

Review Paper

Validation Panzar-Rosse Model in determining the structural characteristics of Tunisian banking industry

Raoudha Abbes Hamza

Department of Economics, Unit of Money, Development and Infrastructure Research, University of Economics and Management, Sfax, Tunisia. E-mail: rawdha.hamza@gmail.com, raoudha.abbes@yahoo.fr.

Accepted December 13, 2010

This paper investigates the market structure of banking industry in Tunisia and evaluates the degree of competition. The current analysis employs a widely used non-structural methodology put forward by Panzar and Rosse (1987), the so-called H-statistic, and draws upon a comprehensive panel dataset of Tunisian banks covering the period 1999 to 2008. The estimated H statistics for the whole sample periods are positive (0.67 and 0.71) and the Wald test for the market structure of monopoly or perfect competition is rejected, implying that the banks in Tunisia earned their revenue in the condition of monopolistic competition.

Key words: Market structure, competition, concentration, Panzar and Rosse methodology.

INTRODUCTION

Competition has become a recurrent topic in the banking literature. Specifically, during the two last decades, a great deal of empirical work has attempted to measure the level of competition. This reflects the various changes that knew operating environment of the banking sector in many countries, including Tunisia. The Tunisian banking environment has experienced many changes and restructuring programs and modernization that the objective was to enable the Tunisian banks to consolidate their financials base, clean up their portfolios of non-performing loans, and increase their levels efficiency. The goal was to align with the requirements of a financial landscape increasingly liberalized. These changes could have various effects on competitive conditions in the sector.

Generally, competition could lower financial intermediation costs and contribute to improvements in economic efficiency. However, since it may also reduce market power and profitability of banks, it could weaken their ability to withstand adverse developments. It is important for policymakers to know the extent of competition in the sector and how it has evolved over time to this end, several research works have attempted to measure the degree of competition between banks using different methods. Indeed, the literature assessing

competition in the banking sector is divided into two types of research: (1) studies that adopt a structural approach and (2) studies that adopt non-structural approach. The structural method has its roots in the theory of industrial organization that measures competitiveness following the Structure-Conduct-Performance (SCP) paradigm and the alternative efficiency hypothesis (EH). The non-structural model of competitive behaviour has been developed within the emerging New Empirical Industrial Organization (NEIO) framework. In our paper, we employ one of the "Non-Structural Model" approach suggested by Rosse and Panzar (1977) and Panzar and Rosse (1982, 1987).

This method has been used by several authors to determine the structure of the banking market in some countries. In Tunisia, Haffani (2002) examined the market structure of Tunisian's banking sector during the period 1980 to 1999, by using the Panzar-Rosse assessment. This study of competition shows that throughout this period, the Tunisian banking market has been characterized by a monopolistic structure, but the indicator of competition has steadily increased since. Similarly, Mensi (2009) examined the degree of competition in the Tunisian banking sector over the period 1990 to 2005. He confirmed the results found by Haffani for this period. Our result, in this paper, confirms these two studies on the Tunisian banks. Indeed, we found H-statistics positive ranging from 0.67 to 0.71 over the period 1999 to 2008,

which confirms the assumption of monopolistic competition that characterizes the Tunisian banking market.

The remainder of this paper is structured as follows. A brief review of literature on the determinants of bank competition is presented first, followed by a brief survey of the literature on the Panzar-Rosse methodology. Next, the empirical model employed in the analysis is presented. Afterwards, estimation results are reported and finally, a brief summary is offered. Above all, it should give an overview on the situation of the Tunisian banking system.

BANKING INDUSTRY IN TUNISIA

The creation of the Tunisian banking system dates back to 1958 when the Central Bank was created in addition to two public institutions. Since then, the government took over management of the banking sector. The latter has been since 1996, a major program of restructuring, of strengthening of financial base and of modernization. This structural reform is part of a strategic direction of the country, usually focused on enhancing growth and monetary stability and in particular on the emergence of a new banking landscape which will be marked by a rationalization of a number of institutions and an increase of their size while taking into account the specificities of the Tunisian banks. The Tunisian banking sector is relatively developed and covers the entire territory. It includes the Central Bank, commercial banks, development banks, which were intended to provide initial capital to start-ups (which recently became mixed banks), investment banks and offshore banks as well as specialized financial institutions. Commercial banks are characterized by an extensive network, for development banks, their role as commercial banks is not yet well developed because, it is only recently that they had had the approval to operate as a universal bank.

To better understand the evaluation of the Tunisian banking system, we will choose two significant periods. The first period is before the introduction of the Structural Adjustment Programme (PAS) from 1970 to 1985. The second is the implementation of Structural Adjustment Program and the current situation from 1986 up to now.

Tunisian banking system before the reforms (1970-1986)

During this period, the Tunisian financial system suffered from a series of malfunctions. The predominance of government and financial policy repression of the monetary authorities have led to inefficient methods of financing. In addition, this period was characterized by limited development of banking supervision and prudential regulation because of the direct control of central bank of credit allocation. These inefficiencies contribute to the accumulation of nonperforming loans in many

banks. Indeed, imprudent investments with monetary laxity, pushed banks to engage in certain projects with doubtful profitability. Having accumulated large debts, some of these banks have become reluctant in granting new loans. As for competition, it remained low, given the high concentration of loans and deposits and the segmentation of the banking activity. Banks have also been isolated from foreign competition because of severe restrictions on current transactions. Capital flows were tightly regulated and foreign investments have been limited and subject to authorities approval. Slack money market has put the commercial banks face a liquidity problem pushing them to refinance with the central bank.

Tunisian banking system after the reforms

The liberalization of financial sector implemented under the Structural Adjustment Plan aimed at establishing a market economy. The restructuring of the commercial banking system began in 1987, and was intended to push banks to be more competitive and allow banks to become more responsible and capable of making their own credit decisions. The reforms were designed to mobilize savings and provide a more efficient allocation of resources. The main measures were the abolition of credit restrictions and a new policy to refinance through the liberalization of interest rates and the establishment of a new policy of reserve requirements. Tunisian banks experienced following these reforms, a steady and relatively large growth of their activity with a volume of credits granted. The expansion of the banking industry seems to focus more on the traditional activities of gathering deposits and lending.

The average net results have also recorded increases quite irregular in the early 80's but seem at the end of this decade to become notable. As for change in the rate of profitability concerning the average return on assets, there is relative stability. Regarding the level of competition, its improvement between banks has led to a change in the structure of their resources through the search for increased revenues associated with non-traditional activities. Despite the changes marked by the Tunisian banking system, it suffers from certain difficulties which can be attributed mainly to:

1. A competitive environment increasingly hard causing financial hardship for small businesses in particular. This helps to increase the risk of re-emergence of bad debts.
2. Owned banks have stakes in public companies or semi-public, to which they give loans which does not guarantee the efficient allocation of savings to productive investments.

In summary, referring to reports of the IMF and World Bank that we can meet the Tunisian banking sector suffers mainly from the high amount of bad loans, the amount of insufficient supplies, weakness in the

profitability of banks and finally to a lack of control and system supervision. The effect of competition between banks is important here, because its improvement may push the Tunisian banks to accept risky clients which affects their profitability and efficiency, hence the need to control the level of this competition.

DETERMINANTS OF BANK COMPETITION: THEORY

The market conditions in the banking industry deserve particular attention for many reasons (Bikker and Haaf (2001)). The soundness and stability of the financial sector may be influenced by the degree of competition and concentration. From a theoretical point of view, sound competition in the banking market is of great economic importance because it lowers prices and improves quality, thereby contributing to the prosperity of consumers and companies alike. The degree of competition in the financial sector can influence the efficiency of the production of financial services (Jiménez et al., 2007). Increased competition in the financial sector to lead to lower costs and enhanced efficiency, even where financial products are hetero-geneous. Furthermore, competition can matter for the quality of financial products and the degree of innovation in the sector. It fosters innovative behaviour, forces banks to improve their efficiency, thus promoting the access of households and firms to financial services and external finance, and thereby enhancing economic growth. Moreover, the strong links between market structure, particularly competition, and efficiency involves that the higher the degree of competition in the banking sector, the higher its efficiency in terms of allocating funds and in general operating as an inter-mediator between lenders and borrowers (De Nicolò and Loukoianova, 2007).

Besides efficiency, competition between banks can influence stability of sector (Carletti and Hartmann (2002)). The link between competition and financial stability has been recognized in theoretical and empirical research, as well as in the conduct of prudential policy with respect to banks. Indeed, competition affects the stability of the sector in the sense of either fragility or excessive risk taking (Geraldine and Weill (2008)). The relationship between competition and financial fragility has been largely ignored in the banking literature. A few models address directly the relationship between competition and liability risk. In theory, competition may have a deleterious impact on stability, if it causes banks' charter value to drop, thus reducing the incentives for prudent risk-taking behaviour. Some experiences have argued that, excessive competition has been one of the factors contributing to the financial crises.

Finally, competition may have an impact on the effectiveness of monetary policy. It improves the monetary transmission of policy rates to bank market rates. Some authors argue that the concentration of the banking and

health are essential to the analysis of the effectiveness of monetary policy like Kashyap and Stein (1997) and Cecchetti (1999).

The literature assessing competition in the banking sector is divided into two types of research: (1) studies that adopt a structural approach and (2) studies that adopt a non-structural approach.

The structural method has its roots in the theory of industrial organization that measures competitiveness following the Structure-Conduct-Performance (SCP) paradigm and the alternative efficiency hypothesis (EH). The SCP paradigm, having its origin in the work of Bain (1951), uses concentration as a proxy for market structure; it investigates whether high levels of market concentration lead collusive behaviour and other non-competitive practices among larger firms. According to the SCP hypothesis, all banks respond similarly to an increase in market concentration by strengthening their collusive behaviour (Franklin and Gale D (2004)).

On the other hand, the EH, which stems from Demsetz (1973) and Peltzman (1977) postulates that, the most efficient firms increase in size and therefore, in market share at the cost of less efficient banks because of their ability to generate higher profits, leading to higher market concentration.

However, various researches suggest that, the number of banks and the concentration index are not sufficient to assess the degree of competition.

In reaction to the shortcomings attributed to the structural stream, three non-structural models of competitive behaviour have been developed within the emerging New Empirical Industrial Organization (NEIO) framework.

The model by Iwata (1974), Bresnahan (1982) and Lau (1982), allow for the estimation of the degree of competition using aggregate industry data and the methodology of Panzar and Rosse (1987) which employs bank-level data.

These models have an important feature in common, they measure competition by estimating deviation from competitive pricing.

These models differ in some aspects; the Iwata model consists in the estimation of conjectural variation values for individual firms supplying a homogeneous product in an oligopolistic market; Bresnahan and Lau estimate demand, supply and price equations simultaneously, for Panzar and Rosse, their methodology allows for bank-specific differences in production functions, provided that banks are examined under long-run equilibrium.

In this paper, we employ one of the "Non-Structural Model" approach suggested by Rosse and Panzar (1977) and Panzar and Rosse (1982, 1987), so called H-statistic, which has been widely employed for the examination of the competitive structure of the banking industry in various countries, in order to investigate the market structure of Tunisian banking industry during the periods of 1999 to 2008.

Table 1. Interpreting the Panzar-Rosse H-statistic.

H statistics	Competitive environment test
H=0	Monopoly equilibrium Perfect colluding oligopoly Conjectural variations short-run oligopoly
$0 < H < 1$	Monopolistic competition free entry equilibrium
H=1	Perfect competition Natural monopoly in a perfectly contestable market Sales maximizing firms subject to breakeven constraints
E statistics	Equilibrium test
E<0	Disequilibrium
E=0	Equilibrium

Source: Rosse and Panzar (1977), Panzar and Rosse (1982, 1987), Shaffer (1982, 1983), Nathan and Neave (1989), Molyneux et al. (1994), Hondroyiannis et al. (1999), etc.

EMPIRICAL APPROACH

The Panzar-Rosse model

John and Panzar and James and Rosse developed an empirical test, to discriminate between oligopolistic, monopolistically competitive and perfectly competitive markets. The Panzar-Rosse (P-R) approach for testing market power relies on the premise that, banks will employ different pricing strategies in response to change in input costs, depending on the market structure in which they operate. The P-R model uses bank-level data and measures how a change in factor input prices is reflected in equilibrium revenues earned by banks; it offers a direct measure of banking competitiveness, called the H-statistic. This statistic is calculated from a reduced-form bank revenue equation and measures the elasticity of total revenues with respect to factor input prices (Gutiérrez de, 2007).

Market power is measured by the extent to which changes in factor prices are reflected in revenues ((Murjan and Ruza, 2002). In this regard, there are three situations. First, in a situation of perfect competition and when banks operate at their long run equilibrium, a proportional increase in factor prices induces an equiproportional change in gross revenues. In other words, marginal costs and total revenues will increase proportionally to input prices. Second, in a situation of monopoly, however, an increase in factor input prices will raise marginal costs but reduce output and hence total revenues.

Finally, under monopolistic competition, revenues will increase less than proportionally, as the demand for banking products facing individual banks is inelastic. The value of H varies from one situation to another. Indeed, the Panzar-Rosse H statistic is interpreted as follows. $H < 0$ indicates a situation of monopoly; $H = 1$ indicates perfect competition; and $0 < H < 1$ indicates monopolistic competition. Nathan and Neave (1989) stated that, this interpretation assumes that, the test is performed based on observations that are long-run equilibrium. In equilibrium, risk-adjusted rates of returns are equalized across banks and both returns on assets (ROA) and returns on equity (ROE) are uncorrelated with input prices. We test so, whether the observations are in long-run equilibrium. This involves estimating a parameter E, where $E = 0$ indicates equilibrium and $E < 0$ indicates disequilibrium. Table 1 summarises these hypothesis.

Applying the Panzar and Rosse technique to evaluate banks' market conduct requires various assumptions about banks' production activity. The first assumption involves that the extension of the Panzar and Rosse methodology to the banking industry requires to assume that banks are treated as single product firms, producing intermediation services by using labour, physical capital, and financial capital as inputs. In Tunisia, the main function of the banking system consists of intermediation between savings and credit because the Tunisian economy is an economy of debt and the main source of funding is the banking system. The second assumption means that one assumes that, higher input prices are not associated with higher quality services that generate higher revenues because such a correlation may bias the computed H statistic (Molyneux et al., 1996). Moreover, other assumptions can be added: (a) banks are profit maximization firms; (b) the performance of these banks needs to be influenced by the actions of other market participants; (c) cost structure is homogenous; and (d) the price elasticity of demand is greater than unity.

Studies using the Panzar and Rosse methodology in banking

Several empirical studies have used the method of Panzar and Rosse to assess the *degree* of competition in some banking markets. The following table summarizes a few of these studies (Table 2).

EMPIRICAL MODEL AND DATABASE

For our analysis, we have used a similar model to that used by Bikker et al. (2006) as a number of the explanatory variables that are used, reflect the bank's behaviour and risk profile that may affect revenues. To derive the H statistic we use the following specification of the reduced-form revenue equation estimated, to run on a panel data set of banks.

Empirical models

Competitive environment test I

The reduced form revenue equation that we will use is:

Table 2. Summary of principal studies adopting the Panzar-Rosse model.

Authors	Countries	Years	Results
Shaffer (1982)	USA	1979	MC
Nathan and Neave (1991)	Canada	1982-1984	PC : 1982 MC : 1983-1984
Liyod-williams et al. (1991)	Japan	1986-1988	M
Molyneux et al. (1994)	Germany, UK, France, Italy and Spain	1986-1989	M: Italy MC: UK, France and Spain MC : Germany except 1987
Rime (1999)	Switzerland	1987-1994	MC
Hondroyiannis et al. (1999)	Greece	1993-1995	MC
Bikker and Groenveld (2000)	15 European countries	1989-1996	MC : except Belgium and Greece
De Bandt and Davis (2000)	France, Germany and Italy	1992-1996	MC: Italy M: France and Germany
Smith and Tripe (2001)	New Zealand	1996-1999	MC
Haffani (2002)	Tunisia	1980-1999	M (indicator of competition has steadily increased since 1987)
Belaisch (2003)	Brazil	1997-2000	MC: except foreign banks
Jiang et al. (2004)	Hong Kong	1992-2002	PC
Lee and Lee (2005)	Korea	1992-2002	MC
Yildirim and Philippatos (2005)	15 countries of Latin America	1993-2000	MC
Bikker et al. (2006)	101 countries	1987-2004	M: for 28% of countries PC: for 38%
Al-Mouharrami et al. (2006)	Arab countries GCC	1993-2002	PC: Kuwait, Saudi Arabia and the union of the emirates MC: Bahrain and Qatar , M: Oman
Turk-Ariss (2008)	12countries of MENA	2000-2006	MC: Countries of North Africa M: Other Countries

PC: Perfect Competition, MC: Monopolistic Competition, M: monopoly.

Table 3. List of Banks

Public bank	
BNA	Banque Nationale Agricole
STB	Société Tunisienne de Banque
BS	Banque du Sud
UIB	Union Internationale des Banques
BH	Banque de l'Habitat
Private bank	
BIAT	Banque Internationale Arabe de Tunisie
BT	Banque de Tunisie
AB	Amen Bank
Foreign bank	
ATB	Arab Tunisian Bank.
BFT	Banque Franco Tunisienne
CITY BANK	City Bank
UBCI	Union Bancaire pour le Commerce et l'Industrie

$$\ln(RI) = a + b \ln(PF) + c \ln(PL) + d \ln(PK) + e \ln(SCALE) + f \ln(CAPAST) + g \ln(BR) + \varepsilon \quad (1)$$

The dependent variable, in Equation 1, RI, is the ratio of Interest Income to Total Assets. Regarding the factor input prices, PF stands for annual funding rate, PL denotes price of personnel expenses and PK is the price of physical capital expenditure. We cannot observe the three input prices directly and thus use proxies instead. Interest expenses to total funds is a proxy for the average funding rate, the ratio of annual personnel expenses to total assets is an approximation of the price of personnel expenses, and the ratio of general operating expenses to total assets serves as a proxy for the price of capital expenditure. The other covariates serve as correction variables. The ratio of customer loans to total assets (BR) Represents credit risk. SCALE equals the ratio of total assets of bank to total assets of banks surveyed. The ratio of capital to total assets (CAPAST) is used to account for the leverage reflecting differences in the risk appetite across banks. Finally, ε is dummy variables. We take natural logarithms of all variables. We estimate model (1) both using OLS with time dummies and GLS with fixed bank-specific effects. The H-statistic then equals $b + c + d$. We test whether $H = 1$ and whether $H = 0$ using F-test. In what follows, we refer to H1 as the H-statistic based on model (1). For robustness, we estimate the following alternative reduced revenue equations:

$$\ln(RT) = a + b \ln(PF) + c \ln(PL) + d \ln(PK) + e \ln(SCALE) + f \ln(CAPAST) + g \ln(BR) + \varepsilon \quad (2)$$

Where, RT is the ratio of total revenue to total assets. This dependent variable now includes non-interest revenues. The H-statistic equals $b + c + d$. We test again whether $H = 1$ and whether $H = 0$ (F-tests). In what follows we refer to H2 as the H-statistic based on model (2).

Equilibrium test I

The PR-model is only valid if the market is in equilibrium. The test

for long-run equilibrium will be performed with the following equations:

$$\ln(1 + ROA) = a + b \ln(PF) + c \ln(PL) + d \ln(PK) + e \ln(SCALE) + f \ln(CAPAST) + g \ln(BR) + \varepsilon \quad (3)$$

$$\ln(1 + ROE) = a + b \ln(PF) + c \ln(PL) + d \ln(PK) + e \ln(SCALE) + f \ln(CAPAST) + g \ln(BR) + \varepsilon \quad (4)$$

Following Claessans and Laeven (2004) and Casu and Giradone (2006) the measure of ROA (respectively ROE) is actually calculated as $\ln(1+ROA)$ (respectively $\ln(1+ROE)$) to adjust for (small) negative values of ROA and ROE. We define the equilibrium E-statistic as $b + c + d$. We test whether $E = 0$, again using an F-test. If rejected, the market is assumed not to be in equilibrium. In what follows we refer to E1 as the E-statistic based on model (3) and to E2 as the E-statistic based on model (4).

Database

The main database employed in this study is the information contained in balance sheets and income statements reported by Tunisian banks and APTBEF over the period beginning in 1999 and ending in 2008. The data are annual observations of 8 domestic and 4 foreign banks operating in Tunisia (Table 3).

RESULTS

In order for the test results to be valid, the banking industry should be in the long run equilibrium during the period of test. The equilibrium in the banking industry is examined by estimating the equations with ROA and ROE as dependent variables. The results of this estimation are presented in Tables 3 and 4 of appendix. The Wald test does not reject the null hypothesis $H=0$,

Table 4. Equilibrium test (1+ROA).

	OLS Estimation		GLS Estimation	
	Coefficient	T-student	Coefficient	T-student
C	-0.020678	-3.563141***	-0.020678	-3.563141***
Ln PF	0.002674	6.199548***	0.002674	6.199548***
Ln PL	-0.004917	-15.96302***	-0.004917	-15.96302***
Ln PK	-0.004386	-8.961243***	-0.004386	-8.961243***
Ln SCALE	0.002343	5.417955***	0.002343	5.417955***
Ln CAPAST	0.002453	12.93133***	0.002453	12.93133***
Ln BR	0.005117	12.79578***	0.005117	12.79578***
Ln AG	-0.004780	-10.27226***	-0.004780	-10.27226***
R-squared	0.964936		0.964936	
Adjusted R-squared	0.962744		0.962744	
H=0	F.statistic	76.94510		
	P.value	0.000000		

E1 = 0.002674 - 0.004917 - 0.004386 = -0.0066 = 0. Notes: * significant at 10%; ** significant at 5%; *** significant at 1%.

leading us to conclude that the Tunisian banking industry was in the long-run equilibrium over the period 1999 to 2008. We can therefore interpret our estimates of H-statistic. Overall, the estimated H-statistic is positive and significant in all cases, regardless of the dependent variable we use (interest income or total income), discarding the hypothesis of monopoly or oligopoly in the short term. At the same time, it is clearly less than unity, rejecting the assumption of perfect competition. Therefore, our data indicate the existence of a certain degree of monopolistic competition in the Tunisian banking sector, which is consistent with the results of most previous studies using the same method. Table 1 of appendix presents the results of the Panzar and Rosse H-statistic, using the interest income as dependant variable.

The Wald test in this table rejects the hypothesis for the market structure of monopoly or perfect competition at the 1, 5 and 10% significance levels; this allows us to conclude that total bank revenues appear to be earned in conditions of monopolistic competition. Consequently, any form of conjectural variation oligopoly and monopoly can be rejected during the period 1999 to 2008. Indeed, H-statistic of 0.715 would suggest that the banking industry in Tunisia operates in monopolistic competitive environment during the sample period. Examining some of the explanatory variables, we remark that the physical capital expenses (PK) variable is negative in relation to interest revenue. Other three variables have a negative sign and they are statistically significant: SCALE, CAPAST and BR. The negative sign implies a negative relationship between these variables and interest income. Both of price of funds (PF) and price of labour (PL) variables have the positive signs, meaning the increased factor costs leading to the higher revenue. All variables PL, PF and PK are statistically significant: these three

variables contribute to the H-statistic. The result of the second equation, using the total income as dependant variable is presented in Table 2 of appendix. The Wald test and the value of H- statistic confirm that Tunisian banks operate in monopolistic competitive environment. This test rejects both hypothesis for the market structure: monopoly and perfect competition. For the H-statistic, its value of 0.67 proves the monopolistic competitive structure of the Tunisian banking market. Investigating the input price variables, we note that the physical capital expenses and the price of funds variables are positive in relation to total revenue; whereas the personnel expenses variable has a negative sign.

Indeed, monopolistic competition is defined as a market structure that combines the attributes of monopoly (market power, each supplier is able to specify its product) and competition (large number of suppliers of similar products). This definition allows us to confirm the mutations occurred in the Tunisian banking system, since its structure has risen from monopoly in the 80s to monopolistic competition. This transition from one structure to another is the result of efforts of Tunisian authorities on improving competition, in order to push banks to become more profitable and reduce non-per-forming loans. But the change in the competition must be controlled, since a high level pushes banks to accept risky clients and a low level does not encourage banks to improve their services and gain more market share. Therefore, it is essential to measure the degree of competition in different markets, in particular the banking market through its role in the economy.

Conclusion

Using a measure for banking competition obtained from

Table 5. Equilibrium test (1+ROE).

	OLS Estimation		GLS Estimation	
	Coefficient	T-student	Coefficient	T-student
C	1.036271	13.07431***	1.036271	13.07431***
Ln PF	-0.008232	-1.397587	-0.008232	-1.397587
Ln PL	-0.047187	-11.21542***	-0.047187	-11.21542***
Ln PK	0.089022	13.31647***	0.089022	13.31647***
Ln SCALE	0.028562	4.835119***	0.028562	4.835119***
Ln CAPAST	-0.010901	-4.206998***	-0.010901	-4.206998***
Ln BR	-0.085311	-15.61847***	-0.085311	-15.61847***
Ln AG	0.054194	8.527493***	0.054194	8.527493***
R-squared	0.971045		0.971045	
Adjusted R-squared	0.969235		0.969235	
F.statistic	153.6962			
H=0 P.value	0.000000			

$E3 = -0.008232 - 0.047187 + 0.089022 = 0,033603 = 0$. Notes: * significant at 10%; ** significant at 5%; *** significant at 1%.

the Panzar-Rosse model, this paper aims to explain competition in the Tunisian banking industry. Several empirical studies have emphasized that, indicators of market structure such as the number of bank and concentration, did not significantly affect on the degree of competition. It was necessary to find other methods to assess banking competition. According to the theoretical and empirical literature, the method of Panzar and Rosse (1987) is far the most used and most effective for determination the nature of banking market structure.

The low number of studies on the structure of Tunisian banking market has led us to develop this work using the model of Panzar and Rosse. The current study aimed to evaluate the market structure of Tunisian banks and got the same result found in two studies mentioned earlier. Indeed, according to the first model where we have used the interest revenue as the dependent variable, we found a H-statistic positive and less than 1. This result implies that banks in Tunisia earned their revenue in the condition of monopolistic competition. For robustness of the results, we used a second model where total income is the dependant variable. We also found a positive value of H and less than 1, implying that the structure of the Tunisian banking market is characterized by monopolistic competition. Since the Panzar-Rosse methodology requires that banks are in a long-run equilibrium, we tested two models where ROA and ROE are the dependent variables. Estimation of these models shows that Tunisian banks are in equilibrium.

The result of the present work confirms most of the results found by other studies where most banking sectors operate in a monopolistic competition (Table 2). The effort of the Tunisian authorities on the promotion of competition has helped change the banking market structure from monopoly to monopolistic competition. Indeed, before the late 80s, the Tunisian banking system

was dominated by a few banks that had monopoly power in the market but after the 1987 reform, we felt a change in the structure of the banking market, where competition among banks has played a fundamental role. This transition from a monopolistic structure to a monopolistic competition structure is verified by studies of Haffani (2002) and Mensi (2009) and this present work.

REFERENCES

- Bikker JA, Haaf K (2001). «Measures of competition and concentration: a review of the literature», De Nederlandsche Bank, Amsterdam.
- Bikker JA, Spierdijk L, Finnic P (2006). The impact of market structure, contestability and institutional environment on banking competition » Tjalling C. Koopmans Research Institute, Discussion Paper Series 07-29 December.
- Bresnahan TF (1982). The oligopoly solution concept is identified », *Econ. Lett.*, 10 : 87-92.
- Carletti E, Hartmann P (2002). Competition and stability: what's special about banking? », Working Paper, p. 146.
- De Bandt O, Davis EP (2000). A cross-country comparison of market structures in European Banking, Working Paper, p. 7.
- De Nicolò G, Loukoianova E (2007). Bank ownership, market Structure and risk , IMF Working Paper, WP/07/215.
- Franklin F, Gale D (2004). Competition and financial stability. *J. Money. Credit. Bank.*, 36(3) : 453-480.
- Geraldine B, Weill L (2008). The effects of concentration on competition and efficiency: some evidence from the French audit market», *Large, Papier*, p. 04.
- Gutiérrez de RL (2007). Testing for competition in the Spanish banking industry: the Panzar-Rosse approach revisited, *Documentos de Trabajo*. p. 0726.
- Jiménez G, Lopez JA, Saurina J (2007). How does competition impact bank risk-taking Working Paper, p.23,
- Mensi S (2009). Measurement of competitiveness degree in Tunisian deposit banks: An application of the Panzar and Rosse model, *PANOECONOMICUS*, 2: 189-207.
- Molyneux P, Thornton J, Lloyd-Williams DM (1996). Competition and market contestability in Japanese commercial banking ». *J. Econ. Bus.*, 48: 33-45.
- Murjan W, Ruza C (2002). The competitive nature of the Arab Middle Eastern banking markets» *IAER*: 8: 4.

Nathan A, Neave E (1989). Competition and contestability in Canada's financial system: Empirical Results. *Canadian J. Econ.*, 22(3): 576-594.

Panzar J, Rosse J (1987). Testing for 'monopoly' equilibrium. *J. Ind. Econ.*, 35(4): 443-456.

Rime B (1999). Mesure de degré de concurrence dans le système bancaire Suisse à l'aide du modèle de Panzar et Rosse. *Revue suisse d'économie politique et de statistique*, 135(1): 21-40.

Turk-Ariss R (2008). Competitive behaviour in Middle East and North Africa banking systems, *The Quarterly Review of Economics and Finance* (2009), 49: 693–710.

APPENDIX

Table 1. Competitive environment test (Interest Income).

		OLS Estimation		GLS Estimation	
		Coefficient	T-student	Coefficient	T-student
C		3.909812	4.862532***	3.909812	4.862532***
Ln PF		0.468105	13.07472***	0.468105	13.07472***
Ln PL		0.345058	5.084768***	0.345058	5.084768***
Ln PK		-0.098144	-10.97173***	-0.098144	-10.97173***
Ln SCALE		-1.941133	-32.39125***	-1.941133	-32.39125***
Ln CAPAST		-1.121531	-42.66746***	-1.121531	-42.66746***
Ln BR		-1.346736	-24.30389***	-1.346736	-24.30389***
Ln AG		1.950355	30.25118***	1.950355	30.25118***
R-squared		0.978424		0.978424	
Adjusted R-squared		0.977075		0.977075	
H=0	F.statistic	305.7678			
	P.value	0.0000			
H=1	F.statistic	62.99786			
	P. value	0.0000			

H1= 0.468105 + 0.345058 - 0.098144= 0,715019. Notes: * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2. Competitive environment test (total income).

		OLS Estimation		GLS Estimation	
		Coefficient	T-student	Coefficient	T-student
C		6.612800	21.18660***	6.612800	21.18660***
Ln PF		0.120316	5.186874***	0.120316	5.186874***
Ln PL		-0.598994	-36.15328***	-0.598994	-36.15328***
Ln PK		1.149677	43.67145***	1.149677	43.67145***
Ln SCALE		-0.731757	-31.45638***	-0.731757	-31.45638***
Ln CAPAST		-0.116278	-11.39596***	-0.116278	-11.39596***
Ln BR		-0.803905	-37.37382***	-0.803905	-37.37382***
Ln AG		1.127335	45.04548***	1.127335	45.04548***
R-squared		0.998482		0.998482	
Adjusted R-squared		0.998387		0.998387	
H=0	F.statistic	1604.580			
	P.value	0.000000			
H=1	F.statistic	238.9312			
	P. value	0.000000			

H2= 0.120316 - 0.598994 + 1.149677 = 0,670999. Notes: *significant at 10%; ** significant at 5%; *** significant at 1%.