

Market Structure and Bank Fragility: Application to the Tunisian Banking System

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Abstract: The purpose of this paper is to study the impact of market structure on bank fragility. We take the case of the Tunisian banking system during the period 1990-2012 and we use panel data for 10 Tunisian banks. The main conclusions show that the Tunisian banking sector fragility and risk taking by banks are explained by market structure. This structure is determined in another work where we found that banks in Tunisia operate in monopolistic competition. Indeed, the Tunisian banking system suffers from fragility that reflects mainly the large share of nonperforming loans and whose principal cause the banking market structure.

Keywords: market structure, competition, banking fragility, banking stability, market power.

JEL Classification: D40, G21, L11

Introduction

The effect of market structure on bank fragility has been a debate in the banking literature. In fact, this relationship is discussed from two points of view (Franklin, F. and Gale D. (2004)). The first, “competition-fragility”, shows that competition destroys the market power of banks, reducing their profit margins and subsequently their franchise value. This drives banks to take more risk to compensate their loss and increase their income which leads to their fragility. Several empirical studies have confirmed this relationship including the study of Keeley (1990) who showed that increased competition and deregulation that characterized the banking system of the United States in 1980, eroded monopoly rents and resulted in fragility of banking system. The second view is “competition-stability”. Boyd and De Nicolo (2005) argue that the market power of credit can lead to a high level of risk as the application of a high interest rate on loans, which makes repayment more difficult and increases

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the moral hazard and encourages borrowers to choose riskier projects. In addition, a strong banking market concentration may lead banks to take more risk if they consider themselves as large banks so that they are far from going bankrupt and if they feel protected by the government (Berger A. N., Klapper L. F. and Turk-Ariss R. (2008)).

In general, many economists suggest that the relationship between market structure and bank fragility is positive and strong, especially in the presence of information asymmetry. Indicators of bank fragility are multiple and are presented by various risks that banks may have. The bank run which induces liquidity risk occupies the largest share in the fragility of banks. Indeed, the rush will occur if the total value of early withdrawals of bank customers exceeds the amount available for short-term investments. In this case, the bank will be forced to sell illiquid assets. This situation may jeopardize the solvency and liquidity of the bank. Credit risk, market risk and operational risk are the other indicators of bank fragility.

Moreover, the fragility of banks can be the cause of social costs as well as private. Indeed, the bank is considered the most important link in the financial system especially in developing countries, since it represents the type of financing the most requested. Thus, the failure of a bank may have harmful consequences on the financing of investment projects and therefore on economic activity. In addition, the bankruptcy of a bank can cause the system failure through contagion or domino effect. It is therefore necessary to ensure "good health" and the soundness of the banking sector.

The causes of banks frailty are many which include the market structure, uncontrolled financial liberalization, behavior of banks and the speculative disaster myopia. In this work, we will focus only on the impact of market structure on excessive risk-taking by banks. The analysis of this impact will be in the empirical section where we will try to identify the relationship of market structure and bank risk taking and consequently the fragility and the stability of banking system.

Thus, the method of measuring risk must be chosen so that it reflects the risk that we attempt to analyze. Some empirical studies use the Z-index which represents a reverse proxy of the overall risk of banks, while others are based on non-performing loans to analyze credit risks, and others use the Lerner index.

In this paper, we propose to present, in the first section, the review of the literature on market structure and fragility of the banks where we will analyze the indicators and consequences as well as the main causes of this fragility in particular the market structure. In a second section, we propose to model empirically the impact of market structure on bank risk taking and the stability of banking system using an econometric model. We will take the case of the Tunisian banking sector where we will use the HHI index of concentration, the concentration ratio of n-banks, the Lerner index and the Z-index to identify the structure of the banking market. So we try to answer to the question: is it the causal relationship between market structure and bank fragility is verified for the Tunisian banking market?

Literature Review

The Indicators and Consequences of Bank Fragility

The Bank Run and Liquidity Risk

The information asymmetry between banks, depositors and borrowers, and the transformation of maturity reflecting the investment by the bank short-term deposits in long-term assets may expose bank to the problem of rush. Banks offer due depositors contracts that allow them to withdraw a fixed amount on demand. If the total value of early withdrawals exceeds the amount available for short-term investments, a run can take place and the bank will be forced to sell illiquid assets. This situation may jeopardize the creditworthiness and liquidity of the bank.

An institution is characterized by liquidity risk if it can be jeopardized by a sudden loss of confidence of its lenders and unexpected. The liquidity risk of an institution depends on both the maturity of its debt and the nature of its assets. To illustrate this mechanism rush and its effect on bank liquidity, Diamond D. and P. Dybvic (1983) have established a model that highlights the important role of banks focusing on the specific characteristic of deposits. Indeed, the specificity of bank deposit is that they are fully liquid assets in the sense that they may be withdrawn at any time. They represent no risk of capital loss and they are perfectly divisible by all and accepted as payment method. In their model, these authors represent the bank as providing insurance to depositors of liquidity; on the contrary, bank credit commitments are irreversible and therefore they are illiquid.

Furthermore, the existence of bank illiquid assets (loans) generates vulnerability in the bank. This vulnerability is due to the phenomenon of the rush of depositors which occurs when all depositors or a majority of them seek to convert their deposits into currency or transfer their deposits to another bank (Laurence Scialom (1999). The rush causes panic and induces banking crisis. Indeed, if there is a massive withdrawal of deposits (rush), banks must write off their long-term assets, which aggravates the problem of liquidity of the banking system, even if banks are solvent. The situation becomes more critical when banks finance projects unproductive and unprofitable, which affects their profitability. Thus, prices of securities are falling, and banks become insolvent.

Other Risks

Credit Risk (Default Risk)

It is related to losses resulting from the failure of a counterparty bank. Indeed, when bank lends money to agents who have severe difficulties, they will suffer losses and

will expose to bankruptcy. In other words, credit risk arises when the debtor can no longer honor its commitments, that is to say pay principal and interest. Thus, credit risk is the risk of insolvency of the debtor. It represents a major source of problems during deceleration of inflation because the real cost of credit is then increased.

The bank must protect themselves from the risk of non repayment of certain borrowers, and this by examining their solvency. Indeed, the bank must examine the files of loan applicants and determine those who are creditworthy and those who are not. Confidence and subsequent repayment are not sufficient because there is never any absolute certainty. Credit risk can be measured by the share of nonperforming loans in total loans.

Market Risk

Market risk appears when a participant is in position to suffer unfavorable market data or market volatility. It represents the danger of loss of banking positions, due to external factors of the bank such as fluctuations in interest rates, exchange rates, asset prices or changes in economic policy.

The interest rate risk: is the risk of loss due to an adverse change in interest rates. A change in interest rates can be very costly, if we are not careful. It involves two types of operations: the intermediation operations that pose a rate risk when the rates references are different for loan and debt, and market operations that are related to interest rate risk often voluntarily taken on the basis of anticipation made by the bank.

The risk of exchange rate: the banker must also reckon with the risk of changes in value following a change in exchange rates. Exchange risk is related to transactions in currency. It is particularly high during periods of volatility of various currencies. Banks are exposed to such risk when the deposits and debts are denominated in two currencies.

The risk of course: it is related to the portfolio of property or shares. This results from an adverse change in a stock index which indicates a risk of loss to the bank.

It should be noted that the market risk can turn into a liquidity risk. This type of risk is specific to the transformation function. It is linked to two conditions: the first is that the assets of the bank must be less liquid than its liabilities; the second is that the liquidation of assets must result in losses to the bank.

Operational Risk

According to BIS (2001a), operational risk is associated with the risk of direct or indirect loss from inadequate or failed due to procedures, people, internal systems or from external events such as for example a poorly written contract. Indeed, opera-

tional risk comes from inefficient management of resources in the bank. It is mainly related to problems of dysfunction and of internal controls.

The Consequences of the Failure of Banks

From an economic standpoint, a bank goes bankrupt when the market value of its assets falls below the market value of its liabilities, so that the market value of its capital, that is to say the net worth, becomes negative (Kaufman G. (1995)).

The failure of banks is considered more serious than the failure of companies to the extent that banks are more fragile and more susceptible to failure than others. According to Kaufman (1996), there are three reasons why banks are considered most vulnerable. The first is related to the low ratio of capital to total assets that does not take into account the likelihood of losses. The second is the low ratio of total fund to assets that may require the sale of productive assets to meet deposit obligations. The third reason is the high demand for short-term loans and the importance of the ratio of short-term loans to total credit.

The Private and Social Costs of Bankruptcy

In general, the failure of banks may have private and social costs:

The private costs of bank failure: these costs are borne by the owners of the bank, depositors, bondholders issued by banks and other creditors. According to Bordes (1991) the failure of banks generates two types of effects. Direct effects concern particularly the costs of bankruptcy proceedings, and indirect effects that are related to operational difficulties of the bank. These effects include: the difficulties encountered by the bank in the recruitment and retention of staff, the time spent in the judicial process rather than the management of the bank and especially the difficulties of finding funding. In addition, depositors must first, recover the amount of their deposits, and secondly establish new customer relationships with other banks.

The social costs of bankruptcy: When bank fails, the clients, not to bear the consequences, exchange deposits against tickets. Thus, to protect themselves against this risk, banks will try to hold excess reserves more important. This behavior results in the reduction of money supply and thus the money supply which means, according to Bernanke (1983), a recession in economic activity and rising unemployment. In addition, monetary policy can also be weakened by the bank failure. Indeed, the central bank fails to achieve its objectives and achieve its strategies including the reduction of inflation because the counterparties in the money will be spent on funding the losses of banks. However, even if the costs of bank failures are deflationary

or neutral in medium term, overreaction of the authorities to limit these costs may actually be causing a risk of inflation.

Risk of Contagion in the Banking Market

Theoretically, the contagion in the banking sector is considered more serious than in other sectors. In this regard Kaufman (1994) identified five reasons:

- Contagion occurs more rapidly
- It is distributed more widely within the banking industry
- It leads to many failures
- It causes significant losses to creditors (depositors)
- It spreads beyond the banking sector to move to other sectors and other countries.

In general, the contagion in the interbank markets may occur in three situations: a situation where global liquidity is insufficient, the second when market expectations create “externalities” and the third situation where a bankruptcy of a bank leads to a domino effect (Degryse H. and Nguyen G. (2004)).

A lack of global liquidity: according to Bhattacharya and Gale (1987) the lack of liquidity in the market could occur in cases where banks have excessive confidence in the ability of interbank markets to absorb temporary liquidity shocks. This confidence pushes banks to reduce their investment in liquid assets. Thus, the link between banks may create problems if the aggregate liquidity is insufficient. In this case, banks try to avoid liquidation of their assets in the long term, and thus to liquidate their claims on other banks which may be in other regions. Therefore, a crisis in one region can spread by contagion to other regions and introduce liquidity problems (Allen, F. and D. Gale (2000)).

The “Externalities” represent a second potential channel of contagion. These externalities are related to the banking panic occurs when depositors run to the bank to withdraw their funds. Depositors of other banks for fear of not recovering their deposits, also decide to withdraw their funds. This results in a massive withdrawal of funds from banks which indicates a lack of liquidity. These externalities may also affect banks of different natures. For example, the bankruptcy of investment bank could cause a liquidity and trust problem for commercial bank for example.

Domino effect: the bankruptcy of a bank may cause a domino effect where each bank insolvent will endanger all other institutions that are related to it. Indeed, an insolvent bank cannot meet its obligations to its creditors and other banks, threatening the market’s confidence and increases the resource cost of other banks. Contagion occurs when “mechanically” by direct links between banks that is to say by inter-bank credits.

The Causes of Bank Fragility

Competition and Fragility in the Banking System

The relationship between competition and financial fragility has been widely ignored by the banking theory. It has been recognized that this relationship is complex and multifaceted. In fact, there is no agreement on its nature or its consequences for economic policy. There are different views in the literature trying to explain this relationship. The first point of view, “competition-fragility”, assumes that competition enhances fragility. This view is supported by analysis that takes into account the risks associated with competition for deposits, banking deregulation and risky behavior of banks. It follows from this that the concentration or regulation can enhance the stability of the banking sector. This partly explains why the assumption of bank competition has long been disputed and justifies the need for banking regulation. However, empirically this implication is questionable. On the one hand, some studies show that banking concentration is negatively correlated with competition; secondly, the question of how competition affects the stability of banking systems and the effectiveness of regulation is not well understood.

Another point of view, “competition-stability”, argues that bank competition enhances financial stability. Theoretically, some analysts argue that competition can enhance stability by reducing information asymmetries or by increasing liquidity in the inter-bank markets. Empirically this hypothesis is verified by studies on the history of U.S. banks and by studies that rely on international data such as for example those of Rolnick and Weber (1983) and Claessens and Klingebiel (2001).

Among the authors who have analyzed the direct relationship between competition and fragility include Smith (1984) which was based on the model of Diamond and Dybvig (1983). Indeed, banks compete to attract depositors who have different probabilities and different dates of withdrawal. Because the problem of adverse selection, only depositors know their own probability of withdrawal. In this case, the Nash equilibrium cannot be established and the contract balance is destroyed by the possibility for banks to offer contracts to a particular segment of depositors. Thus, the banking system is no longer viable. Pauzner (2005) and Rochet and Vives (2005) stressed that the relationship between competition and banking fragility may be positive. Indeed, the increased rate on deposits causes a failure of coordination between banks and consequently causes a bank run.

Other recent empirical studies show that the relationship between bank competition, concentration, and the fragility of the banking system is ambiguous. For example, Beck, Demirguc-Kunt and Levine (2006) find that the risk of financial crises is weaker in more concentrated banking systems, but higher in the less competitive systems and in countries where legal systems are less developed.

Market Structure and Risk-Taking

There are no clear results regarding the effect of competition on risk taking by banks. What is generally acknowledged is that intense competition in the credit market may encourage banks to accept bad risks. In fact, banks can offer terms of the debt that does not match the risk profile of the borrower or alternatively to their credit policy, particularly a non risk-adjusted pricing, which generates a margin that does not pay the cost of risk. Indeed, shareholders and bank managers are encouraged to take more risks because lower profits, due to increased competition, reduce the economic value of the bank. However, several authors examined the relationship between competition and risk-taking that some of them have checked this link and admitted that competitive factors are the cause of excessive risk-taking, while others do not. Hellmann et al. (2000) for example, demonstrate the ability to conduct excessive risk-taking in a highly competitive market and how regulation can help to mitigate this link.

The impact of increased competition on the probability of bank failure is studied by Caminal and Matutes (2002). Their goal was to find a relationship between market structure and bank failures. According to these authors, banks have two ways to influence the selection of projects submitted by borrowers: the rationing of credit that can increase the marginal return of capital and may reduce incentives for excessive risk taking, and control of the borrower. The result found was an ambiguity in the relationship between market structure and bank failures. Monitoring has a positive effect on investment while increasing the rate of credit generates lower investment. On the other hand, a positive relationship between the level of investment and risk; improve investment increases the credit risk in the presence of decreasing returns to scale and non-diversifiable risk.

The study of a direct relationship between competition and the level of risk is presented by Boyd and Nicolo (2005). They argue that low competition in the credit market leads to an increase in the excess risk and consequently the probability of bank failure. Indeed, the weakness of competition resulted in a high concentration of banks allows the latter to increase their pension. However, excess of rent implies a high interest rate and therefore a risk of default of the bank. These authors show that when entrepreneurs choose risky investment projects, banks are becoming more risky as competition decreases. Indeed, a high level of competition in the credit market reduced the lending rates that entrepreneurs pay, this increases their return and reduces their incentives to take risks.

The excessive risk-taking related to the degree of competition may also be explained by the pricing of risk. In this regard, Cordella and Yeyati (2002) have sought to verify the relationship between competition and pricing risk. The rates on deposits adjust to the default probability of the bank when there is asymmetric information on the degree of portfolio risk. However, when information on risk is available or when

the deposit insurance premium is adjusted for risk, then the effect of competition on the excess risk can be reduced.

Keely (1990) concluded that franchise value has a negative effect on risk taking. The general idea is that a high level of competition reduces the franchise value of the bank which pushes bank to take risks. Keely has seen bank failures in the United States during the year 1980 whose causes were deregulation and market factors that reduce the rents of monopoly banks. In the same context, Edwards and Mishkin (1995) show that the excessive risk-taking observed in the United States in 1980 was the response of banks to the sharp decline in profits due to competition in the financial market.

Besanko and Thakor (1993) use this implication in the context of banking relationship, where banks have private information about their customers. This allows the bank to be informational monopoly and acquire information rents. The bank does not take risk as long as it captures at least some of these rents. However, as soon as the banking sector becomes more competitive, the value of banking relationship decreases and banks' exposure to risk increases.

Marcus (1984) used a model of a single period to show that the decline of franchise value grow the bank to engage in riskier policies. Dermine (1986) extended the Klein-Monti model by incorporating the risk of bankruptcy and insurance deposits, and shows a negative relationship between the level of credit risk of the bank and its power on the deposit market. Chan, Greenbaum and Thakor (1986) showed that increased competition will destroy the surplus that banks can earn by identifying quality borrowers. In fact, reducing the franchise value leads banks to reduce their screening of potential borrowers and, therefore, the quality of loan portfolio decreases.

Even if the prospect of a negative relationship between competition and stability remains the predominant, more recently, a number of studies have suggested that the relationship between competition and risk taking must not be robust. In particular, a higher degree of competition may encourage banks to be more cautious when specific aspects of the relationship between banks and companies, important functions of banks and characteristics (eg monitoring) are taken into account.

Using a dynamic optimization model with an infinite horizon, Suarez (1994) showed a compromise between market power and solvency. If the market power of banks decreases, then the incentive to engage in riskier policies increases significantly. As the franchise value of the bank is a component of bankruptcy costs, this should encourage the Bank to pursue a cautious policy that increases the solvency of the bank (G. Jimenez, Jose A. Lopez, and Saurina J. (2007)).

Market Structure and Fragility of Banks: Empirical Modeling

We will test the effect of market structure on bank fragility using data from the 10 Tunisian banks during the period 1990-2012. Referring to the work of Marti-

nez-Miera and Repullo (2008) and Berger, Klapper and Turk-Ariss (2008), we use a nonlinear relationship between financial stability and market structure in banking. The general model used for estimation is of the form:

Financial stability_{*i*} = f (market structure_{*i*}, market structure_{*i*}², control of the bank, banking environment)

Where *i* represents banks. We will use various indicators of risk exposure as a proxy for financial stability (dependent variable): the ratio of non-performing loans to total loans (NPL) to measure credit portfolio risk, the Z-index as an inverse measure of overall risk of banks and the ratio of equity to total assets (ETA) to measure the level of capitalization of banks.

The Z-index is a reverse proxy for the probability of bank failures. It combines profitability, debt and the volatility of profitability in a single formula. It is presented by the ratio:

$$Z_i = \frac{ROA_i + E / TA_i}{\sigma_{ROA_i}}$$

Where:

- ROA is the average of profitability of banks' assets during the test period.
- E / TA is the ratio of equity to total assets and σ_{ROA_i} is the standard deviation of return on assets throughout the study period.

The Z-index increases with increase of profitability and capitalization, and decreases with unstable incomes resulted in an increase in the standard deviation of return on assets. It represents the inverse of the probability of bank failure and an indicator of the financial stability of the bank.

In the banking literature, several measures of degree of competition were used. In this work, we use the Lerner index as a proxy of market power to analyze the relationship between market structure and financial stability. The Lerner index has been widely used in the banking sector as an indicator of market power. It is a more accurate measure of market power that measures the concentration standard. In accordance with the new approach of industrial organization, this index is calculated to obtain a measure of bank competition. The use of the Lerner index as an indicator of degree of market power is explained by two reasons. The first is that the Lerner index can be estimated for each bank of the sample; therefore, we can analyze the determinants of market power by using the information at the banking level (bank-specific variables). The second reason is that we can analyze the evolution of market power by estimating the Lerner index each year.

The Lerner index is the average mark-up of price over marginal costs. In other words, it is defined as the difference between the price (P) and marginal cost (MC), divided by the price, either (P - MC) / P. Different values of this index allow to deter-

mine the nature of the market structure. Indeed, in a situation of perfect competition, price equals marginal cost and the index is equal to zero. When prices are above marginal cost, the Lerner index is positive and varies between zero and unity. When the value of the index approaches the unity, so the power of market increases.

The Lerner index is calculated by the following formula:

$$Lerner_{it} = \frac{P_{TAit} - MC_{TAit}}{P_{TAit}}$$

Where:

- P_{TAit} is the average price of banking production presented by the ratio of total income over total assets of bank i in year t , as presented by Fernandez de Guevara, Maudos and Perez (2005) and Carbo et al. (2009).
- MC_{TAit} is the marginal cost of total assets of bank i at time t .

The marginal cost is estimated on the basis of a translog cost function with an output (represented by total assets) and three input prices (price of labor, price of physical capital, and price of borrowed funds).

The cost function is specified as follows:

$$\begin{aligned} \ln(CT_{it}) = & \beta_0 + \beta_1 \ln(Q_{it}) + \frac{\beta_2}{2} \ln(Q_{it}^2) + \sum_{k=1}^3 \gamma_{kt} \ln W_{k,it} + \sum_{k=1}^3 \phi_k \ln Q_{it} \ln W_{k,it} \\ & + \sum_{k=1}^3 \sum_{j=1}^3 \delta_{kj} \ln W_{k,it} \ln W_{j,it} + \varepsilon_{it} \end{aligned}$$

Where:

CT: means the total cost

Qit: total assets of bank i at time t

W1: the price of labor (ratio of personnel expenses to total assets)

W2: the price of physical capital (the ratio of non-interest expenses of other fixed assets)

W3: The price of borrowed funds (ratio of interest paid to total funding).

The total cost is the sum of staff costs, expenses other than interest and interest paid. The estimated coefficients of the cost function are then used to calculate the marginal cost (MC) using the following equation:

$$MC_{TA_{it}} = \frac{Cost_{it}}{Q_{it}} \left[\beta_1 + \beta_2 \ln Q_{it} + \sum_{k=1}^3 \phi_k \ln W_{k,it} \right]$$

We will also use the Herfindahl-Hirschman Index (HHI) as an indicator of market power. The HHI is defined as the sum of squared market shares of banks. Its value

depends on the measuring of the market share held by large banks (Honohan & Kinsella (1982), Rhoades (1993)). It measures the degree of concentration of deposits and loans market, where the total deposits and total loans are taken as indicators for measuring the size of banks. Concentration is high when the index is high.

The U.S Department of Justice (DOJ) divides the values of the HHI into three categories. For an HHI less than 0.1 (or 1000) the market is considered unconcentrated. For a value between 0.1 and 0.18 (or 1000 and 1800) market concentration is moderate. Finally, if the value of HHI is more than 0.18 (or 1800) then the market is highly concentrated. Generally, a decrease in the HHI means a loss of market power of banks and increased competition, while an increase indicates otherwise. HHI has the advantage of including information from the distribution of market shares and the number of firms (banks) involved in the industry.

Variables and Data Sources

We collect data on Tunisian banks for 2001 to 2006 from the Bank-Scope database and from APTBEF¹ and activity reports banks for the remaining years (1990 to 2000 and 2007 -2012). The model includes 10 Tunisian banks:

Table 1: List of banks

<i>Public Banks</i>	
BNA	National Agricultural Bank
STB	Tunisian Bank Corporation
BS	Bank of the South
UIB	International Union of Banks
BH	Housing bank
<i>Private Banks</i>	
BIAT	Arab International Bank of Tunisia
BT	Bank of Tunisia
AB	Amen Bank
<i>Foreign banks</i>	
ATB	Arab Tunisian Bank.
UBCI	Banking union for trade and industry

The dependent variable is represented by the ratio of nonperforming loans to total assets, by the Z-index and by the ratio of equity to total assets. The exogenous variable indicates the structure of the banking market measured by the Lerner index. We also use traditional methods for measuring concentration like HHI deposit and HHI credit to ensure verification.

We use other variables to control the size and composition of bank assets. The size control is provided by the logarithm of total assets, while the composition of

assets is measured by the share of loans in total assets and the ratio of fixed assets to total assets. We also include control variables at the macro level. The first is used as a proxy for the environment of banks, which is the “legal rights” index² (Djankov, McLiesh, and Shleifer (2005)). This index measures how collateral and bankruptcy-related laws help to facilitate the granting of credits. The second is the log of GDP per capita, which allows monitoring of changes in economic development in Tunisia³⁴.

Empirical Results and Interpretations

Tables 2, 3, 4 of appendix show the results of our estimates. We used the methods of ordinary least squares and generalized least squares. Financial stability is presented by three variables. In Table 2 we measure credit portfolio risk by the ratio of non-performing loans (NPL). The overall risk of the bank is measured by Z-index and presented in Table 3, while the risk of leverage is measured by the ratio of capitalization of banks and presented in Table 4.

Competition (or market power) is measured by the HHI deposits and HHI loans and by the Lerner index. As already mentioned, a high value of these indices implies a significant market power and hence a less competitive market. We also include the size of the bank, the asset mix, the “Legal Rights” index and GDP per capita expressed in logarithms in all regressions to control developments in the business environment and economic development.

We include a quadratic term in the estimated equations to allow a nonlinear relationship between the measure of risk and market structure in banking.

Table 2 of appendix presents the estimation results where the ratio of non-performing loans (NPL) to total assets is the dependent variable and is used as a proxy for portfolio risk. In the first column where market power is measured by the Lerner index, the coefficient of linear term and squared term are positive and statistically significant. Then there exists a significant and positive relationship between market structure and credit portfolio risk.

In the second and third column the signs of the coefficients of HHI of linear term are different from those of squared terms. So it was necessary to calculate the inflection points to clarify the nature of the relationship between market power and risk. For HHI deposits, the coefficient of linear term is negative and statistically significant, whereas the sign of the coefficient of squared term is positive and statistically significant. The calculation of the inflection point of the function to the square allowed us to determine the type of relationship. Indeed, we found an inflection point equal to 0.12 implying that 88% of the values of the HHI deposits are located below this point which allows us to conclude that a positive relationship is established between market structure and credit risk. The result for the HHI credit shows that the level of banks

power in the credit market has an effect on the amount of non-performing loans given that 82% of values are below the inflection point which is equal to 0,14.

Table 3 of appendix presents the results concerning the relationship between market structure and the Z-index used as proxy to the overall risk of the bank. The inflection point calculated for the Lerner index leads us to conclude that all values are above this point. It follows that there is no relationship, neither positive nor negative, between the market structure determined by the Lerner index and the level of risk. However, the relationship is positive and significant between market structure measured by the HHI deposits and the overall risk of the bank. The inflection point calculated from the square function allows us to conclude that almost 89% of the values of the HHI deposits are located below this point. The result for the HHI credits indicates that the relationship is significant between market structure and risk.

The results of the third model where the ratio of equity to total assets is the dependent variable figure in Table 4 of appendix. The first column shows the coefficients of the Lerner index which are positive and statistically significant. The inflection point is equal to -0.05 and lies below the values of the Lerner index. Therefore, a positive and significant relationship may exist between market structure and capitalization of banks.

The second column shows the coefficients of the HHI deposits where we observe a negative sign for the linear term and a positive sign for the squared term. In this case, it is not possible to determine what type of relationship is there between the market power and capitalization of banks. However, the calculation of inflection point allow we to conclude that the market structure presented by HHI deposits influence positively and significantly the capitalization and thereafter banking stability (94% of HHI values are below the inflection point that is equal to 0.13).

For the third index (HHI loans), its coefficients are not statistically significant, therefore no relationship, either positive or negative, can exist between market structure measured by HHI loans and capitalization of banks.

Regarding the control variables, our model includes three variables which are the logarithm of total assets to control the size of banks, the share of loans in total assets and the share of fixed assets to total assets for measuring the composition of the asset. The different results are presented in the tables above. First, we note that in most cases the variable measuring the size (BASI) has a negative sign and is statistically significant. Therefore, we can conclude that the large banks have fewer non-performing loans (NPL) than small banks. As a result, the portfolios of these banks are generally of good quality and are characterized by greater stability in spite of their low capitalization. This result confirms the argument "too big to fail" that a major bank has a low probability of bankruptcy. This is also verified by Claey's and Schoors (2007). Secondly, it was found that banks with a high ratio of loans to total assets are less capitalized and therefore more fragile. This implies that financial intermediation of banks is so strong that banks are more likely to take more risk. This relationship is found by Wheelock and Wilson (2000) for the United States, and Arena (2008) for Asia and the countries

of Latin America. Thirdly, the results indicate that the composition of the asset has a positive and significant effect on the behavior of banks in most cases.

Moreover, we note that the “legal rights” index is positively and significantly related to the fragility of banks presented by non-performing loans, and to bank capitalization. This result appears normal in the case of credits insofar as the increase in this index implies that the bankruptcy laws and safeguards are used to facilitate the granting of credits. But the increased volume of loans and guarantees may explain the high proportion of non-performing loans. For capitalization, an inverse relationship between the index and the level of capitalization could exist only in the case of countries where the business environment is robust with strong investor protection. In this case, banks are not required to hold capital levels very high (Allen N. Berger, Leora F. Klapper and Rima Turk-Ariss (2008). However, the positive relationship between the “legal rights” index and the ratio of equity in a country like Tunisia is expected that the business environment is too strong and investors are not heavily protected.

Regarding economic development measured by GDP per capita is negatively associated with bank fragility and positively associated with market capitalization.

Conclusion

The purpose of this paper was to analyze, in one hand, the theoretical foundations and explanations of the banking system fragility and secondly, the relationship between banking market structure and the fragility of banks in Tunisia. According to the theory, the fragility of banks is explained by several factors related to bank behaviour. Indeed, the market structure associated with information asymmetry in the banking sector is an important element in determining the behaviour of bank. Thus, a bank has market power behaves differently from that suffered competition from other banks. This difference in behaviour implies a difference in risk taking by the bank and therefore the level of fragility.

It should be noted that taking excessive risk exposes the bank at risk of bankruptcy and thereafter collapse of the banking system. The spread of bankruptcy due to the contagion effect that occurs when aggregate liquidity is insufficient, when market expectations create “externalities” and when the bankruptcy of a bank leads to a domino effect. The contagion is considered more serious in the banking system than in others since the banks are linked to each other because of interbank lending. Thus, risk-taking becomes more serious when it is started at a bank and later switching to the whole banking sector and even the financial sector; in other words, when the bank risk becomes a systemic risk.

The empirical part of this paper was to test the impact of market structure on the fragility of Tunisian banks during the period 1990-2012. The main conclusions show

that the Tunisian banking sector fragility and risk taking by banks are explained by market structure. This structure is determined in another work where we found that banks in Tunisia operate in monopolistic competition. Indeed, the Tunisian banking system suffers from fragility that reflects mainly the large share of nonperforming loans and whose principal cause the banking market structure.

The fragility of the banking system legitimizes government intervention via the definition of rules and regulatory measures. Indeed, given the risks posed to financial institutions throughout the economy and social costs of bank failure, supervision and regulation of credit institutions are determining factors in the stability of the banking system. The main objectives are then, the protection of customer and of the banking system of market failures. This may be the subject of a future work.

Appendix

Table 1 : Variables definitions

Variable	Definition
<i>Dependent variables:</i>	
NPL	The ratio of nonperforming loans to total loans; a higher value indicates a riskier loan portfolio. Source: APTBEF and BankScope, 2006.
Z-index	A proxy to the overall risk of the bank; a larger value indicates a higher bank stability and less overall bank risk Source: APTBEF and BankScope, 2006
E/TA	The ratio of capitalization: the ratio of equity to total assets; Source: APTBEF and BankScope, 2006
<i>Explanatory Variables:</i>	
Lerner Index	Indicator of bank competition, calculated as the average mark-up of price over marginal costs; higher values indicating less competition in the banking market Source: APTBEF and BankScope, 2006
HHI deposits	Indicator of bank concentration, measured by the Herfindahl-Hirschman Deposits Index; Higher values indicating greater market concentration. Source: APTBEF and BankScope, 2006
HHI loans	Indicator of bank concentration, measured by the Herfindahl-Hirschman Loans Index; Higher values indicating greater market concentration. Source: APTBEF and BankScope, 2006
Composition of assets (FATA, CRTA)	The ratio of loans to total assets (CRTA) and the ratio of fixed assets to total assets (FATA). There are used as bank controls variables. Source: APTBEF and BankScope, 2006
Bank size (BASI)	The log of total assets; used to control the size of bank Source: APTBEF and BankScope, 2006
LPIB	The log of GDP per capita, used to control changes in economic development. Source: BCT (Central Bank of Tunisia)
« Legal rights » index	An index measuring the degree to which collateral and bankruptcy laws facilitate lending. The index ranges from 0 to 10 with higher scores indicating that collateral and bankruptcy laws are better designed to expand access to credit. Source: «Doing Business 2010, Tunisia»: The World Bank/the International Finance Corporation. «Doing Business 2013»

Table 2: The effect of market power on the Nonperforming Loans (NPL)

Dependent Variable: Nonperforming Loans to Total Loans	Market Power Measure		
	Model (1) Lerner Index	Model (2) HHI Deposit	Model (3) HHI Loans
Degree of Market Power	1.142266 (8.929009)***	-273.2400 (-12.13678)***	25.35768 (1.687264)*
Degree of Market Power Squared	13.60016 (8.828456)***	1101.227 (11.92470)***	-86.91184 (-1.475870)
C	40.98677 (8.900717)	17.75981 (13.05285)	-0.775108 (-0.831032)
BASI	-1.677062 (-0.280469)	-5.380305 (-1.227160)	-30.50322 (-5.470223)***
LPIB	-25.14535 (-2.075902)**	-24.25920 (-2.478821)**	-3.461282 (-0.252532)
LRI	-0.045665 (-5.599406)***	0.017366 (5.423450)***	0.011425 (2.570003)**
FATA	10.96070 (6.595126)***	0.425870 (0.426035)	-0.312739 (-0.235038)
CRTA	-1.961905 (-3.232080)***	-1.411426 (-3.481620)***	0.684694 (1.324556)
R-squared	0.839630	0.883122	0.803588
Adjusted R-squared	0.833461	0.878627	0.796034
F-Statistic	136.1246	196.4538	106.3747
Probability	0.000000	0.000000	0.000000

*, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively.

Table 3: The effect of market power on the Z-index

Dependent Variable: Z-Index	Market Power Measure		
	Model (1) Lerner Index	Model (2) HHI Deposit	Model (3) HHI Loans
Degree of Market Power	-1.484222 (-22.33322)***	128.5618 (5.170905)***	27.44250 (2.281710)**
Degree of Market Power Squared	17.97645 (22.46265)***	-530.9877 (-5.206554)***	-119.9460 (-2.545178)**
C	-54.17580 (-22.64660)	-7.935313 (-5.281122)	-1.727598 (-2.314521)
BASI	-13.39066 (-4.310761)***	0.832499 (0.171939)	4.895112 (1.096945)
LPIB	37.47286 (5.955008)***	0.239582 (0.022168)	13.80369 (1.258453)
LRI	0.018142 (4.282068)***	-0.040424 (-11.43177)***	-0.033188 (-9.328607)***
FATA	-9.067216 (-10.50208)***	4.532496 (4.105832)***	3.448574 (3.238609)***
CRTA	4.256195 (13.49715)***	3.442675 (7.689792)***	2.337079 (5.649506)***
R-squared	0.910460	0.705104	0.739764
Adjusted R-squared	0.907016	0.693762	0.729755
F-Statistic	264.3729	62.16676	73.90919
Probability	0.000000	0.000000	0.000000

*, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively.

Table 4: The effect of market power on bank capitalization

Dependent Variable: Equity to Assets	Market Power Measure		
	Model (1) Lerner Index	Model (2) HHI Deposit	Model (3) HHI Loans
Degree of Market Power	0.137208 (10.61895)***	-24.55869 (-3.215706)***	2.697201 (0.538644)
Degree of Market Power Squared	1.313120 (8.439374)***	89.57380 (2.859324)***	-11.28878 (-0.575349)
C	6.074871 (13.06121)	4.994967 (10.82209)	3.199814 (10.29663)
BASI	5.618876 (4.592654)***	-5.739457 (-1.728826)*	-0.795109 (-0.174109)
LPIB	0.006262 (7.602001)***	0.035134 (32.34588)***	0.033663 (22.72709)***
LRI	0.929209 (5.535584)***	-0.853550 (-2.517151)**	-1.292378 (-2.915148)***
FATA	5.618876 (4.592654)***	-5.739457 (-1.728826)*	-0.795109 (-0.174109)
CRTA	0.004020 (0.065568)	1.437274 (10.45141)***	1.961087 (11.38639)***
R-squared	0.997815	0.982037	0.970879
Adjusted R-squared	0.997731	0.981346	0.969759
F-Statistic	11872.91	1421.410	866.8185
Probability	0.000000	0.000000	0.000000

*, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively.

NOTES

¹ APTBEF: Tunisian Professional Association of Banks and Financial Institutions

² An index measuring the degree to which collateral and bankruptcy laws facilitate lending. The index ranges from 0 to 10 with higher scores indicating that collateral and bankruptcy laws are better designed to expand access to credit.

³ All these variables are presented in Table 1 of Appendix.

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