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Measurement of Competitiveness Degree in Tunisian Deposit Banks: An Application of the Panzar and Rosse Model

Summary: This paper explores the use of the Panzar-Rosse statistic as a basis for empirical assessment of competitive conditions among Tunisian deposit banks. The elaborated model has been tested with an interest revenues equation and a total revenues equation. Proceeding by means of an Ordinary Least Square analysis, the H-statistics is respectively estimated at 0.87 and 0.91. The computations undertaken using bank fixed effects and bank random effects General Least Square methods yield similar results. With reference to the reviewed literature, we are inclined to believe that Tunisian banks implement neither a joint monopoly nor a collusive competition context, and that they evolve within an oligopolistic competition context in a contestable market. Thus, it confirms the presence of a competitive environment.

Key words: Tunisia, Banking competition, Contestability, Panzar-Rosse statistic, Panel data.

JEL: D21, D41, G21, L13.

Economics literature concerned with the problem of competitiveness measurement is divided into two types of studies: those that adopt a structural or informal approach and those that privilege a non-structural or a formal approach.

The structural approach focuses on the parameters of Structure-Conduct-Performance (SCP). The SCP hypothesis causally relates market structure and prices fixing behaviour. The SCP model has two hypotheses: the first assumes that market structure affects conduct, while the second hypothesis stipulates that it is the conduct which influences performance. The implications of these two hypotheses lead us to suspect that banking industry concentration may generate a market power allowing banks an opportunity to reduce interest rates over deposits and to favour interest rates over loans, internally yielding monopolistic profits.

The non-structural approach is characterized by the frequent use of two techniques that allow for the measurement of degree of competitiveness. The first technique is developed by Timothy F. Bresnahan (1982) and Lawrence J. Lau (1982), the second is developed by John C. Panzar and James N. Rosse (1987). The Bresnahan's model is a general market equilibrium model. The model is based on maximising firms' profits at equilibrium. The prices and quantities are determined according to

the marginal costs equal marginal revenue rule, an aspect that coincides with price demand under pure and perfect competition, or coincides with marginal revenue under monopoly.

The procedure suggested by Bresnahan (1982) and Lau (1982) needs an estimation of a model based on simultaneous equations over industry-driven data. A parameter representing the degree of market power is included. Empirical implementation of this technique is found throughout a number of studies, of which we mention Sherrill Shaffer (1993). The second technique is that of Panzar and Rosse (1987); it is based on the "*H*-statistic". The PR method examines the relationship between price variations and the revenue of a specific bank.

This paper is organized as follows. Section 1 introduces the Panzar-Rosse theory and presents the advantages of their *H*-statistic. Section 2 surveys the literature on competitive conditions using PR methodology. Section 3 presents the context of the Tunisian Banking industry. Section 4 provides the empirical analysis. Section 5 draws conclusions of the analysis.

1. The Theory of Panzar and Rosse

The Panzar and Rosse model (1987) is the first technique issued on the new theory of industrial organization and applied to the case of banks. Panzar and Rosse obtained measurements of market power, as well as competition conditions in a sector, by studying the impact of variations in production factors prices over revenues of the sector's entities. The Panzar and Rosse's approach is based on the idea that banks employ different strategies based upon the price, in response to changes in input costs of the market structure in which they operate.

In order to measure competitiveness of the banking industry, Panzar and Rosse (1987) define the competitiveness *H* measure as the sum of the elasticities of the reduced form bank revenue equations with respect to the bank's input prices. Specifically, the *H*-statistic measures the percentage of change in the equilibrium revenue of a bank generated by a change of 1 percent in entry costs.

In a case of a perfect competition, the *H*-statistic is 1. This situation might emerge with an oligopoly operating in a contestable market. In situations of pure and perfect competition, applying the hypothesis that companies produce a long-term equilibrium level, an increase in production factors prices creates an increase proportional to revenues. This takes into account the fact that the output volume minimising average costs does not vary, whereas the price of this output evolves in the same proportion of input production prices.

If the market, in which banks operate, is characterized as being a monopole, then the *H*-statistic is inferior or equal to zero. This is due to economic intuitions which stipulate that revenue of a monopole negatively induces a change in market entry costs. In fact, an increase of 1 percent in entry costs leads to an increase of 1 percent in marginal costs, which reduces production and revenue equilibrium. Therefore, when the costs of a company operating in a monopolistic or collusive market increase, this entity raises its prices, taking into account conditions proper to its situation as a monopole, and its revenues diminish. The authors illustrate that in the case of a market monopole, this environment forces a situation in which an increase in

input prices causes increase in marginal costs, thus reducing the level of equilibrium and revenues provision. Accordingly, sensitivity of revenues is null, or even negative.

In the third case, Panzar and Rosse distinguish a monopolistic situation where banks act as monopoles, but entry or exit of other banks with imperfect competitive products often produces a null profit. In this case, the H value falls between 0 and 1 given that revenues increase less proportionally to changes in the entry cost levels. If the company evolves towards a monopolistic competition context, its response to a rise in sector-level costs will be situated between the above-mentioned figures. The same theory applies for its revenue index. Given this, the effect of a rise in revenue costs will be positive, but less proportional.

Luis Gutiérrez de Rozas (2007) schematically presents the different interpretations of the H-statistic in terms of the nature of competition.
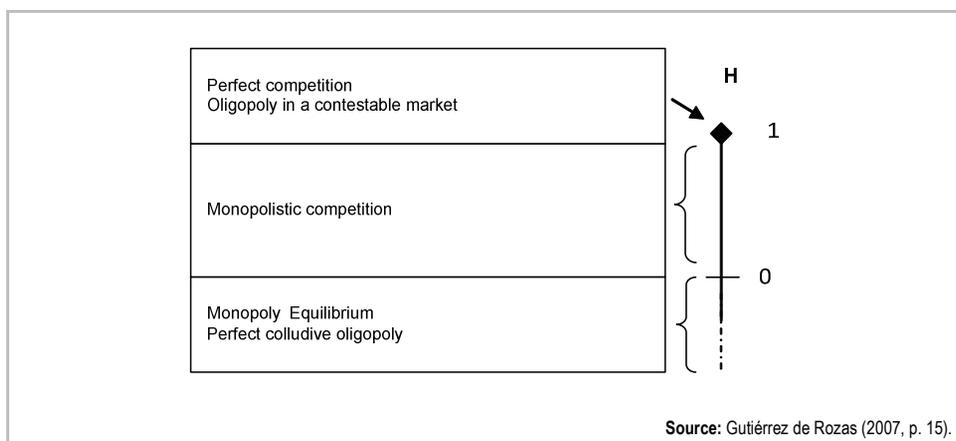

Source: Gutiérrez de Rozas (2007, p. 15).

Figure 1 Interpretation of *H*- Statistic

An important advantage of the PR methodology is that it does not require the price of production and data on quantities that are not often available or expensive to obtain. In this case we assume input and revenue prices are easy to obtain (Hannah S. Hempell 2002).

We can mention another advantage of the model. Indeed, the PR model allows the inclusion of specific bank factors in the production function as well as it allows for the examination of the differences which may arise between banks at the level of size (small vs large banks) or at the level of ownership (domestic vs foreign banks or public vs private banks).

From another perspective, we put focus on the non-need to detect the market and the non-need to specifically define the notion of a local market, which relieves us from the consequences of an inaccurate specification. The *H*-statistic reflects the average behaviour of banks in each market, in the case that the bank operates in several markets. Jose Negrin et al. (2006) align to these arguments and assert that authors

often opt for a market definition with reference to corresponding specific activities. On the whole, the authors judge the H-statistics as a statistic which does not lack efficiency, despite its simplicity and transparency.

Incontestably, does the choice of this technique for the estimation of competitiveness degree observed over bank markets come with serious theoretical and empirical hypotheses? Jacob A. Bikker and Katharina Haaf (2000) establish four conditions in order for the approach to be retained: (1) banks operate for their long-term equilibrium, (2) performance of banks is influenced by actions of other market players, (3) the structure of the cost is homogeneous and (4) demand price elasticity is superior to 1.

2. Literature Review

Recently, an increasing number of researchers have focused their attention on researching and analyzing competition within the banking industry. The new phenomena of liberalization within an increasing number of countries, financial and other internationalization initiatives contributed to explaining this particular interest in the subject. Kent Mattews, Victor Murinde, and Tianshu Zhao (2007) witnessed that the SCP and Efficient Structure are misleading models when they are set to analyse competition behaviour by means of profitability. According to these authors, it is by the means of analysing output price deviation, in relation to cost margin, that an adequate theoretical frame is established.

The first instrument issued from the new theory of industrial organisation applied to banking is the Panzar and Rosse (1987) model. Upon the emergence of this approach, theorists have quickly adopted into the study of banking systems' competitiveness. A number of research studies have privileged and applied the PR methodology to European banking systems (Jukka Vesala 1995; Olivier De Bandt and Philip E. Davis 2000; Bikker and Johannes M. Groeneveld 2000; Bikker and Haaf 2002; Hempell 2002; Barbara Casu and Claudia Girardone 2006; Negrin et al. 2006; Gutiérrez de Rozas 2007; Mattews, Murinde, and Zhao 2007; Semih H. Yildirim and George C. Philippatos 2007) to American and Canadian banking systems respectively for Shaffer (1982) and particularly for Alli Nathan and Edwin H. Neave (1989), and to Asian countries like the case of Philip Molyneux, John Thornton, and Michael D. Lloyd-Williams (1996), Ananthakrishnan Prasad and Saibal Ghosh (2005), Yuan Yuan (2006) papers. However, papers which treat emerging countries, Arab countries and Middle East and North Africa (MENA) region countries are less abundant in the literature (Gaston R. Gelos and Jorge Roldos 2004; Saeed Al-Muharrami, Kent Mathews, and Yusuf Khabari 2006; Louis Kasekende et al. 2009; Rima Turk-Ariss 2009).

Whereas results vary between studies, these latter generally reject perfect collusion and perfect competition. The majority is inclined to support a monopolistic competition. According to Gutiérrez de Rozas (2007), Bikker and Haaf (2002), and others[1], monopolistic competition is the most plausible framework able to character-

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[1] There are many studies on the competitiveness of banking systems using Panzar and Rosse as shown in Appendix 1.

ize interactions between banks. This theory is supported under the idea, that takes into account the existence of product differentiation, and it fits the idea that banks tend to be different in as far as variables of product quality and promotion are concerned, despite the homogeneity of its principal activity. The limit of a monopolistic competition is seen when banks provide products that are perfectly substitutable.

One of the first applications of the PR methodology on banking is that of Shaffer's (1982), who based herself on the foundation of the methodology developed in Panzar and Rosse's (1977) article. Shaffer (1982) applied this approach to a sample of banking firms established in New York in 1979 and has estimated the H-statistics value between 0.32 and 0.36. This result indicates that the banks do behave neither as a monopole nor as banks in perfect competition, and that they are in a monopolistic competition. Similarly, Nathan and Neave (1989) have studied competition within the Canadian financial industry (banks, insurance companies…) using data from 1982 to 1984. In so far as commercial banks are concerned, the authors confirmed that the H-statistic took the values 1.058 in 1982, 0.68 in 1983 and 0.729 in 1984. Following these H-statistics, they rejected the two hypotheses of monopole and pure and perfect competition and they concluded that Canadian commercial banks evolve within a monopolistic competition. Yuan (2006) measures the degree of competition within the Chinese banking sector using the PR methodology before China became a member to the World Trade Organization and this from 1996 to 2000. Like Stijin Claessens and Luc Laeven (2004) and Bikker and Haaf (2002), the H-statistics have been elaborated in a way which would allow for international comparisons. On the whole, the Chinese banking system is characterized by a situation close to a perfect competition with a relatively higher level than that shown in previous studies. This study illustrates that the Chinese banking sector is competitive during the years 1996, 1997, 1999 and 2000. In 1998, despite the high value of the H-statistics, competition is monopolistic. Molyneux, Thornton, and Lloyd-Williams (1996) used PR statistics to evaluate competition conditions in a number of European banking markets. This large-scale study incorporated a great deal of variables in order to control for risk, cost and size characteristics of the studied institutions. A sample of German, French, Italian, Spanish and British banks has been considered for the period 1986-1989. The paper concluded that a monopolistic competition prevailed the British banking market. Similar results have been obtained for the other European markets. Molyneux, Thornton, and Lloyd-Williams (1996) observed the Japanese commercial banks' competition behaviour and obtained the following results; for the year 1986, they proved that H=0,0193 and for the year 1988, H=0,6353; these two values are different from zero and the unit, thus concluding that Japanese commercial banks are in monopolistic competition and that the other two hypotheses of monopole and pure and perfect competition be rejected. As for Bikker and Groeneveld (2000), they measured the H-statistics for a number of European Union (EU) banks. This statistic is estimated on the one hand for all EU banks and on the other hand for each individual country during the period 1989-1996. Monopolistic competition behaviour is detected for the majority of European banking markets. The authors assume the existence of a monopolistic competition, but with varying degrees for EU countries. Among the recent studies, De Bandt and Davis (2000) developed a new

model to examine competition within EU banking market[2], using data from the period 1992-1996. This study has been conducted on large and small banks. De Bandt and Davis' (2000) results and conclusions support the hypothesis that European banks are less competitive than American banks. As for small banks, competition level seems particularly less elevated in France and Germany. This suggests that in these countries small banks have market power, probably due to the fact that they lend more interest to local markets. In Italy, a monopolistic competition has governed small and large banks. Among the novelties reported by the authors is the fact of having made their conclusions on two different dependent variables i.e. interest income and total income. Since that, a big number of studies adopted their approach. Like Bikker and Haaf (2002) and Vesala (1995), who applied to the PR model two groups of different banks, i.e. small and large banks, Negrin et al. (2006) have conducted a similar study on Mexican banking sector. The innovation consisted in subdividing banks, not only according to their size, but also according to sources of income, in other words, the different components of income. David Hauner and Shanaka J. Peiris (2006) investigate the banking sector in Uganda and find that the level of competitiveness has significantly increased over time. Al-Muharrami, Mathews, and Khabari (2006) concerned themselves with the study of market structure and competition behaviour within the banking system of the Gulf countries. The authors evaluate banks' monopole power over a decade untill 2002. Six countries have been retained on which the authors applied the usual concentration measurement, the k bank concentration ratio (CR_k) and Herfindhal-Hirschman's index (HHI). They, however, used the H-statistics of the PR model to measure monopolistic power. The results suggest that for Qatar, Bahrain and Oman, banks operate in a monopolistic competition. As for Kuwait, Saudi Arabia and United Arab Emirates (UAE), competition between banks touches on a perfect competition. Yildirim and Philippatos (2007) analyse 14 Central and East European banking systems using banking data and apply the PR methodology. Among these, we mention Bulgaria, the Czech Republic, Estonia, Croatia, Hungary, Lithuania, Macedonia, Poland, Romania, Slovenia, Russia and Yugoslavia. The sample includes a panel of 2113 observations belonging to 325 banks over the period 1993-2000. They proved that, except for Latvia, Macedonia and Lithuania, these systems are characterized neither by a perfect competition nor by a monopolistic one. On the whole, large banks of economies in transition operate in a more competitive environment compared to small banks[3]. Mattews, Murinde, and Zhao (2007) conducted an empirical study using the PR model over 12 large British banks during a period of major structural changes between 1980 and 2004. The robustness of the results is confirmed by Lerner's index. The theoretical model of monopolistic competition characterises competition between British banks during the whole period, yet its intensity remains unchanged during the 1980-1990 decade. Over the non-core (off-balance sheet) business, competition is shown less intensive.

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[2] The authors show a particular interest to France, Germany and Italy. They seek to evaluate the impacts of the Monetary and Economic Union on market conditions and this for banks of the countries adopting the common currency.

[3] The authors have defined the two sub-markets basing themselves on the size of capital; large and small banks are defined in terms of total assets compared to the median of the sample.

To our knowledge, no previously published paper took Tunisia as its focus. However, the paper of Turk-Ariss (2009) attempted to examine competition structures of the MENA region countries' banking sectors of which Tunisia is a part. Based on revenue elasticity to input prices, and retaining a set of market and contestability indicators, the degree of competition measured during the period 2000-2006 demonstrates that the region is characterised, for the most part, by a monopolistic competition. The exceptions exist for Bahrain and Turkey, which exhibit perfectly competitive markets, and the North African countries (Tunisia, Algeria and Morocco) where monopole conditions are observed.

3. Banking Industry in Tunisia

During the 1960s, socialist-driven economic policies adopted by Tunisia created a number of drawbacks. In addition, these same policies generated distortion of financial resources, lack of savings allocations towards private investment, a decrease in savings rates and an increase of external debt ratio in relation to Gross Domestic Product [1961-1967]. In 1970, the socialist inspiration experience came to an end. However, the repressive practices of the financial system lasted until 1987. Starting from this date, the authorities adopted the Structural Adjustment Plan focusing on policies of economic restructuring in order to develop bank intermediation and to improve the efficiency of the financial system.

In the context of financial openness, the central bank issued management regulations and prudential norms targeting banks and financial institutions[4]. These norms used return on equity (ROE), ratios of ROE to commitments, cash flow ratios, funds given by credit institutions to their branches, and risks in general.

In the context of reorganizing the banking sector, a modernization program was implemented in 1997. The program targets the quality of bank products and services in order to face foreign competition. Restructuring and modernizing the banking sector represented a necessary process as part of the reforms undertaken by the Tunisian financial sector. From a technology point of view, new instruments have been introduced with the aim of improving bank services, including for example, tele-compensation, electronic payment as well as training people on new management methods and techniques. During the year 2007, 253 new Automatic Teller Machines (ATMs) have been installed, increasing the total number of ATMs to 1100.

Financial globalization is more and more observable in openness, deregulation, disintermediation processes and in the liberalization of the Tunisian economy. In parallel, reconciliation efforts have been imposed in order to obtain an important size in terms of assets and stock market capitalization, and eventually to achieve economies of scale. Putting into effect the merger of The Economic Development Bank of Tunisia (BDET) and The National Tourism Development Bank (BNDT) by the Tunisian Banking Company (STB) on September 26th 2000 was without doubt a monumental year for the Tunisian banking sector. This merger gave birth to the first universal Tunisian bank.

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[4] In March 1994, banks were submitted to prudential regulations in order to control for change balances. In 1997, some prudential regulations have been modified.

In 2007, the banking sector totalled 20 banks; the entry of a new bank named "Bank for Financing Small/Medium-sized Businesses" (BFPME) in March 2005, the conversion of Tunisian-Saudi Investment and Development Company (STUSID Bank) and Tunisian-Libyan Bank (BTL) into universal banks respectively in April and October 2005 and privatising the Bank of the South in November 2005. In addition, deposit banks have continued to develop thanks to the extension of their network in a way which made bank services more accessible. As a result, as of December 2007, the network of bank agencies was 1094 units of which 980 agencies, 20 branches and 94 offices. This allowed for the improvement of the rate of banking which reached 9.6 thousand habitants per agency.

Performance of deposit banks have yielded an increase in ROE and ROA which respectively stand at 6.5 per-cent, 7 per-cent and 8.8 per-cent in 2008, compared to 0.5 per-cent, 0.6 per-cent and 0.9 per-cent respectively in 2005, 2006 and 2007.

Table 1   Return and Financial Solidity Indicators

Title	2005	2006	2007
ROE	6.5	7	8.8
ROA	0.5	0.6	0.9

Source: Central Bank of Tunisia (2009).

4. Empirical Specification of the PR Model

4.1 Presentation of the Model

This statistical analysis requires the estimation of the reduced form of bank revenue. The quantity and price of the equilibrium determining total revenue equilibrium depend on costs, demand and conduct. Accordingly, all determinants of costs and demand must be included in banks' revenues functions. A particular attention will be devoted to the price of factors.

The equation for the reduced form of revenue i over a period t is shown in the following specification:

$$R_{it} = f(W_{it}, Z_{it}, Y_{it}, \varepsilon_{it})\tag{1}$$

with : W_{it} = Vector of the price of factors;
Z_{it} = Variables of the cost function;
Y_{it} = The variable of the demand function;
ε_{it} = Error term.

In this case, $\delta R_{it} / \delta W_{itk}$ is a derived total revenue in relation to k^{nth} input price. The *H*-statistic of the PR model is defined by the sum of the elasticities of the reduced form revenue, knowing the price of factors.

$$H = \sum \left[\left(\delta R_{it} / \delta W_{itk} \right) * \left(W_{itk} / R_{it} \right) \right]\tag{2}$$

In the elaborated model, we preserve the linear form of the relationship between dependant and independent variables. The works of Claessens and Laeven (2004), Prasad and Ghosh (2005), Yuan (2006), Gutiérrez de Rozas (2007) and Turk-Ariss (2009), have established its theoretical basis.

The reduced form of the following specification is:

$$\ln IR = a + b\ln(PF) + c\ln(PL) + d\ln(PK) + e\ln(SCALE) + f\ln(CAPAST) \\ + g\ln(BR) + h\ln(AG) + \varepsilon \tag{3}$$

with : ln: The natural operating logarithm;

IR: Interests and revenues assimilated over total assets;

PF: Price of loanable funds is computed as: interests over customers deposits+ charges over treasury operations and over inter-banks operations+ charges over obligatory, budgetary and external borrowing, +miscellaneous losses in relation to borrowing from Central Bank of Tunisia and deposit bonds, Banks and specialised entities+ customers' deposits+ savings deposit+ deposit bonds subscribed by customers+ others amounts incurring from customers, special and obligatory resources, and other borrowings;

PL: Price of labor estimated by personnel expenses is equal to the sum of salaries in relation to the number of employees;

PK: Price of capital expenditure is computed as provision and amortization donations+ charges over miscellaneous operations in relation to fixed capital and gross non-assets amortization;

SCALE : Ratio of total assets to the sum of banks assets;

CAPAST: Ratio of capital to bank's total assets;

BR: Ratio of loans to total deposits;

AG: Ratio of number of branches (offices and agencies) to total number of branches in the country.

The control variables have been introduced to take into account the specific characteristics of the bank. The ratio of total assets to the sum of banks assets (SCALE) logarithm may be considered as a proxy for the size of the bank, and just acts as importantly as an indicator for the incorporated demand. The ratios CAPAST and BR have been introduced to take into account the firm's level of risk. The sign of the coefficient associated with the first ratio may be negative or positive, however, we are looking for a positive sign of the coefficient associated with the second ratio. The number of the bank's branches to the total number of branches ratio (AG) represents another useful proxy to evaluate the effect of the size of the bank over revenues. This would allow us to identify the expected sign, which will be positive or negative as a function of the effect of the increase or the decrease over revenues relative to the evolution of the network of agencies and offices between banks.

4.2 Data

The Professional Association of Tunisian Banks is our principal source of data through its annual reports. In addition, we have used balance sheets and accounting results taken from the banks' activities reports. The data represents the period 1990-2007. The choice of the period is a function of the availability of the necessary information. The two dimensions, i.e. time and individual dimensions, are present which leads us to proceed to a panel-based data analysis.

The sample includes 10 banks. We retained the deposit banks having a regular activity over the period under consideration. The sample of banks retained includes three public banks, three private banks and four foreign banks. The public banks are; the Tunisian Banking Company (STB), Bank of Housing (BH), the National Agricultural Bank (BNA). The private banks are; International Arab Bank of Tunisia (BIAT), Bank of Tunisia (BT), and Amen Bank (A. Bank). The banks with foreign participations are; the Banking Union for Trade and Industry (UBCI)[5] and the Arab Tunisian Bank (ATB)[6], ATTIJARI Bank of Tunisia[7], and the International Banking Union (UIB)[8].

4.3 Econometric Models, Tests and Results

4.3.1 Tests of Conditions of Competition in Interest Revenues

As in Yuan (2006), we follow the interpretation of Bikker and Haaf (2002): *"...the H-statistic ranges between 0 and 1, and a large value indicates greater competitive than a small value, and if the revenue equations, demand elasticity and quantity of banks are the same in the various markets, the H-statistic can be used to make comparisons by country and size of bank"* (p.524), assuming thus that the *H*-statistic is between 0 and 1, and that a larger *H*-statistic indicates a higher degree of competition.

We start with an econometric specification to measure the intensity of competition over the Tunisian deposit banks market. Given that the model cannot be applied only in a case of stationary variables, we made recourse to the Unit Root test, known as IPShin (Kyung So Im, Hashem M. Pesaran, and Shin Yongcheol 1997). The results reported in appendix 2 show that all the variables turned out to be stationary with an exception (ln AG), and even if we consider its first-order difference in the estimations, results are not really affected (see Appendix 2).

Appendix 3 reports tests of conditions of competition in interest revenues. The Ordinary Least Square (OLS) method provides the estimates. The results exhibit statistically significant coefficients for the labor input price variable, non-significant for the capital and funds inputs variables. With the exception of the BR variable, all con-

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[5] Benefitting from its rank in the PNB Paribas Group, the bank offers a direct access to international trade centers network in 85 countries in the five continents.

[6] In December 31st 2008, the capital of the ATB is 80.000.000 TND divided into 64.24 per cent for the Arab Bank PLC and 35.76 per cent for moral and physical resident persons.

[7] Starting from December 11th 2006, the bank of the South became Attijari Bank of Tunisia.

[8] During the month of November 2002, the Groupe Société Générale acquires 52% of the bank's capital, however in 2008 the bank's capital moves from 106.000.000 to 196.000.000 TND.

trol variables are significant, associated with the hoped for signs which mentioned in the literature. The size of bank, for example is expected to positively affect bank's interest revenues. Accordingly, size is associated with a generation of a revenue-making economy of scale. It is the case of the SCALE and AG variables. As far as the risk variable (CAPAST), this latter has a negative sign.

The *H*-statistic is measured by the sum of the coefficients of price input variables (b+c+d). This latter is estimated at 0.87. The labor price variable is positive and neatly significant as mentioned above. It is the variable that has the largest contribution in explaining interest revenues and the *H*-statistic.

The estimations obtained from bank fixed effects and bank random effects General Least Square (GLS) models are compared to results mentioned in Appendix 2. The *H*-statistic takes respectively the values 0.88 and 0.89 for the two methods adopted (see Appendix 4). Fisher's Test signals that the *H*-statistic is significantly different from zero, and significantly close to 1. These results suggest that over the period 1990-2007, Tunisian banking sector is characterized by an oligopolistic competition in a contestable market according to PR standards. The results therefore favour the existence of a competitive situation in opposition to other studies that set to assess the Panzar and Rosse model as applied to banking industry. Generally, these studies have pleaded in favour of a monopolistic situation (see Appendix 1).

The theory of contestable markets is based on the fact that the degree of competition is less determined by the number of enterprises than by the possibility of firms entering or exiting the market (William Baumol, John C. Panzar, and Robert Willig 1982). The theory of contestable markets assumes that the current number of competitors, and their respective shares in the market, are not important given that new competitors may enter the market without incurring costs. The threat of new competitors leads the market to leverage optimal prices among the structures of the potential market. Free circulation of resources inside and among markets justifies the presence of a competitive behaviour.

Having said this, the importance attached to recent tendencies at the level of the Tunisian banking sector is justified and may affect what has been termed "market contestability". Investigating modifications of the international financial context, as reflected in the dynamic changes, undergone by the Tunisian deposit banks, allows us to notice the will to move from a debt-oriented economy to a market economy, with a series of measures which aim at liberalizing the economy. Certainly, in this economy the transition period is still pending, however, certain market mechanisms start to function well.

4.3.2 Tests of Conditions of Competition in Total Revenues

The dependent variable is now represented by total revenues. This includes the assimilated interests and revenues, the commissions over banking operations, profits on portfolios and financial operations, revenues on investment portfolios, operating provisions made available and various products.

The reduced form of the following specification is:

$$\ln(TR) = a + b \ln(PF) + c \ln(PL) + d \ln(PK) + e \ln(SCALE) + f \ln(CAPAST) \\ + g \ln(BR) + h \ln(AG) + \varepsilon$$

(4)

Concerning the variables related to the *H*-statistic, the results yield significant coefficients associated with inputs except for capital input. We notice predominance of the labor factor on the explanation of total revenues and the *H*-statistic. Concerning the control variables, it is the variables size, number of branches and offices that are associated with significant coefficients. The coefficients of the risk variables are not conclusive (see Appendix 4).

The *H*-statistic is estimated at 0.91 when estimated by OLS. Fisher's test is extended over *H*-statistic and is statistically different from zero and equals 1. We conclude that although the *H*-statistic seems slightly superior according to the specification total revenues in relation to interest revenue, the Tunisian banking market rejects a monopolistic competition and confirms presence of competitive conditions. The same observations are maintained for bank fixed effects and bank random effects GLS. The *H*-statistic within the first and second method respectively takes the values 0.88 and 0.90 (see Appendix 4).

The obtained results are in conformity with the studies of De Bandt and Davis (2000), Hauner and Peiris (2006) and Yuan (2006). Compared to the countries of the MENA region and Arab Gulf Cooperation Council countries, our findings are similar to those of Kuwait, Saudi Arabia and UAE as reported by Al-Muharrami, Mathews, and Khabari (2006), and to those of Bahrain and Turkey as reported by Turk-Ariss (2009). Measures of competitive conditions conducted by Kasekende et al. (2009) on the banking industry in the four largest African economies, mainly South Africa, Algeria, Nigeria and Egypt (SANE region), show findings which suggest that, although the degree of competition confirms a monopolistic competition for South Africa, commercial banks were increasingly facing competition from the growth of other providers in the financial services sector. Egyptian and Algerian commercial banking are characterized by a higher level of oligopoly than Cournot, though there is a higher level of competition than joint-profit maximization. In Nigeria, commercial banks are characterized by a certain level of oligopoly and are less competitive than Cournot. However, the study of Kasekende et al. (2009) shows that reforms in South Africa, Nigeria and Egypt, and financial restructuring in Algeria, have induced more competitiveness in the financial services sector.

4.3.3 Equilibrium Test for the Tunisian Bank Market

Since the PR model is only valid if the market is in equilibrium, in the initial equation we retain the same explanatory variables which we regress on the dependent variable ROA and ROE. Return on assets might take small negative values, that is why we compute the dependent variable as ROA'=ln(1+ROA) and then as ROE'=ln(1+ROE).

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

(5)

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

(6)

The equilibrium test consists of the idea which stipulates that return on bank assets should not be linked to input price. We define E1 as equilibrium statistics issued from equation (5), and E2 as the statistic computed from equation (6). The equilibrium statistics E1 and E2 are measured by the sum of the coefficients (b+c+d). We test then, using Fisher's statistics, whether E1=0 and E2=0, which would allow us to examine whether the observations are in long-term equilibrium (see Appendix 5).

Over the equilibrium equations in which the dependent variables are ln(1+ROA) and ln(1+ROE), Fisher's test cannot reject the hypothesis that the parameter E1 is equal to zero and E2 is equal as well to zero. From another perspective, and from an economic viewpoint, the statistics E1 and E2 turn out to be close to zero. With reference to the two equilibrium tests, we can conclude that Tunisian bank market is in equilibrium.

5. Conclusion

The analysis of the relationship between structures of different markets (competitive or imperatively competitive) and bank performance has been enriched by recent studies treating the subject under a bimodal analysis, i.e. the non-structural approach vs the structural approach. Under the non-structural perspective, it is the behaviour of firms operating on the market that may provide us with an idea about the structure of the market. Between the two extremes, pure and perfect, and collusive competitive markets, lies the contestable market whose theoretical foundations are initiated by Baumol, Panzar, and Willig (1982).

The literature review reminds us of the main studies that have used different methods to measure and test bank competition. Among these studies, we have cited the works that directly treat competition within the banking system, notably the works of Claessens and Laeven (2004), Prasad and Ghosh (2005), Al-Muharrami, Mathews, and Khabari (2006), Yuan (2006), Gutiérrez de Rozas (2007), Kasekende et al. (2009) and Turk-Ariss (2009).

Albeit, we have opted for Panzar and Rosse's *H*-statistic, one of the main theories, which was able to model, measure and test bank competition, mainly a model issued from the new industrial organisation theory.

We have delivered a series of empirical validations. The results of the estimations in terms of interest revenue and total revenue have yielded very interesting observations. Proceeding by means of an OLS method, the *H*-statistics is respectively estimated at 0.87 and 0.91. The computations undertaken using bank fixed effects and bank random effects GLS methods yield similar results. These results support the idea that Tunisian deposit banks operate in a context of an oligopoly competition, in a contestable market according to PR standards. Thus, it confirms the presence of a competitive environment.

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Appendix 1   Panzar-Rosse Model Results in Other Studies

Authors	Countries	Years	Results
Smith Robert and David Tripe (2001)	New Zealand	1996-1999	MC
Bikker and Haaf (2002)	23 countries of the OCDE	1998,…	MC
Hempell (2002)	Germany	1993-1998	MC
Claessens and Laeven (2004)	50 countries	1994-2001	MC
Gelos and Roldos (2004)	Argentina, Brazil, Chile, Czech Republic, Mexico, Hungary, Poland and Turkey	1994-1999	MC
Emmanuel Mamatzakis, Christos Staikouras, and Anastasia Koutsomanoli-Fillipaki (2005)	South-East European countries	1998-2002	MC
Armenuhi Mkrtchyan (2005)	Armenia	1998-2002	MC
Prasad and Ghosh (2005)	India	1996-2004	MC
Burak Günalp and Tuncay Çelik (2006)	Italy	1990-2000	MC
Al-Muharrami, Mathews, and Khabari (2006)	GCC	1993-2002	PC : Kuwait, Saudi Arabia et UAE MC : Bahrain and Qatar M : Oman
Gutiérrez de Rozas (2007)	Spain	1985-2005	MC
Turk-Ariss (2009)	12 MENA region countries	2000-2006	PC: Bahrain and Turkey M : North Africa countries MC: the other countries

Note: MC: Monopolistic Competition; M: Monopoly; PC: Perfect Competition.

Appendix 2   Unit Root Tests

Variables	t- Statistic	Probability
ln IR	-4.5175	0.0003
ln TR	-4.3461	0.0005
ln PF	-5.3063	0.0000
ln PL	-6.2096	0.0000
ln PK	-6.5544	0.0000
ln SCALE	-2.6418	0.0866
ln CAPAST	-5.7342	0.0000
ln BR	-6.5757	0.0000
ln AG	-2.2814	0.1791
ln (1+ROA)	-12.446	0.0000
ln (1+ROE)	-13.112	0.0000

Appendix 3   Tests of Conditions of Competition in Interest Revenues and Total Revenues: The OLS Method

		Interest Revenues (IR)	Total Revenues (TR)
Intercept		11.172 $(38.13)^{***}$	12.366 $(55.04)^{***}$
ln PF		0.045 (0.68)	0.168 $(3.30)^{***}$
ln PL		0.810 $(17.49)^{***}$	0.741 $(20.86)^{***}$
ln PK		0.0145 (0.41)	0.005 (0.19)
ln SCALE		0.660 $(10.62)^{***}$	0.733 $(15.37)^{***}$
ln CAPAST		-0.088 $(-1.77)^{*}$	-0.017 (-0.45)
ln BR		0.021 (0.55)	0.003 (0.10)
ln AG		0.285 $(4.70)^{***}$	0.209 $(4.48)^{***}$
R-sq.		0.8881	0.9236
Adj. R-sq.		0.8835	0.9205
H=0	**F.statistic**	68.12^{a}	127.87^{a}
	P. value	0.0000	0.0000
H =1	**F.statistic**	1.50^{c}	1.11^{c}
	P. value	0.2223	0.2936

Notes: Figures in parentheses are t- statistics.
*significant at 10% ; ** significant at 5% ; *** significant at 1%.
[a] significantly different from 0 on F test.
[b] not significantly different from 0 on F test.
[c] not significantly different from 1 on F test.

Appendix 4 Tests of Conditions of Competition in Interest Revenues and Total Revenues: Bank Fixed Effects and Bank Random Effects GLS Methods

		Interest Revenues (IR)		Total Revenues (TR)	
		Bank Fixed Effects	Bank Random Effects GLS	Bank Fixed Effects	Bank Random Effects GLS
Intercept			11.250 (30.29)***		12.507 (43.63)***
Ln PF		0.047 (0.69)	0.050 (0.76)	0.140 (2.60)***	0.148 (2.84)***
Ln PL		0.805 (17.44)***	0.810 (18.19)***	0.707 (19.47)***	0.719 (20.48)***
Ln PK		0.035 (0.90)	0.033 (0.88)	0.040 (1.30)	0.034 (1.14)
Ln SCALE		0.740 (7.28)***	0.716 (8.00)***	0.732 (9.16)***	0.712 (10.28)***
Ln CAPAST		-0.093 (-1.66)*	-0.096 (-1.79)*	-0.013 (-0.29)	-0.022 (-0.53)
Ln BR		-0.031 (-0.73)	-0.027 (-0.64)	-0.029 (-0.85)	-0.028 (-0.87)
Ln AG		0.269 (2.41)**	0.261 (2.80)***	0.370 (4.2)***	0.294 (4.11)***
R-sq.		0.8861	0.8868	0.9139	0.9204
H=0	**F.statistic**	70.21[a]	76.52[a]	113.45[a]	125.47[a]
	P. value	0.0000	0.0000	0.0000	0.0000
H =1	**F.statistic**	1.10[c]	1.07[c]	1.77[c]	1.47[c]
	P. value	0.2955	0.3008	0.1857	0.2260

Notes: Two empirical models are considered: fixed effect models and random effect models. Based on the results of the Haussman test, tests of conditions of competitions are run with random effects. Figures in parentheses are t- statistics.
*significant at 10%; ** significant at 5%; *** significant at 1%.
a significantly different from 0 on F test.
b not significantly different from 0 on F test.
c not significantly different from 1 on F test.

Appendix 5   Tests of Conditions of Equilibrium in Interest Revenues (IR) and Total Revenues (TR)

	Interest Revenues (IR)		Total Revenues (TR)	
	ln (1+ ROA)	T.stat.	ln (1+ ROE)	T.stat.
Intercept	-0.0099608	-0.74	-0.1857871	-0.73
ln PF	-0.0003632	-0.12	-0.0121279	-0.21
ln PL	0.0031763	1.50	0.0096508	0.24
ln PK	0.0064261	3.93[***]	0.1714947	5.53[***]
ln SCALE	-0.0051536	-1.81[*]	-0.0658539	-1.22
ln CAPAST	0.0008616	0.37	-0.0307687	-0.70
ln BR	-0.0003376	-0.19	-0.0263998	-0.78
ln AG	0.0002486	0.09	0.0115507	0.22
R-sq.	0.1780		0.1778	
Adj. R-sq.	0.1446		0.1444	
H=0 **F.statistic**	3.65[b]		3.40[b]	
P. value	0.0576		0.0671	

Notes: Based on the results of the Hausman test, tests of conditions of equilibrium are run with random effects. Figures in parentheses are t- statistics.
*significant at 10% ; ** significant at 5% ; *** significant at 1%.
a significantly different from 0 on F test.
b not significantly different from 0 on F test.
c not significantly different from 1 on F test.

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