Competition and concentration in the Turkish banking sector

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Abstract

The paper estimates the competitive conditions and concentration in the Turkish banking sector during the period 2002-2009. This paper also reports the results of two common measures of concentration, which are the concentration ratio and the Herfindahl-Hirschman index using Turkish banking system data which cover from 2002 to 2009. We can conclude that the Turkish banking sector is almost non-concentrated. The highest concentration was found in the Turkish deposits market, which it is possible characterize as slightly concentrated. The Panzar-Rosse model is used for testing the competition in the Turkish banking industry. Specifically, we use a panel with data for most of the Turkish banks to estimate the *H* statistics. We concluded that the Turkish banking industry can be characterized as a monopolistic competition which is close to a monopoly. The result implies the Turkish banks do not operate in a competitive environment and enjoy monopoly rents. It can be concluded that competitive conditions were decreasing during the analysed period.

Key words: Turkish banking sector, concentration, concentration ratio, competition, Herfindahl-Hirschman index, Panzar-Rosse model

JEL codes: D40, G21

1. INTRODUCTION

During 1980s, in emerging economies financial deregulations were started as a result of globalisation in the world. Initially, these deregulations were accepted as an integration of the world economy. We can accept financial liberalization applications as financial deregulations which intensively applied by emerging markets during 1980s. These deregulations were especially focused on a banking system. Consequently, main sources of the financial crisis came from bank systems. In 1980, a development policy that targeted

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opening-up the economy and producing for exports, based on a market economy, was adopted in place of an industrialization strategy in Turkey. As a part of the new economic system the international supervision and international banking standards were introduced to the banking system in 1985. In the same period as a result of the deregulation, the Turkish banking system has its own financial crisis too. After 1980s the Turkish banking system has some financial crisis in 1994, 1998 and 2001.

The aim of this paper is to examine the degree of competition and concentration in the Turkish banking industry during the period 2002-2009. We use the concentration ratio and the Herfindahl-Hirschmann index to estimate the degree of concentration of the Turkish banking industry. For finding the degree of competition it is applied the New Empirical Industrial Organization approach, especially the Panzar and Rosse approach (1987) based on panel data for commercial banks in Turkey. In the paper we use the methodology according to Stavárek and Řepková (2011). The structure of this paper is as follows. The importance of the subject is discussed and brief information about Turkish banking system is given in the second section. In the third section, it has been given literature review and next section describes methodologies about banking concentration and competition subjects. The fifth section explains data and methodology structure while sixth section presents empirical results. In last section the study is concluded the study and references are given.

2. BRIEF INFORMATION ON THE TURKISH BANKING SYSTEM

The Turkish economic structure is based on planned economy from 1923 which the Turkish Republic was found to 1980. Therefore, during that the period banking system also structured mainly with state banks. Banking sector was widely under the control and influence of the government during the planned economy period.

The Turkish banking system milestones began in 1980 with economic decisions about the Turkish economy adaptation to a market economy. During this period new arrangements were issued for regulating, monitoring and supervising the activities of banks. Due to bad economic conditions, Turkish banking system has had problems. Consequently, governments have taken precautions. One of them was the banking restructuring program in 2001 that can be accepted as the second milestone.

The restructuring process in the banking system was first started with the Disinflation Program at the end of 1999, and followed by the extensive banking restructuring program in 2001. The restructuring process in banking sector was based on four basic aims and elements:

(i) The settlement of the problems of banks transferred to the Saving Deposits Insurance Fund (SDIF) within the shortest possible time, (ii) Financial and operational restructuring of state-owned banks, (iii) rehabilitation of the structure of state-owned banks which have been affected negatively by the crisis in the banking sector and (iv) Realization of legal and corporate regulations to increase the efficiency of supervision in banking sector and to make the banking sector's structure more efficient and competitive. For this purpose, the Banking Regulation and Supervision Authority (BRSA) have been established as a regulatory and financial authority with administrational and financial autonomy in the banking sector.

That period explained by Faure (2009), as the Turkish banking system underwent a deep-seated restructuring. The aim was to overcome the weaknesses that had been the direct cause of the 2001 crisis, namely (i) the structural need to refinance publicly-owned banks as a result of their "duty losses" (losses on subsidised loans to farmers and small businesses), (ii) the dominant share of portfolios of public securities in the bank assets and thus the considerable exposure of their balance sheets to market risk and (iii) the exposure of private sector banks to forex risk.

Main characteristics of Turkish banking system from the banking restructuring program in 2001 to today are:

- individual banking instruments improved,
- share of foreign banks within total assets increased,
- Turkish banks started to open new branches abroad, especially in the EU,
- Turkish banks caught to international standards.

Table 1 Number of banks in the industry

	2002	2003	2004	2005	2006	2007	2008	2009
Number of banks	54	50	48	47	46	46	45	45
Deposit banks	40	36	35	34	33	33	32	32
State-owned banks	3	3	3	3	3	3	3	3
Privately-owned banks	20	18	18	17	14	11	11	11
Banks in the fund	2	2	1	1	1	1	1	1
Foreign banks	15	13	13	13	15	18	17	17
Dev't. and inv. banks	14	14	13	13	13	13	13	13

Source: Authors' compilation

Table 1 presents the number of banks in the period 2002–2009. Number of banks was decreasing during the analysed period. Banks can be divided into two main groups as those with the permission to collect deposits and those not accepting deposits.

3. LITERATURE REVIEW

Even there are many researches about the Turkish banking system; there are several empirical studies that analyzed competition and concentration in the banking sector in Turkey. Gunalp and Celik (2006) used the Panzar-Rosse *H* statistic to assess the competitive environment of the Turkish banking industry over the period 1990-2000. The results indicate for the period under consideration that bank's revenues behaved as if they were earned under conditions of a monopolistic competition. The liberalization process and deregulation measures appear to have beneficial effects on competition.

Abbasoglu et al. (2007) suggested that in spite of recent merger and acquisition activities, Turkey's banking sector is still characterized as non-concentrated in the period 2001-2005. They also revealed that the *H* statistics were always between zero and one, which can be interpreted as an evidence for the existence of the monopolistic competition in the Turkish banking sector even if the values of the *H* statistics decreased from 2001 to 2005. Their findings do not show a clear relationship between concentration and competition.

Yayla (2007) found that concentration in the relevant markets shows a decreasing trend in the period of 1995-1999 and increasing tendency in 2000-2005. However, net interest margins which can be seen as the relevant prices in the sector had declined in both periods.

Masood and Aktan (2010) examined competitive structures of 17 paramount banks in the Turkish banking sector over the period 1998-2008 and investigates factors that can explain differences in the degree of competitiveness. Their results indicate that Turkey banking sector is in an equilibrium state, actually they are in the long run equilibrium. The banks in Turkey are operating as a whole under conditions of monopolistic competition. They observed market power resulting from high concentration levels in Turkey does not exclude the competitive behaviour. This suggests that the degree of competition in banking was affected by different factors for differences. They concluded that due to high concentration in the Turkish banking system in the last decade, the market power for the leading firms was reduced.

Yaldiz and Bazzana (2010) calculated the average Lerner index 0.9674 in period 2001-2009, which indicator implies the banks in Turkey do not operate in a competitive

environment, and enjoy monopoly rents. With this calculation of market power, it is seen that Turkey has a less competitive banking sector than, particularly, the EU economies. In a recent study Carbo et al. (2009) calculated the average Lerner index 0.16 for EU countries.

4. CONCENTRATION AND COMPETITION AND THEIR MEASURES

Concentration and competition became a recurrent topic in the banking literature. Specifically, during the last decade a great deal of empirical work has attempted to measure the level of competition prevailing in banking markets. The conventional view which holds that increasing concentration may lead to undesirable exercise of market power, i.e. that concentration impairs competition, has been subject to an enormous amount of controversy (Gutiérrez de Rozas, 2007).

Measures of concentration and competition are essential for welfare-related public policy toward the banking market. Concentration and competition are linked to product markets and geographical areas, both in theory and in empirical analyses. Banks provide a multitude of products that do not serve a unique market, and defining a relevant market involves making a preliminary decision about potentially relevant structural characteristics, such as concentration and competition (Bikker and Haaf, 2000).

4.1 Measures of the concentration

The importance of concentration ratios arises from their ability to capture structural features of a market. Concentration ratios are therefore often used in structural models explaining competitive performance in the banking industry as the result of the market structure. As Bikker and Haaf (2002) note that a measure of concentration does not warrant conclusions about the competitive performance in a particular market. Even in a highly concentrated market, competitive behaviour between the leading banks is still possible. Concentration ratios are also able to reflect changes in concentration as a result of the entry of a bank into the market or its exit from it, or caused by a merge.

Bikker and Haaf (2000) divide the structure of concentration indices on discrete or cumulative. Discrete measures of concentration correspond to the height of the concentration curve at an arbitrary point. The *k* bank concentration ratio, for instance, belongs to this class of discrete measures. Practical advantages of discrete measures are simplicity and limitation of required data. Cumulative or summary measures of concentration, on the other hand,

explain the entire size distribution of banks, implying that structural changes in all parts of the distribution influence the value of the concentration index. Cumulative measures of the concentration include e.g. the Herfindahl-Hirschman Index (*HHI*), the comprehensive industrial concentration index (*CCI*), the Rosenbluth Index (*RI*) and the Hall-Tideman Index (*HTI*) as well as the Entropy Measure (*E*).

In this paper, we measure competition of the Turkish banking sector by the *k* bank the concentration ratio and the Herfindahl-Hirschman index. The concentration ratio (*CR*) shows the degree to which an industry is dominated by a small number of large firms or made up of many small banks. Simplicity and limited data requirements make *CR* one of the most frequently used measures of concentration in the empirical literature. Summing over the market shares of the *k* largest banks in the market, it takes the form:

$$CR_k = \sum_{i=1}^{k} s_i \ . \tag{1}$$

CR gives equal emphasis to the *k* leading banks, but neglecting the many small banks in the market. There is no rule for the determination of the value of *k*, so the number of banks included in the concentration index is a rather an arbitrary decision. The concentration ratio may be considered as one point on the concentration curve, and it is a one-dimensional measure ranging between zero and unity. The index approaches zero for an infinite number of equally sized banks and it equals unity if the banks included in the calculation of the concentration ratio make up the entire industry.

The Herfindahl-Hirschman index is the most widely treated summary measure of concentration in the theoretical literature and often serves as a benchmark for the evaluation of other concentration indices. Bikker and Haaf (2000) defined *HHI* as the sum of the squares of the bank sizes measured as market shares. Often called the full-information index because it captures features of the entire distribution of bank sizes, it takes the form:

$$HHI = \sum_{k=1}^{n} \left(\frac{q_k}{Q} \right)^2 = \sum_{k=1}^{n} r_k{}^2 \ , \tag{2}$$

where n is the number of banks in the banking sector,

q_k is the volume of the output of the bank k, $k = 1, 2, \ldots, n$,

Q is the volume of the output of the banking sector,

r_k is the share of the output of the bank k to the output of the banking sector.

The Herfindahl-Hirschman index stresses the importance of larger banks by assigning them a greater weight than smaller banks, and it incorporates each bank individually, so that arbitrary cut-offs and insensitivity to the share distribution are avoided. The *HHI* index ranges between $\frac{1}{n}$ and 1, reaching its lowest value, the reciprocal of the number of banks, when all banks in a market are of equal size, and reaching unity in the case of monopoly (in a market with only one bank). Sometimes the value of the *HHI* is multiplied by 10000 and then *HHI* indices in the range below 1000 show a very low concentration, in the range 1000–1800 show a moderate concentration, in the range above 1800 show a very high concentration of the banking system, whereas the index value equal to 10000 shows a full concentration (monopoly).

4.2 Measures of the banking competition

The literature on the measurement of the competition can broadly be divided into two branches: the (non-formal) structural approach and the (formal) non-structural approach (Bikker and Haaf, 2000). The structural approach centres on the Structure-Conduct-Performance paradigm (SCP) or the efficiency hypothesis. For the SCP, the collusive behaviour among large firms due to a highly concentrated market is the main driver of market over performance. On the other hand, the efficiency hypothesis, implicitly assumes the presence of economies of scale through which large firms achieve increased efficiency and improved performance. Thus, if a firm is more efficient than the rest (e.g., due to a lower cost structure) it could gain market share by reducing prices, and hence, market structure is endogenously shaped by firms performance so that concentration is a result of the superior efficiency of the leading firms (Yeyati and Micco, 2003). The traditional SCP paradigm and the efficiency hypothesis integrate measures of concentration and competition. Formal derivations of this class of relationships provide evidence of the theoretical appropriateness of both the *HHI* and the *CR* as measures of concentration in structural models (Deltuvaitė et al., 2007).

There are three main non-structural models proposed in the literature: Iwata (1974), Bresnahan (1982) and Panzar and Rosse (1987) models. Their derivations are based on

oligopoly theory of the Industrial Organisations approach (Bresnahan and Iwata model), or on the comparative static properties of reduced form revenue equations (Panzar-Rosse approach). Whereas both the Bresnahan and the Panzar-Rosse methods were applied to the European banking industry, the application of the Iwata model posed difficulties, given the lack of required micro-data on the structure of cost and production of a large number of players in the European banking markets. Empirical applications of the Bresnahan model are also relatively scarce for developed countries.

4.2.1 Panzar-Rosse model

The method developed by Panzar and Rosse (1987) determines the competitive behavior of banks on the basis of the comparative static properties of reduced-form revenue equations based on cross-section data. The Panzar-Rosse (PR) model is the first technique issued on the new theory of industrial organization and applied to the case of banks. The PR model 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 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 (Mensi, 2010). This model uses bank-level data. It investigates the extent to which a change in factor input prices is reflected in (equilibrium) revenues earned by a specific bank. Panzar and Rosse show that if their method is to yield plausible results, banks need to have operated in a long-term equilibrium, while the performance of banks needs to be influenced by the actions of other market participants. The model assumes a price elasticity of demand greater than unity, and a homogeneous cost structure. To obtain the equilibrium output and the equilibrium number of banks, profits are maximized at the bank as well as the industry level. In means the bank *i* maximizes its profits where marginal revenue equals marginal cost:

$$R_i'(x_i, n, z_i) - C_i'(x_i, w_i, t_i) = 0, \tag{3}$$

where R_i is the total revenue,

C_i is the total expenses,

x_i is the output of bank *i*,

n is the number of banks,

w_i is a vector of m factor input prices of bank i,

z_i is a vector of exogenous variables that shift the bank‘s revenue function,

t_i is a vector of exogenous variables that shift the bank‘s cost function.

In addition, if the market is in equilibrium, the zero profit constraint should hold at the market level:

$$R_i^*\left(x^*, n^*, z\right) - C_i^*\left(x^*, w, t\right) = 0\,. \tag{4}$$

Variables marked with * represent equilibrium values. The market power is measured by the extent to which a change in factor input prices $\left(\delta w_{k_1}\right)$ is reflected in the equilibrium revenues $\left(\delta R_i^*\right)$ earned by bank i. Panzar and Rosse define a measure of competition, the H statistic as the sum of the elasticities of the reduced form revenues with respect to factor prices:

$$H = \sum \left(\frac{\delta R_i^*}{\delta w_{k_1}}\right)\left(\frac{w_{k_1}}{R_i^*}\right). \tag{5}$$

The estimated value of the H statistic ranges between $-\infty < H \leq 1$. In particular, the H statistic is non-positive if the market structure is a monopoly, a perfectly colluding oligopoly, or a conjectural-variation, short-run oligopoly. In such a case, an increase in input prices will increase the marginal cost of the bank and reduce equilibrium output as well as total revenue accordingly. Panzar and Rosse proved that under monopoly, an increase in input prices will increase marginal costs, reduce equilibrium output and subsequently reduce revenues; hence H will be zero or negative. If H lies between zero and unity, the market structure is characterized as the monopolistic competition. Under monopolistic competition, total revenues increase less than proportionately to changes in input prices, since the demand facing individual banks is inelastic. Assuming some sort of product differentiation between the outputs of the different banks, the profit maximizing firms are confronted with a falling aggregate demand curve and behave like monopolists, which results in equalizing marginal costs and marginal revenues in the equilibrium state. By market exit and entry of imperfect substitutes, the demand curve always shifts in a way that the monopolist just earns zero profits

(Panzar and Rosse, 1987). The *H* statistic is unity if the market structure is characterized as perfect competition. Under this condition, any increase in input prices will increase both marginal and average costs without changing the equilibrium output of any individual bank. The *H* statistic is also equal to one for a natural monopoly operating in a perfectly contestable market and a sales-maximizing bank subject to break-even constraints. Tab. 2 summarizes the discriminatory power of *H*.

Table 2 Panzar-Rosse *H* statistic

$H \leq 0$	Monopoly equilibrium or perfect cartel
$0 < H < 1$	Monopolistic competition
$H = 1$	Perfect competition

Source: Authors' compilation

An important feature of the *H* statistic is that it must be performed on observations that are in long-run equilibrium, as suggested in previous studies such as Bikker and Haaf (2002), Claessens and Laeven (2004), Casu and Girardone (2006), Matthews, et al. (2007), Fu (2009) and Rezitis (2010). This suggests that competitive capital markets will equalize risk-adjusted rates of return across banks such that, in equilibrium, rates of return should be uncorrelated with input prices (Matthews, et al., 2007). The equilibrium test is carried out with the return on assets (or equity), replacing bank revenue as the dependent variable in the regression equation for the *H* statistic. The *E* statistic is derived from the equilibrium test and measures the sum of elasticities of rate of return with respect to input prices (Fu, 2009). If the *E* statistic is equal to zero, it indicates long-run equilibrium, while $E < 0$ reflects disequilibrium. Table 3 summarizes the discriminatory power of *E* statistic.

Table 3 Equilibrium test

$E = 0$	Equilibrium
$E < 0$	Disequilibrium

Source: Authors' compilation

The advantage of the PR model is that it uses bank-level data and allows for bank-specific differences in production function (Cleassens and Leaven, 2003). 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 is assumed input and revenue prices are easy to obtain (Hempell, 2002). Mensi (2010) mention another advantage of the model, that 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).

The *H* statistic reflects the average behaviour of banks in each market, in the case that the bank operates in several markets. 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. Bikker and Haaf (2000) establish four conditions in order for the approach to be retained, (i) banks operate for their long-term equilibrium, (ii) performance of banks is influenced by actions of other market players, (iii) the structure of the cost is homogeneous and (iv) demand price elasticity is superior to 1.

Its drawback is it assumes that the banking industry is in long-run equilibrium, but a separate test exists whether this condition is satisfied.[2] As we have access to bank-level information and as we want to study differences among banks, we choose for the PR model (Cleassens and Leaven, 2003).

5. METHODOLOGY AND DATA

It is useful elaborating on the choice of the set of variables, since previous studies have employed a wide range of explanatory indicators. One of the crucial differences among studies is the definition of the dependent variable applied in the estimation of *H* statistic. Whereas traditional approaches in the literature have used e. g. gross interest or total income as dependent variable. Chan, et al (2007), Pawlowska (2005), Deltuvaitė (2007) or Lee and Nagano (2008) use interest income (revenues). Alternatively, Hempell (2002), Bikker, et al. (2009) or Rezitis (2010) apply a total income or net income (Gutiérrez de Rozas, 2007). Chun and Kim (2004) and Fu (2009) use a combination of more than one equation and apply total revenues and interest revenues as dependent variables. The decision to consider total revenue, rather than only interest revenue, relies mainly on the fact that non-interest income has

[2] In case of short-run, but not long-run equilibrium, the parameter *H* represents a one-tail test in the sense that a positive value rejects any form of imperfect competition, but a negative value is consistent with a variety of possibilities, including short-run competition (Shaffer 1983).

increased dramatically in recent years. This choice is supported, among others by Casu and Girardone (2006), Pererera, et al. (2006) and Rezitis (2010), who argue that in a more competitive environment, the distinction between interest and non-interest income becomes less relevant, as banks struggle for profits in both fronts. By the same token, the existence of accounting differences across years is an additional argument in favor of a broader view of bank revenues (Staikouras et al., 2006). According Gutiérrez de Rozas (2007) we used as the dependent variable in Eq. (6) the ratio of the net income to total assets.

$$lnNITA_{it} = \alpha_0 + \alpha_1 lnPL_{it} + \alpha_2 lnPK_{it} + \alpha_3 lnPF_{it} + \beta_1 lnASSET_{it} + \beta_2 lnBR_{it} + \beta_3 lnRISKASS_{it} + \varepsilon_{it}, \quad (6)$$

where $NITA_{it}$ is ratio of net income to total assets,

PL_{it} is ratio of personnel expenses to number of employees,

PK_{it} is ratio of other expenses to fixed assets,

PF_{it} is ratio of annual interest expenses to total loanable funds (deposits + tradable securities + subordinated instruments).

Bank-specific and market-specific variables include:

$ASSET_{it}$ is sum of total assets,

BR_{it} is he ratio of the number of branches of a bank to the total number of branches of all banks,

$RISKASS_{it}$ is the ratio of provisions to total assets,

i denotes the bank ($i = 1, \ldots, N$), t denotes time ($t = 1, \ldots, T$).

PL_{it}, PK_{it} and PF_{it} correspond to the three input prices, i.e., labor, capital and funds. Consistently with the intermediation approach, we assume that banks use all the three inputs. Other explanatory variables are chosen to account for bank-specific and market-specific factors. Similar variables are used also in Chun and Kim (2004), Matthews, et al. (2007), Fu (2009) or Rezitis (2010).

The total asset variable ($ASSET_{it}$) is included to take account of possible scale economies. The ratio of the number of branches of each bank to the total number of branches of the whole banking industry variable (BR_{it}) is used in order to account for bank size. Branching has been viewed as a means for maintaining market share by providing consumers with close-quarter access to financial services, mitigating to some extent price competition.

The provisions to total assets variable ($RISKASS_{it}$) is a measure of the riskiness of the bank's overall portfolio. It is used to account for firm specific risk and it is expected to be positively correlated to the dependent variables, since higher provisions should lead to higher bank revenues. An increase in provisions is a diversion of capital from earnings, which could have a negative effect on revenue. In contrast, a higher level of provisions indicates a more risky loan portfolio and therefore a higher level of compensating return. All variables are expressed in logarithmic form.

The model assumes a one-way error component as described by

$$\varepsilon_{it} = \mu_i + \vartheta_{it} \,, \tag{7}$$

where μ_i denotes the unobservable bank-specific effect and ϑ_{it} denotes a random term which is assumed to be IID. The *H* statistic is given by

$$H = \alpha_1 + \alpha_3 + \alpha_3. \tag{8}$$

For obtaining equilibrium conditions the model is defined as follows:

$$lnROA = \alpha_0^{'} + \alpha_1^{'} lnPL_{it} + \alpha_2^{'} lnPK_{it} + \alpha_3^{'} lnPF_{it} + \beta_1^{'} lnASSET_{it} + \beta_2^{'} lnBR_{it} + \beta_3 lnRISKASS_{it} + u_{it} \tag{9}$$

$$u_{it} = \theta_i + \vartheta_{it}, \tag{10}$$

where ROA is the return on assets ratio, θ_i is the bank-specific effect and ϑ_{it} is an IID random error. The banking market is deemed to be in equilibrium if

$$E = \alpha_1^{'} + \alpha_2^{'} + \alpha_3^{'} = 0. \tag{11}$$

The panel data for this analysis comprises almost 90% of the Turkish banking market. These statistics consist of annual data from banks and cover the period from 2002 to 2009. The dataset has been collected from the annual bank reports and BankScope database and it consists of 30 banks over 8 years. Due to some missing observations we have an unbalanced

panel of 240 bank-year observations. To allow for heterogeneity across the banks, we use an error-component model, with the bank-specific error components estimated as fixed effects.

6. EMPIRICAL RESULTS

We analyse concentration and competition of the Turkish banking industry between 2002 and 2009. As it was mentioned before, 2002 is a milestone of Turkish banking system because of some important regulation decisions have been taken by the government.

6.1 Concentration of the Turkish banking industry

We analyze the market concentration of the Turkish banking sector in period 2002-2009. In paper it two common measures of concentration are calculated, which are the concentration ratio and Herfindahl-Hirschman index. We use the three largest bank concentration ratio (*CR3*) and the five largest bank concentration ratio (*CR5*) and *HHI*. It is calculated market concentration of the whole banking sector and also we calculated concentration in credit market and deposit market separately. *CR3* and *CR5* of whole banking sector are defined as the ratio of the total assets of the three and five largest banks to the total assets of all the banks in a given year. Concentration of the Turkish credit market is measures as the ratio of the total loans of the three and five largest banks to total loans. And concentration of the deposit market is calculated as the ratio of the deposits of the three (five) largest banks to total deposits.

Table 4 Concentration of the Turkish banking sector

	2002	2003	2004	2005	2006	2007	2008	2009
CR3	40.38	42.92	42.56	45.63	42.15	40.87	40.75	41.71
CR5	58.43	60.27	59.17	60.83	62.61	61.88	62.37	63.00
HHI	855.38	921.62	931.91	962.14	954.18	931.61	941.59	981.72

Source: Authors' calculation

Table 4 illustrates the market concentration of the Turkish banking sector in period from 2002 to 2009. In general, *CR* and *HHI* show a trend of modest increase, meaning that market concentration changed appreciably over the sample period. Concentration ratio of the three largest banks achieves the average value about 42 % and the value *HHI* does not achieve

1000. The Turkish banking market could be described as almost non-concentrated market over the period of 2002-2009.

Table 5 Concentration of total loans in Turkish banking sector

	2002	2003	2004	2005	2006	2007	2008	2009
CR3	41.20	39.94	37.42	41.14	41.08	40.23	40.32	37.80
CR5	62.04	59.48	57.42	58.57	60.56	59.55	60.07	58.26
HHI	914.54	879.75	859.39	901.38	935.58	918.20	939.78	925.69

Source: Authors' calculation

Concentration of the Turkish credit market in period 2002-2009 is presented in Table 5. Table shows the credit market concentration is similar to concentration of banking sector. The concentration ratio demonstrates moderate decrease in the credit market concentration. The value of the *HHI* indices in the range below 1000 shows a non-concentration market. Therefore, the Turkish credit market can be characterized as non-concentrated.

Table 6 Concentration of deposits market in Turkey

	2002	2003	2004	2005	2006	2007	2008	2009
CR3	43.03	45.09	45.40	47.57	44.83	44.21	44.13	46.03
CR5	61.40	62.64	64.18	65.92	64.42	64.17	64.95	65.85
HHI	960.22	1041.00	1117.50	1093.20	1072.21	1063.91	1071.77	1107.30

Source: Authors' calculation

Next, Table 6 illustrates concentration of the deposits market in Turkey in period 2002-2009. It seen that the deposits market is more concentrate than the Turkish credit market in this period. The *HHI* exceeds the value 1000 and the deposits market can be characterized as slightly concentrated, because the value of *HHI* is between the 1000 and 1800. Concentration ratio reaches the average value about 45 %, which also show slightly concentrated market. Therefore, we conclude that the Turkish deposits market is modestly concentrated and concentration was increasing during analysed period.

6.2 Competition of the Turkish banking sector

Following the empirical literature on competition in banking markets, the reduced form equations specified in Eq. (6) and Eq. (9) are estimated using a panel data framework since the data are both a cross section and time series. We estimated competitive conditions for the whole time period (2002–2009) and also for the two sub-periods (2002–2005 and 2006-2009) using the fixed effects estimation approach.

The first point of the analysis of competition is to test if the Turkish banking market is in the long-run equilibrium. We run regressions of two 4-year sub-periods and also a rolling regression of a 3-year window in order to reveal periods of market disequilibrium. Tab. 6 reports the results of estimation of Eq. (9). To conserve the space only elasticities required to the equilibrium test (Eq. 11) are presented. The result for lnROA as described by Eq. (9) suggests that market equilibrium over the full sample period is questionable. We find that market equilibrium may not hold over the full sample, market was in equilibrium in most of the sub-periods. In the whole period the market is in disequilibrium. However, as argued by Shaffer (2004) or Matthews et al. (2007), the equilibrium restriction that E=0 (market equilibrium) is necessary only for the case of perfect competition and not for that of monopolistic competition and monopoly case. Therefore, such a finding would be incorrect only if it were disclaimed that the Turkish banking sector was perfectly competitive.

Table 7 Equilibrium tests (rolling sample) dependent variable lnROA

	lnPL	lnPK	lnPF	Sum	H0: E=0	Eq./Diseq.
2002-2009	-0.1495	-0.0728	-0.1432	-0.3655	F (1,184) = 4.192[b]	Diseq.
2002-2005	-0.1104	0.1702	-0.3608	-0.3010	F (1,75) = 0.7595	Eq.
2006-2009	-0.3336	-0.4287	0.0715	-0.6908	F (1,76) = 2.5335	Eq.
2002-2004	0.3288	0.4146	-0.5954	0.1480	F (1,49) = 0.0284	Eq.
2003-2005	-0.2767	-0.7276	0.1401	-0.8642	F (1,47) = 8.7026[a]	Diseq.
2004-2006	-0.2898	-0.7286	0.1086	-0.9098	F (1,44) = 11.016[a]	Diseq.
2005-2007	-0.1587	-0.4079	0.4247	-0.1419	F (1,45) = 0.1350	Eq.
2006-2008	-0.2241	-0.2127	0.4307	-0.0061	F (1,48) = 0.0001	Eq.
2007-2009	-0.2120	-0.0297	-0.3911	-0.6328	F (1,50) = 2.9760	Eq.

[a, b, c] denote significance at 1%, 5% and 10% level, t-values in parentheses

Source: Authors' calculation

For the Turkish banking sector the *H* statistic has been estimated for all analyzed period 2002-2009, as well as for two sub-periods, i. e. 2002-2005 and 2006-2009. We estimate Eq. (6) and calculate the *H* statistic Eq. (8).

Regard to competitive condition tests based on the market concentration measures *CR* and *HHI* shown in Tab. 3, it is expected the *H* statistic for testing the competitive positions in the Turkish banking sector will be approximately zero. Non-concentrated market would imply that banks in the Turkey operate under monopoly conditions.

In Eq. (6), the coefficients of the unit price of labour is negative and statistically insignificant at any conventional level of significance, while the coefficient of the unit price of capital and unit price of deposits are positive in full sample and in first sub-period and negative in the second sub-period. We can see substantial differences between the sub-periods used. The sign of the coefficient of the ln*ASSET* variable is positive in full sample and in first sub-period and negative in the second sub-period. The coefficient of the ln*RISKASS* variable is positive and statistically insignificant. The positive effect of the riskiness of the bank's overall portfolio supports the argument that higher risk commands a higher compensating return. The coefficient of the ln*BR* variable is negative and statistically significant for full sample and the second sub-period, which indicate that banks with a greater number of branches generate lower revenues. Or in other words, the effect of ln*BR* suggests that the increased cost of maintaining a higher branch network dominates the negative effects of maintaining market share. The coefficient of the ln*BR* variable is positive and statistically insignificant for the first sub-period. The results obtained from the regression analysis are presented in Tab. 8.

Table 8 Test of competitive conditions dependent variable lnNITA

Variable	2002 – 2009	2002 – 2005	2006 – 2009
Intercept	-0.0578 (-0.6233)	-0.5211[c] (-1.8041)	-0.0916 (-1.0942)
ln*PL*	-0.0025 (-0.5938)	-0.0000 (-0.0083)	-0.0056 (-1.4495)
ln*PK*	0.0349[a] (6.2997)	0.0148 (0.8079)	-0.0089 (-1.6628)
ln*PF*	0.0068 (1.3750)	0.0232[b] (2.1493)	-0.0018 (-0.6132)
ln*ASSET*	0.0040 (0.6591)	0.0413[b] (2.0489)	0.0064 (1.1779)
ln*BR*	-0.0157[a] (-3.0382)	0.0040 (0.3777)	-0.0193[a] (-2.8834)
ln*RISKASS*	0.0127[b] (2.5391)	0.0018 (0.1835)	0.0132[b] (2.1299)
H0: μ_i=0	*F* (29, 204) = 2.4338[a]	*F* (29, 84) = 1.4516[c]	*F* (29, 84) = 7.6584[a]
H0: *H*=0	*F* (1, 204) = 22.5159[a]	*F* (1, 84) = 3.4735[c]	*F* (1, 84) = 4.0819[b]
H1: *H*=1	*F* (1, 204) = 13449.15[a]	*F* (1, 84) = 2229.97[a]	*F* (1, 84) = 15446.73[a]
H	0.0391	0.0380	-0.0163

[a, b, c] denote significance at 1%, 5% and 10% level, t-values in parentheses

Source: Authors' calculation

The null hypothesis that the bank fixed effects are jointly zero (H0: μ_i=0) is rejected at the 1% significance level for the full sample as well as for the second sub-sample and the 5% significance level for the first sub-sample. This indicates the usefulness of the fixed effects panel model and suggesting that the base levels of the dependent variables differ.

A significance test on the sum of the input elasticities shows that the *H* statistic lies between zero and unity in the full sample and in the first sub-period. The results show that Wald statistic for testing the null hypotheses *H*=0 and *H*=1 can both be rejected at the 1% significance level for full sample, which indicates the monopolistic competition. For the first sub-sample the null hypotheses *H*=1 can be rejected at the 1% significance level and null hypothesis *H*=0 can be rejected at the 10% significance level, which also indicates monopolistic competition. By contrast, the *H* statistic in the second sub-period is non-positive, which indicates monopoly.

We can conclude that the Turkish banking industry can be characterized as the monopolistic competition in the period 2002-2009. From our analysis of competition is evident that intensity of competition decreased over the estimated period. We find the

monopoly in the banking industry in the second sub-period. Our result is in consistent with the empirical literature, which estimated competitive condition in the Turkish banking sector.

7. CONCLUSIONS

The aim of the paper was to examine the degree of competition and concentration in the Turkish banking industry during the period 2002-2009. Using the concentration ratio of the three and five largest banks and the Herfindahl-Hirschmann index we find that Turkish banking sector is almost non-concentrated. The highest concentration was in the Turkish deposits market, which it is possible characterize as slightly concentrated. The concentration of the credit market and the banking sector measures by total assets was very similar and both of the markets we characterized as non-concentrated.

Next, we apply the Panzar-Rosse model to estimate the competition condition in Turkish banking sector. The *H* statistic computed for the full sample is 0.0391, the *H* statistic for the first sub-period is 0.0380, and the *H* statistic for the second sub-period -0.0163. The Turkish banking sector in the first sub-period and second sub-period operate under monopoly condition. When we analyse full sample the bank operate under monopolistic competition, but the value of the *H* statistic is around zero, therefore the competition approaches to monopoly condition. Our result implies that the banks in Turkey do not operate in a competitive environment, and enjoy monopoly rents. We can conclude that competition conditions decrease during analyses period. As argue Chan et al. (2007), increases in the *HHI* generally indicate a loss of pricing power and a decrease in competition, whereas decreases imply the opposite. Thus, we can conclude that our findings show relationship between concentration and competition. In analysis period, concentration measures by *CR* and *HHI* increase over the time and competition condition decrease over the time.

As argues Bikker (2003) a disadvantage of the PR approach is its assumption that banks provide one banking product only. Hence, it does not allow us to distinguish between different products or geographical markets, which by the way would also be hampered by a lack of required data, e.g. bank-level interest rates and production figures. Therefore we suggest use other models for further development, e.g. Bresnahan's model can play a supplementary role, as it allows the investigation of submarkets, due both to its nature and to its data requirements.

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