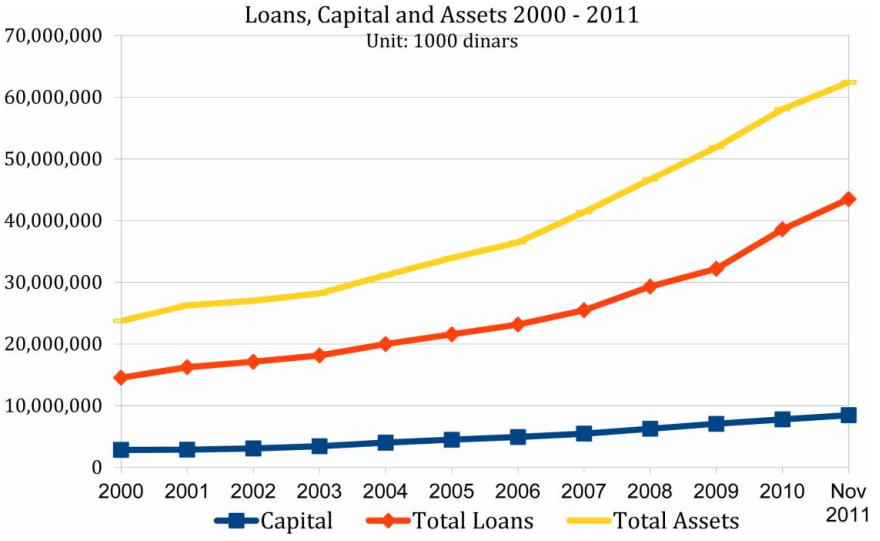

Figure 2. Loans, capital and total assets (2000–2011).
Source: Central Bank of Tunisia (BCT).

Lown, & Friedman, 1991; Peek & Rosengren, 1995a, 1995b, 1995c). The underlying hypothesis is whether the pressure to meet the capital adequacy requirements could constrain banks from granting new loans as issuing new equity involves costs associated with the asymmetric information between investors and banks. The binding capital requirement applied on banks could cause a *credit crunch* and, therefore, seriously harm the real economy.

The work of Bernanke et al. (1991) constitutes a cornerstone paper in the c*redit crunch* empirical literature. In their paper, a *credit crunch* phenomenon is defined as '*a significant leftward shift in the supply curve for bank loans, holding constant both the safe real interest rate and the quality of potential borrowers*'.

Bernanke et al. find evidence in favor of a *capital crunch* occurrence in the USA in the early 1990s.[4] They argue that the *beginning-of-period* level of capital ratio was more stringent on lending by small banks than large banks.

Peek and Rosengren (1995a) argue that the formal regulatory actions, such as capital requirements, have played a key role in the *credit crunch* of the early 1990s in New England. Using a simple static model, Peek and Rosengren (1995b) provide evidence that capital-constrained and unconstrained banks react *differently* to the changes in the federal funds rate. These authors concluded that the financial situation of the banking sector should be taken into account by the monetary policy-makers. In a third paper, Peek and Rosengren (1995c), by adopting a different approach based on deposits (*liabilities*) rather than loans (*assets*), find evidence of a *capital crunch* occurrence. The authors insist again on the need for a greater appreciation of the macroeconomic impact of bank regulatory policy.

Conversely, Bergers and Udell (1994) found that the risk-based capital ratio (henceforth, the RBCR)[5] does not explain *much* of the credit supply between 1990 (first quarter) and 1992 (second quarter). These authors attribute the observed slowdown in US bank credits to a fall in the demand during the above-mentioned period.

The one important methodological contribution, which differentiates their work relatively from other papers, consists in including a *control period* in order to draw definitive conclusions about the existence of a credit crunch.[6]

Honda, Kawahara, and Kohara (1995) reveal that the capital requirement ratio had affected major banks' lending in Japan in the early 1990; that is, after the adoption of the Basel Accords. Woo (2003) and Watanabe (2007) have proved empirically the occurrence of a *capital crunch* in Japan in 1997, a year of an acute banking crisis in this country.

Using an inter-temporal model, Guizani (2015) argues that during the period of an ultra-monetary easing policy that was conducted between 1999 and 2005, a credit crunch was taking place in Japan. Unlike the one occurring in 1997, this credit crunch is not attributed to regulatory pressure but to a voluntary risk-reduction policy followed by increasingly risk-averse Japanese bankers. Guizani (2015) points out that several major regulatory reforms implemented since the late 1990s, especially the prompt corrective action (PCA) and the deposit insurance measures, have reduced the regulator's forbearance margin and reinforced banks' self-discipline. Note that these reforms aimed to cope with the banking crisis of the late1990s.

Chiuri, Ferri, and Majnoni (2002) examine a panel of data for 572 banks in 15 developing countries and find consistent evidence that the capital regulation induced an aggregate slowdown of bank credit. Barajas and Steiner (2002) looked at eight Latin American cases and report that, after Basel I had been introduced, banks switched the composition of their balance sheets toward less risky assets.

With regard to Tunisia, there is only a small published literature about the impact of Basel Accords on bank behavior. After the introduction of Basel I Accords in 1988, several regulatory reforms were adopted, especially in 1991 and 2011.[7] Naceur and Kandil (2013), using panel data on bank balance sheets in five Middle East and North Africa (MENA) countries including Tunisia for the period from 1989 to 2003, examined the effect of the implementation of the Basel I rules on credit growth. Their panel model showed that Tunisian banks with lower capital-to-assets ratio were able to expand more loans than well-capitalized ones. This result shows the laxity of the Tunisian banking supervisor in coping with reckless banks throughout the above-mentioned period.[8] Boudriga, Taktak, and Jellouli (2012), using MENA countries' financial data from 2002 to 2006, find that the capital adequacy ratio did not prevent banks from having high levels of delinquent loans. However, they demonstrate the importance of the institutional environment, particularly a sound regulatory quality, in reducing the percentage of bad loans in banks' balance sheets.

Belanes and Ben Hajiba (2012), working on a set of panel data of Tunisian commercial banks from 1997 to 2007 and using a static model, show that capital regulation has helped to deter bankers from seeking risk. However, the effectiveness of this regulation depended on the type of bank risk.

Ayadi, Arbak, Ben Naceur, and Casu (2011) use the regulatory adequacy indices, determined from the Bank Regulation and Supervision Surveys (developed by Barth, Caprio, and Levine (2001) and revised in 2003 and 2007). They conjecture that the soundness of capital adequacy ratios throughout the 2000s in south-Mediterranean countries, including Tunisia, is attributed to the business models and the risk aversion of bankers rather than the stringency of the capital requirements. Naceur, Casu, and

Ben-Khedhiri (2011) emphasize that the improvement of the regulatory and supervisory practices in the MENA region would enhance banks' performance.

3. Model

In this paper the empirical framework will be based on a theoretical micro-foundation analysis. According to Rochet (2008) in today's banking activity, one-period models necessarily miss important consequences of bank solvency regulations. The intertemporal approach to be followed in this paper represents a contribution to the Tunisian banking literature.[9]

This micro-foundation analysis is based on the maximization of a regulatory-constrained profit function of a representative bank *i*. The first-order condition equation is then used to determine the loan–supply function. This approach has been used in Ogawa and Kitasaka (2000), Montgomery (2004), Montgomery and Shimizutani (2007) and Guizani (2015).

The theoretical approach consists in the maximization of *the profit function* of a bank *i*, under the subsequent two constraints:

(1) The balance sheet identity
(2) The prudential regulation constraint

3.1. Theoretical framework

Consider a representative banking firm *i* that has the following balance sheet structure:

Assets	Capital and Liabilities
• Loans (L)	
• Securities (S)	• Capital (K)
	• Position in money market (M)
	• Deposits (D)

Thus, we have at time t the following balance sheet identity:

$$L_t + S_t = K_t + D_t + M_t, \quad 0 \leq t \leq \infty. \tag{1}$$

Bear in mind that we choose to express the above balance sheet items in logarithmic values.[10]

We assume bank *i* to be risk-neutral and pursuing a profit maximization objective in a *perfectly competitive* credit market. Therefore, the interest rate, r^{L}, is given. Moreover, the interest rates on the securities, r^{S}, the deposits, r^{D}, and the money market, r^{M}, are also assumed to be given.[11]

If bank *i* is constrained by the prudential regulation, the following capital constraint a la Kashyap and Stein (1994) applies:

$$\mu L_t \leq K_t, \tag{2}$$

where μ is the required minimum level of the capital ratio.

According to the balance sheet structure, the representative bank *i*'s revenue is composed of interest incomes on loans and securities:

$$r_t^{\mathrm{L}} L_t, \tag{3}$$

$$r_t^{\mathrm{S}} S_t. \tag{4}$$

On the other hand, bank *i* is subject to the following costs:

(1) Interests paid on deposits:

$$r_t^{\mathrm{D}} D_t. \tag{5}$$

(2) Interests paid on the position on the money market:

$$r_t^{\mathrm{M}} M_t. \tag{6}$$

(3) Cost of default on loans:

$$\theta_t L_t. \tag{7}$$

The theta, θt, is the percentage of defaults on loans that depends on some macroeconomic factors to be spelled out below.[12]

(4) Adjustment costs:[13] It is assumed that the bank *i*'s adjustment costs have the following – quadratic – function:

$$\frac{h}{2}(L_t - L_{t-1})^2. \tag{8}$$

where $h > 0$.

3.2. Statement of the optimization problem

The profit of the representative bank *i* is the discounted sum of the future net cash flows. Hence, after taking into account Equations (1)–(8), the profit function π becomes as follows:

$$\pi_t = E\sum_{i=0}^{\infty} b^i \left[(r_{t+i}^{\mathrm{L}} L_{t+i} + r_{t+i}^{\mathrm{S}} S_{t+i}) - \left(D_{t+i} r_{t+i}^{\mathrm{D}} + r_{t+i}^{\mathrm{M}} M_{t+i} + \theta_{t+i} L_{t+i} + \frac{h}{2}(L_{t+i} - L_{t+i-1})^2 \right) \right], \tag{9}$$

where $0 \leq i \leq \infty$, *$E_t[.]$: mathematical expectation operator conditional on the information available at period t, b is the discount factor assumed to be equal to one when i=0.*

Using the equation $M_{t+i} = L_{t+i} + S_{t+i} - K_{t+i} - D_{t+i}$ to substitute for M_{t+i} in the profit function (9), we obtain:

$$\pi_t = E\sum_{i=0}^{\infty} b^i \left[(r^{\mathrm{L}}_{t+i} L_{t+i} + r^{\mathrm{S}}_{t+i} S_{t+i}) - \left(\begin{array}{l} D_{t+i}(r^{\mathrm{D}}_{t+i} - r^{\mathrm{M}}_{t+i}) + r^{\mathrm{M}}_{t+i} L_{t+i} \\ + r^{\mathrm{M}}_{t+i} S_{t+i} - r^{\mathrm{M}}_{t+i} K_{t+i} + \theta_{t+i} L_{t+i} + \dfrac{h}{2}(L_{t+i} - L_{t+i-1})^2 \end{array} \right) \right]. \tag{10}$$

Thus, maximization of bank *i*'s profit function π under the prudential regulation constraint (2) can mathematically be stated as follows:

$$\text{Max } \pi_t = E\sum_{i=0}^{\infty} b^i \left[(r^{\mathrm{L}}_{t+i} L_{t+i} + r^{\mathrm{S}}_{t+i} S_{t+i}) - \left(\begin{array}{l} D_{t+i}(r^{\mathrm{D}}_{t+i} - r^{\mathrm{M}}_{t+i}) + r^{\mathrm{M}}_{t+i} L_{t+i} \\ + r^{\mathrm{M}}_{t+i} S_{t+i} - r^{\mathrm{M}}_{t+i} K_{t+i} + \theta_{t+i} L_{t+i} + \dfrac{h}{2}(L_{t+i} - L_{t+i-1})^2 \end{array} \right) \right],$$

s/c

$$\mu L_t \leq K_t.$$

Maximization of the profit function (10) subject to the prudential regulation constraint (2) yields the following Euler equation:[14]

$$E[L_{t+1}] = \frac{(1+b)}{b} L_t - \frac{1}{b} L_{t-1} - \frac{1}{bh}(r^{\mathrm{L}}_t - r^{\mathrm{M}}_t) + \frac{\mu}{bh}\lambda_t, \tag{11}$$

where λ_t is the *Lagrange* multiplier associated with the prudential regulation constraint.

4. Empirical model

4.1. Assumptions

In order to estimate the model in Equation (11), several additional assumptions have yet to be taken:

(1) The cost of default on loans, θ, depends on some macroeconomic factors. In fact, a recessionary business cycle exerts pressures on the corporate sector's cash flow and harms, consequently, its creditworthiness and ability to reimburse its debts and arrears. As a result, the costs related to the default on loans jump during recessions.

According to the above analysis, the percentage of defaults on loans, θ, can be formulated as a function of the business cycle. To represent changes in the business cycle, the Gross Domestic Product (GDP) growth rate is employed.

For the sake of simplification, it is assumed that θ is a linear function of GDP growth rates:

$$\theta_t = \theta\left(\frac{\Delta \text{GDP}}{\text{GDP}}\right)_t,$$

where

$$\frac{\partial \theta}{\partial(\Delta \text{GDP}/\text{GDP})} < 0.$$

(2) The *Lagrange* multiplier, λ, in Equation (11) is not observable and therefore must, for empirical purposes, be substituted by an observable proxy. The unobservable variable, λ, is interpreted as the marginal increase in bank *i*'s objective function – that is, the profit function – when the inequality constraint, $\mu L_t \leq K_t$, is relaxed by one unit. The degree to which the inequality constraint is severe might be measured by how distant the observed capital adequacy ratio is from the required level (8%). It can be argued, therefore, that as the RBCR decreases, as the *Lagrange* multiplier λ_t increases. Consequently, this argument justifies the inclusion of the observable RBCR as a proxy of the unobservable $(-\lambda_t)$ in Equation (11).

(3) Finally, we assume that, on the basis of the information available in period *t*, bank *i* forms its expectations rationally. Hence, the expected future lending level $E[L_{t+1}]$ can be substituted by the actual lending value L_{t+1} and a forecast error term ξ_{t+1}, as follows: $E[L_{t+1}] = L_{t+1} + \xi_{t+1}$.

4.2. Regression

After considering the above-mentioned assumptions and rearranging Equation (11), we obtain the following lending function for bank *i*:[15]

$$\Delta L_{it} = \beta_1 \Delta L_{it-1} + \beta_2 (r^{\text{L}}_{it-1} - r^{\text{M}}_{t-1}) + \beta_3 \text{RBCR}_{it-1} + \beta_4 \left(\frac{\Delta \text{GDP}}{\text{GDP}}\right)_{t-1} + \xi_{it}, \qquad (12)$$

where

$$\beta_1 = \frac{1}{b};\ \beta_2 = -\frac{1}{bh};\ \beta_3 = \frac{\mu}{bh};\ \beta_4 = \frac{1}{bh}.$$

ξ_{it} is an error term[16]; *i* represents the *i*'th bank and *t* represents date *t*. All the other variables in Equation (12) have been defined earlier.

5. Data set description

The chosen sample comprises all commercial and healthy banks continuously active between 1999 and 2010. Distressed and newly created banks that lack sufficient

data are dropped from the sample. In addition, *development* banks[17] that changed their status to commercial banks during the period of study are not included in the sample.

A panel of annual data on financial and macroeconomic variables throughout the above-mentioned period is collected. In addition, following Hovakimian, Kane, and Laeven (2003), observations below the first or above the 99 percentile of all variables used in the estimation were dropped. This sample trimming allows us to neutralize the effects of extreme values.

Merged banks are treated as one entity for the entire sample period.[18] As a result, the retained sample includes 13 banks (5 state-owned banks[19] and 8 private banks) representing about 72% and 81% of total banks assets in 1999 and 2010, respectively.

Table 1 exhibits the descriptive statistics of the sample data. This annual panel data contain a number of bank observations between 152 and 156. During the period of study, the mean capital ratio of all banks was almost 14%, a ratio largely above the required minimum of 8%. However, the percentage of bad loans is quite high – with a percentage mean of 18.6% during the period. From 1999 to 2010, the economy has been experiencing positive, though insufficient, growth rates in real terms.

Data sources are the financial statements of the sample banks as published by the Tunisian Professional Association of Banks and Financial Institutions (APTBEF), the Central Bank of Tunisia's annual reports and World Bank country data.

Note that because the Basle capital ratio per bank is not published by any of the above sources, we approximate it by the capital-to-loans ratio.[20] The money market rate, r^{M}, data are collected from the TMM figures; it represents the average rate in the Tunisian money market.[21] For more details about the data, refer to the data appendix.

6. Results

6.1. Baseline results

Table 2 – column (1) provides the estimation results of the dynamic model (12) for all viable banks during the sample period between 1999 and 2010.

The estimation method employed is the general method of moments (GMM) technique developed by Arellano and Bond (1991).[22] The list of instruments used in the estimation include the lagged lending percentage changes, $\Delta\ln(L)$; the lagged interest rate differential, $(r^{L}-r^{M})$; the lagged RBCR and the lagged GDP growth rate, $\Delta\ln(GDP)$.

The coefficient estimate for the capital adequacy ratio has the expected positive sign and is highly statistically significant in the regression. This finding shows that,

Table 1. Descriptive statistics (1999–2010).

Variable	Obs.	Mean	Std. Dev.	Min	Max
Lending percentage change	152	0.104	0.111	–0.187	0.638
Interest rate differential	156	0.022	0.026	–0.034	0.142
Capital adequacy ratio	152	0.138	0.076	0.018	0.751
Nonperforming loans ratio	156	0.1862	0.0475	0	0.274
GDP growth rate	156	0.046	0.013	0.018	0.063

Table 2. Dynamic model.

Lending change (ΔL)	GMM (1)	GMM (2)
Lagged lending change (ΔL)	0.2027**	0.1562*
	(0.0846)	(0.0852)
Lagged interest rate differential ($r^{L}-r^{M}$)	2.8844**	1.9200
	(1.1605)	(1.1947)
Lagged capital adequacy ratio (RBCR)	1.1489***	1.3709***
	(0.3365)	(0.3420)
Lagged GDP growth rate (ΔGDP/GDP)	0.4809	0.8980*
	(0.4664)	(0.4821)
Lagged nonperforming loans ratio (NPL/L)		−0.6317***
		(0.2183)

*, ** and *** indicate that values are statistically significant at 10%, 5% and 1% significance level, respectively.

during the period of study, lending decisions by Tunisian banks were constrained by the capital regulatory requirements. Indeed, less-capitalized banks were more reluctant to grant new loans than well-capitalized ones. Obviously, the capital regulation framework has started limiting Tunisian banks from excessive risk-taking a few years after its official implementation by the authorities.

The coefficient estimate for the monetary policy variable, namely, the net interest margin ($r^{L}-r^{M}$), has a positive sign and is highly significantly different from zero. This result shows that throughout the period (1999–2010) any monetary policy easing was effective in instigating Tunisian commercial banks to grant more loans to the economy.

Moreover, the estimation results point out that the lending behavior of Tunisian banks does not depend significantly on the business cycle, but it does depend positively and significantly on past realizations. This unchangeable behavior of the Tunisian financial institutions might explain the high percentage of accumulated nonperforming loans in their balance sheets[23]; when lending behavior is unaffected by business cycle, banks may end up lending more during recessionary periods, resulting in more bad loans.[24]

Overall, these findings suggest that, during the period from 1999 to 2010, bank lending in Tunisia was driven principally by supply-side factors rather than demand-side factors.[25]

However, these results should be interpreted with caution. In fact, despite the constraining effect of the regulatory capital framework, bank credits did not stop rising steadily during the period; throughout the study's 10-year period, the total amount of Tunisian bank loans has more than doubled (see Figure 2).

Thus, two important questions remain to be investigated further and to which the current findings can but give only a partial answer. These questions are the following: Is this *apparently prudent* lending behavior on the part of Tunisian banks the result of a stringent banking supervisor (i.e. the central bank of Tunisia) or a voluntary risk-reduction behavior? If the former is true, how efficient was this banking supervision stringency in restraining risk?

6.2. A stringent banking supervision or a voluntary risk-reduction behavior on the part of Tunisian banks?

Even though lending in Tunisia did not stop rising during the 2000s, the regulatory capital ratio (RBCR) did have, to a certain extent, a disciplinary effect on banks' risk-taking.

In this section we will investigate further this issue by examining whether this seemingly prudent behavior is the result of strict banking supervision or merely a voluntary risk-reduction behavior on the part of increasingly risk-averse bankers. In fact, according to the literature, the capital adequacy ratio can mirror both attitudes.[26]

To do this test, we add a new variable to the model, that is, the lagged percentage of the nonperforming loans in total loans[27] (the average per sector[28]). It is expected that as the nonperforming ratio in the balance sheet of a bank increases, the regulator becomes stricter and more careful in scrutinizing this bank.[29] Usually, in such a case, the Tunisian central bank proceeds to an on-site inspection in addition to its regular off-site surveillance.

After the introduction of the nonperforming loans ratio in Equation (12), the regression becomes:

$$\begin{aligned}\Delta L_{it} = {} & \beta_1 \Delta L_{it-1} + \beta_2 (r^{\mathrm{L}}_{it-1} - r^{\mathrm{M}}_{t-1}) + \beta_3 \mathrm{RBCR}_{it-1} \\ & + \left(\frac{\mathrm{NPL}}{L}\right)_{jt-1} + \beta_5 \left(\frac{\Delta \mathrm{GDP}}{\mathrm{GDP}}\right)_{t-1} + \xi_{it},\end{aligned} \tag{13}$$

where *NPL/L*: *sector j's average of the nonperforming loans ratio*, and *j*: stands for *the public sector* or *private sector.*

The estimation results are shown in Table 2, column (2). The capital adequacy ratio coefficient keeps its positive sign and is still highly statistically significant, confirming therefore the baseline findings. The nonperforming loans coefficient has the right theoretical negative sign and is highly statistically significant. The more a bank holds delinquent loans, the less it is willing to lend.

This result demonstrates that the bank regulator has been, to a certain extent, stringent during the period between 1999 and 2010. This stringency might extend not only to nonperforming loans, but undoubtedly also to other prudential regulation standards such as the capital adequacy ratio requirements. This finding contradicts, to some measure, a conjecture made by Ayadi et al. (2011) who attributed the soundness of south-Mediterranean banks to only their risk-averse business model. Although the available data do not allow us to entirely deny the voluntary risk-reduction behavior on the part of Tunisian banks, our findings provide strong evidence in favor of the existence of a certain banking scrutiny stringency during the 2000s. To the best of our knowledge, this finding represents a contribution of this paper to the existing literature.

The lagged GDP growth rate coefficient is now weakly significantly positive. Like the baseline results, the lagged lending change coefficient is still positive and significant, confirming therefore the uniformity feature of the Tunisian banks' lending behavior during the period of study. However, the net interest margin coefficient is positive but no longer statistically significant.

These results reaffirm further that during the period between 1999 and 2010, the bank lending pattern in Tunisia was to a large scale driven by supply-side factors rather than demand-side factors. Tunisian bankers were to a certain extent taking into account the level of their financial soundness and the quality of their assets when making their lending decisions. This precautionary behavior was made possible by a stringent supervisory policy from the central bank.

However, it is important to note that this stringent supervisory policy was manifestly not sufficiently effective. In fact, the nonperforming loans ratio (a two digits figure, as shown by Figure 3) was judged *high* by the International Monetary Fund (IMF).[30] It is worth noting that according to Reinhart and Rogoff (2009), banking problems of the late 2000s in many countries originated largely from non-performing loans; in the pre-2008 worldwide crisis, the averages of nonperforming loans ratio in financially distressed countries such as Iceland, Italy, Greece and Portugal were approximately 12%, 5%, 4.8% and 2%, respectively.[31] Reinhart and Rogoff (2009) state that the protracted deterioration of asset quality represents the onset of a banking crisis.

This evidence reveals that despite the empirical proofs backing its stringency, the banking supervision policy was noticeably only weakly effective during the period of study, and further diligence is obviously still needed from the central bank in this regard. It is clear that even the other lending regulatory measures such as the loan-to-value ratios and debt service-to-income ratios were not sufficient to moderate assets growth and limit consequently the escalation of bad assets.[32] This represents another proof in favor of a lax banking supervision policy.

Note that the IMF has requested the Tunisian authorities on many occasions to reinforce their banking supervision framework in order to reduce the burden of the financial system's delinquent assets.[33]

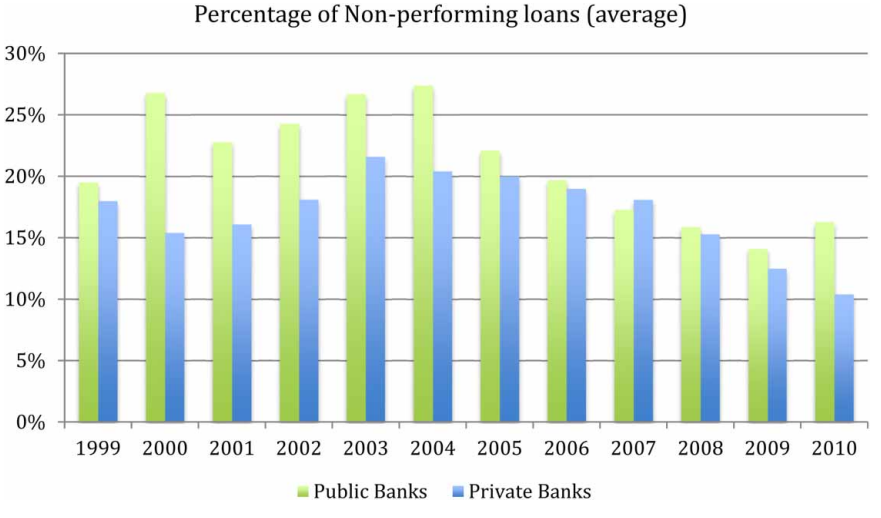

Figure 3. Percentage of nonperforming loans (average).
Source: IMF reports.

6.3. Robustness tests

In order to check the robustness of our results, the following tests are implemented. The first test is a replication of the Bernanke et al. (1991) approach and the second one is a time effect approach.

6.3.1. Bernanke et al. (1991) approach

We follow the same approach as in Bernanke et al. (1991) by, basically, using their model. For the banking supervision stringency test, we will add, in a second regression, the nonperforming loans variable in order to tailor the model to our empirical needs. The results are reported in Table 3. The findings are qualitatively similar to our baseline results.[34] In both regressions, the RBCR coefficient is positive and highly statistically significant, confirming consequently the binding effect of the regulatory capital ratio on credits. In the second regression, the nonperforming loans coefficient is negative and highly significant, suggesting that the central bank was to a certain extent following a strict banking supervision. The Bernanke et al. approach does not show a highly significant role of business cycles in shaping banking lending in Tunisia; the GDP growth rate coefficient in both panel regressions is either insignificant or weakly significant.

The Bernanke et al. approach endorses our findings and shows that, during the period between 1999 and 2010, bank credits in Tunisia were mainly driven by supply-side factors rather than demand-side factors.

6.3.2. Additional robustness test

We conduct an additional test to check the soundness of our baseline results. For this purpose, we include in the dynamic model (12) a dummy variable for each year of the period of study so as to check whether the positive and significant coefficient of the capital adequacy ratio captures unobservable shocks affecting all banks' risk-taking throughout the period.

Table 4, column (1) reports the results. Overall, the findings are qualitatively unaltered; the capital adequacy ratio keeps its positive and highly statistically significant coefficient.

Table 3. Panel random effect model.

Lending change (ΔL)	RE	RE
Constant	0.01953	0.1203***
	(0.0392)	(0.0436)
Lagged capital adequacy ratio (RBCR)	0.8015***	1.0753***
	(0.2106)	(0.2072)
Lagged GDP growth rate (ΔGDP/GDP)	−0.5192	0.4094
	(0.6069)	(0.6080)
Lagged nonperforming loans ratio (NPL/L)		−0.9448***
		(0.2207)

*, ** and *** indicate that values are statistically significant at 10%, 5% and 1% significance level, respectively.

Table 4. Dynamic model with dummy variables.

Lending change (ΔL)	GMM (1)	GMM (2)
Lagged lending change (ΔL)	0.2623***	0.2634***
	(0.0889)	(0.0894)
Lagged interest rate differential ($r^{L}-r^{M}$)	2.1163*	2.1461*
	(1.1067)	(1.1125)
Lagged capital adequacy ratio (RBCR)	0.9165***	0.8916**
	(0.3273)	(0.3509)
Lagged nonperforming loans ratio (NPL/L)		0.0467
		(0.4190)

*, ** and *** indicate that values are statistically significant at 10%, 5% and 1% significance level, respectively.

When we include the time effect dummy variable in model (13), the results, as reported in Table 4, column (2), are generally unaltered; the RBCR coefficient is still highly positively significant, showing a tightening effect of capital ratio regulation on bank lending. However, the nonperforming loans coefficient becomes not significantly different from zero.

Note that the Arab Banking Corporation (ABC) bank data show that the lending percentage changes have been, unlike in the other banks, highly negative during the period. Fearing the inclusion of these data would compromise the consistency of the baseline results, we run the regressions above without this bank's data. The findings are qualitatively unaltered. The results are not reported for reasons of brevity.

7. Conclusion

This paper represents a contribution to the meager literature on banking regulation in Tunisia. Employing a dynamic model, we examine the impact of the capital regulation on lending behavior during the period between 1999 and 2010. The empirical investigation provides evidence of a binding effect of the capital requirements framework on bank credits. The more a bank's capitalization is sound and its assets are healthy, the more it is able to grant new loans. The effect of the Basel capital ratio was extensively made possible by certain stringency in the supervision policy on the part of the bank regulator, that is, the central bank of Tunisia. To the best of our knowledge, this finding is a new contribution to the existing literature.

However, this finding should be interpreted with caution. Even though the Tunisian regulator was to certain extent strict on banks, this stringency can only be described as very weakly effective. In fact, the nonperforming loans ratio in Tunisian banks' balance sheets has been persistently high during the period of study. This fact points to the need for further reinforcement of the banking supervision policy in order to significantly improve its effectiveness in containing the financial systemic risk in Tunisia. Macroeconomic objectives are most likely behind this supervisory *forbearance* on the part of the regulator. This policy might be beneficial when applied for a short period and during recessions, but when kept for a longer period of time its side effect is to burden heavily the banking system with accumulating unpaid credits that seriously harm the prospects of sustainable growth in the real economy. Being

at the same time a monetary policy authority and a banking supervisor, the central bank of Tunisia has obviously missed harmonizing both policies more appropriately. This is very likely attributed to its focus on short-run real economy objectives.

Tolerance for a high level of nonperforming loans would put the banking system at a persistent threat of a systemic risk which consequently would have long-run negative impacts on the economy as a whole and inevitably on taxpayers. In their investigation of the history of banking crises, Reinhart and Rogoff (2009) point out that on average, unemployment rises for almost five years with an increase in the unemployment rate of about 7 percentage points in the aftermath of a crisis. After its 2001 financial crisis, Argentina's GDP decreased by more than 20% and the recession lasted for 4 years. Moreover, bailout costs, transfer payments and debt servicing costs following episodes of economic distress lead to a rapid and striking deterioration in the fiscal balance; during the three years following a banking crisis, real government debt rises more than 86% on average.[35]

Would a separation of the banking supervision function from the central bank of Tunisia be a good idea to solve this obvious conflict of interests between the two missions, that is, banking regulation and monetary policy? May be it is time for the Tunisian policy-makers to start assessing the current design of the banking supervision and thinking about the implementation of the more *objective* regulatory procedure, that is, the PCA, in order to mitigate the supervisory forbearance. These interesting questions still need further investigation by researchers.

Disclosure statement

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Notes

1. Law 2001-65 on Lending Institutions and the central bank of Tunisia Law 2006-26.
2. Notice that the official implementation of the Basel Accords in Tunisia took place in the mid-1990s.
3. Many papers have shown the occurrence of a credit crunch in the aftermath of the adoption of the capital adequacy ratio regulation. Among these papers, we can cite Bernanke et al. (1991), Peek and Rosengren (1995a, 1995b, 1995c) for the USA and Honda (2002), Ito and Sasaki (1998), Watanabe (2007) and Montgomery (2005) in Japan.
4. Expression first used by Richard Syron who was a member of the Federal Reserve Board's monetary policy committee 1989–1994. In short, capital crunch means a fall in bank capital.
5. The risk-based capital ratio, the Basel ratio, the capital adequacy ratio and the capital requirement ratio will be used interchangeably in this paper.
6. They define the credit crunch as a reduction in the credit supply relative to the normal supply.
7. The central bank regulation No. 91-24 of 1991 on prudential regulation and the Law 2001-65 on Lending Institutions.
8. Note that 'banking supervisor' and 'banking regulator' will be used interchangeably in this paper.

9. From an econometric point of view, dynamic models have the advantage of keeping away the problem of simultaneity that we might face with static models.
10. This mathematical device would simplify and improve the model formulation without any prejudice.
11. The last argument is not illogical since interest rates on the money market are fixed by the Central Bank.
12. With a purpose of simplification, it is assumed that bank i's customers default on loans and not on interests' income. Therefore, θ applies only on the stock of loans and not on the underlying amount of interests.
13. In addition to interest cost, there are several costs associated with banking activities. Blackwell and Santomero (1982) and Stanhouse (1983) argue that if banks want to issue loans to the general public, then the banks must devote resources to the evaluation of the credit rating of the customer, as well as the administration and monitoring of the loan during its duration. If there is a change in the amount of the loans issued by the banks, then the banks need to adjust the amount of the resources allocated to loan activities.
14. See Model Appendix for further details on the formulation of Euler Equation (11).
15. When rearranging Equation (11), we use the following approximation: $\Delta L_{it} \approx$ percentage change in lending. Recall that L_{it} is the natural logarithm of the total amount of loans of bank i at time t.
16. It should be noted that the forecast error ξ_{it} is uncorrelated with any variables contained in the bank's information set in period t under the rational expectation assumption. This property is very useful in solving the problems of endogeneity of the explanatory variables and especially the simultaneity between lending level and the capital adequacy ratio.
17. Development banks are joint-venture banks between the Tunisian government and other foreign governments. Unlike conventional banks, development banks were aiming to provide long-run finance.
18. Method employed by Peek and Rosengren in many of their research papers.
19. The share of the state in Attijari Bank was sold to private shareholders in 2006.
20. Since capital and loans are its main components, it is conjectured that the capital-to-loans ratio is highly correlated and adjacent to the undisclosed Basel capital ratio. For this reason, in the rest of the paper, we will keep using the same terminology about the capital ratio as before.
21. TMM are the initials of 'Taux du Marché Monétaire' (Rate of the money market).
22. To solve the autocorrelation problem that arises from the lagged dependent variable in a dynamic model, the GMM estimation method should be employed. This method was used in the literature such as Ogawa and Kitasaka (2000)
23. A two-digit figure, as shown in Table 1.
24. Since, according to the data, there is no significant statistical relationship between the lending percentage change and the business cycle, we cannot attribute the escalation of bad assets in the balance sheets of Tunisian banks during the period (1999–2010) to the pro-cyclical feature of the capital adequacy ratio.
25. This finding contradicts Naceur and Kandil (2013) who attribute the lending behavior of Tunisian banks during the period (1989–2003) to demand fluctuations related to the real growth and cost of borrowing. This finding is to a great extent in accordance with one of the main FSAP (2007) conclusions that says: '*Most bank loans continue to be granted on the basis of collateral, rather than as the result of an in-depth financial analysis aimed at assessing counterparty risk factors, such as the quality of the project and its ability to generate cash-flows*'.
26. Wagster (1999).
27. Percentage of nonperforming loans and nonperforming loans ratio are used interchangeably in this paper.
28. Unfortunately, the percentage of nonperforming loans per bank is also not publicly disclosed. Only the sector's average is published in financial reports.
29. Note that there is no consensus among researchers concerning the effective variable that can represent the regulatory scrutiny hypothesis the best (Shrieves & Dahl, 1995). We follow Bergers and Udell (1994) and employ the nonperforming loans ratio.
30. FSSA (2002) and Article IV consultation (2004).

31. Nkusu (2011).
32. These lending ratios are detailed in the Central Bank Circular no 87/47.
33. FSSA (2002) and Article IV consultation (2004).
34. Note that the Hausman test is in favor of the panel Random Effect (RE) model.
35. Reinhart and Rogoff (2009).

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Data Appendix

(1) Banks' data collected are annual and unconsolidated.
(2) The amount of banks' outstanding loan has been adjusted in order to neutralize the effect of the disposal of nonperforming loans (Loan charges off or written-off claims) on the evolvement of bank lending. This adjustment is carried out according to the following formula:
Adjusted total loans outstanding of bank i at the end of (t) = total loans outstanding of bank i at the end of (t) + written-offs of claims of bank i at the end of (t)
(3) The Risk-Based Capital Ratio, RBCR, is approximated by the capital-to-loans ratio.
(4) The nonperforming loans ratio per bank is approximated by its average in each sector, that is, public and private.

Model Appendix

Consider a representative banking firm i that has the following balance sheet structure:

Assets	Capital and Liabilities
• Loans (L)	• Capital (K)
• Securities (S)	• Position in Money Market (M)
	• Deposits (D)

Thus, we have at time t the following balance sheet identity,

$$L_t + S_t = K_t + D_t + M_t, \quad 0 \leq t \leq \infty. \tag{1}$$

The balance sheet items are all expressed in terms of their logarithmic values.

Statement of the optimization problem:

The profit of the representative bank i is the discounted sum of the future net cash flows. Hence, after taking into account Equations (1)–(8), the profit function π becomes as follows:

$$\pi_t = E\sum_{i=0}^{\infty} b^i\left[(r^{\mathrm{L}}_{t+i}L_{t+i} + r^{\mathrm{S}}_{t+i}S_{t+i}) - \left(D_{t+i}r^{\mathrm{D}}_{t+i} + r^{\mathrm{M}}_{t+i}M_{t+i} + \theta_{t+i}L_{t+i} + \frac{h}{2}(L_{t+i} - L_{t+i-1})^2\right)\right], \tag{9}$$

where: $0 \leq i \leq \infty$,
$E_t[.]$: mathematical expectation operator conditional on the information available at period t,
b: is the discount factor assumed to be equal to one when i=0.

Using the equation $M_{t+i} = L_{t+i} + S_{t+i} - K_{t+i} - D_{t+i}$ to substitute for M_{t+i} in the profit function (9), we obtain the following equation:

$$\mathrm{Max}\,\pi_t = E\sum_{i=0}^{\infty} b^i\left[(r^{\mathrm{L}}_{t+i}L_{t+i} + r^{\mathrm{S}}_{t+i}S_{t+i}) - \left(\begin{array}{l} D_{t+i}(r^{\mathrm{D}}_{t+i} - r^{\mathrm{M}}_{t+i}) + r^{\mathrm{M}}_{t+i}L_{t+i} \\ + r^{\mathrm{M}}_{t+i}S_{t+i} - r^{\mathrm{M}}_{t+i}K_{t+i} + \theta_{t+i}L_{t+i} + \frac{h}{2}(L_{t+i} - L_{t+i-1})^2 \end{array}\right)\right], \tag{10}$$

s/c

$$\mu L_t \leq K_t.$$

Maximization of the profit function (10) subject to the prudential regulation constraint (2):

Let Γbe the *Lagrangian*

$$\Gamma = \pi - \lambda_t(\mu L_t - K_t) \Rightarrow$$

$$\Gamma = E\sum_{i=0}^{\infty} b^i \Bigg[(r^{\mathrm{L}}_{t+i} L_{t+i} + r^{\mathrm{S}}_{t+i} S_{t+i}) - \left(D_{t+i}(r^{\mathrm{D}}_{t+i} - r^{\mathrm{M}}_{t+i}) + r^{\mathrm{M}}_{t+i} L_{t+i} + r^{\mathrm{M}}_{t+i} S_t - r^{\mathrm{M}}_{t+i} K_{t+i} + \theta_{t+i} L_{t+i} + \frac{h}{2}(L_{t+i} - L_{t+i-1})^2 \right) \Bigg] - \lambda_t(\mu L_t - K_t) \Rightarrow$$

The first-order condition gives the following:

$$\frac{d\Gamma}{dL_t} = 0 \Rightarrow$$

$$[r^{\mathrm{L}}_t - r^{\mathrm{M}}_t - \theta_t - hL_t + hL_{t-1}] + b^1[hE(L_{t+1}) - hL_t] - \mu\lambda_t = 0.$$

Finally, we get the following Euler Equation (11):

$$E[L_{t+1}] = \frac{(1+b)}{b} L_t - \frac{1}{b} L_{t-1} - \frac{1}{bh}(r^{\mathrm{L}}_t - r^{\mathrm{M}}_t) + \frac{\mu}{bh}\lambda_t. \tag{11}$$