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# Empirical analysis of collusive behaviour in the Turkish deposits market

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This paper examines the degree of cartel formation in the Turkish banking industry for the period 2002–2011. Taking up a conjectural variation approach, it is found that Turkish banks appear to have exercised collusive pricing during the sample period. This result is a reflection of the fines imposed by the Competition Authority on March 8, 2013 after its recent investigation of the banking industry. It was also found that the size distribution of banking institutions is significant in explaining the differences in conduct patterns, and in particular, smaller banks have acted more collusively than larger ones. The estimation results also demonstrated that there has been less collusive behaviour among Turkish banks following the 2008 global financial crisis.

**Keywords:** Turkish banking; market structure; competition; conjectural variation

**JEL classification:** G21, L13, L22

## 1. Introduction

Recently, the banking industry in Turkey has been in the spotlight due to an ongoing investigation by the Turkish Competition Board regarding alleged collusive behaviour among 12 major banks. These banks were accused of conducting anti-competitive policies regarding loan and deposits rates as well as credit card services. Despite strident objections by the media and the banking industry, on March 8, 2013, the Competition Board imposed fines totalling US$620 million, which is the largest amount in its 16-year history.[1] In an earlier investigation, the Competition Board also fined seven major banks after its investigation regarding the 'gentlemen's agreement' among the eight largest banks in the industry. At that time, these banks were accused of engaging in anti-competitive agreements regarding the limitations of promotions offered to private and government companies for salary payments. On March 8, 2011, the Competition Board imposed fines totalling US$46 million (Turkish Competition Board, 2011).[2] This evidence suggests that Turkish Banking industry may, in fact, not be that competitive.

The Turkish banking industry is known to be highly concentrated in comparison with other banking markets in the world (see Banking Regulation and Supervision Agency (BRSA), 2012 report).[3] For example, the ten largest banks account for more than 83% of the total assets in the industry over the last decade. Even higher levels of concentration are observed in the deposits market, where the top ten banks are in possession of around 86% of the total deposits. Another important characteristic of the Turkish banking indus-

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try is the broad range of size dispersion among banks (see BRSA, 2012 report). A comparison of the shares of deposits and depositors indicates that there are very large banks, such as Ziraat Bank and Is Bank, and also smaller banks operating in the deposits market. It is also important to note the significance of Ziraat Bank in the deposits market, as it accounts for almost 30% and 39% of total deposits and depositors, respectively.

According to the Structure-Conduct-Performance (SCP) paradigm,[4] higher concentration in an industry leads to higher bank profitability, and hence bad performance in terms of social welfare. The high profits observed in the Turkish banking industry relative to others in the world confirm the SCP paradigm (see BRSA Report). Given the high fees and commissions charged by banks, this oligopolistic structure of the industry casts doubt on whether or not competitive conduct among Turkish banks is possible. Several studies have examined the competitive conditions of different market segments of the Turkish banking industry. For example, Akin, Aysan, Kara, and Yildiran (2010) have shown that the credit card market in Turkey is not competitive, and Aydemir (2012) has found evidence of collusion in the Turkish loan market.[5]

Prompted by these observations, I examine the possibility of collusion in the Turkish deposits market using a conjectural variation approach (Roller & Sickles, 1995). This approach has been applied to evaluate the degree of oligopolistic coordination between banks in countries such as the US (Shaffer, 1989), Canada (Shaffer, 1993), Portugal (Canhoto, 2004), Italy (Coccorese, 2005), Hong Kong (Wong, Wong, Fong, & Choi, 2007), Thailand (Mahathanaseth & Tauer, 2012) and Turkey (Aydemir, 2013). All these studies, with the exceptions of Mahathanaseth and Tauer (2012), Canhoto (2004) and Aydemir (2013), found no significant evidence for collusion in the corresponding banking markets. Using the same conjectural variation framework, I find that the Turkish banks under consideration actually have exercised collusive pricing in the deposits market during the period 2002–2011. Owing to the broad size dispersion observed in the data, I also investigate the effect of size distribution on the competitive conduct of the industry. Estimation results indicate that the size distribution of banking institutions is significant in explaining the differences in conduct patterns. In particular, smaller banks have acted more collusively than larger ones. Lastly, this paper looks at the impact of the 2008 global financial crisis on the industry, and the empirical findings detect less collusive behaviour among Turkish banks following the crisis.

## 2. Model and empirical methodology

With the aim of examining competition in the Turkish deposits market, we consider the static partial equilibrium model developed by Freixas and Rochet (1997).[6] In the model, there are $N$ banks competing in the markets for loans ($L$), deposits ($D$) and securities ($S$). Banks choose their prices (i.e., interest rates) to maximise their profit functions. As in the literature, in the securities market each bank is assumed to be small compared with the market size, hence banks are supposed to be price-takers. However, I assume product differentiation between banks as well as price competition in markets for loans and deposits. Thus, banks' decision variables are loan and deposit interest rates. Another important assumption is that banks' demand for loans and supply of deposits is separable (Adams, Roller, & Sickles, 2002). The supply of deposits depends on their own interest rates and a weighted average of the other remaining $N$–1 rivals' interest rates. In other words, we consider a duopoly game being played by each bank and the other remaining $N$–1 rivals as one big group. Hence, each bank is expected to contend with the following supply function for deposits:

$$Q_{it} = Q_{it}(p^Q_{it}, p^Q_{jt}, Z_{it}) \tag{1}$$

where $Q_{it}$ is the quantity of deposits supplied by bank $i$, $p^Q_{it}$ is the deposit rate set by bank $i$, $p^Q_{jt}$ is a weighted average of competitors' prices where weights are defined as the share of each rival bank in terms of deposits supplied, and $Z_{it}$ is a vector of exogenous factors affecting supply. Here, the own-price elasticity of supply is expected to be positive, while cross-price elasticity is expected to be negative.

Each bank is assumed to have the following separable cost function incorporating the relevant bank activities:

$$C_{it}(Q_{it}, L_{it}, S_{it}) = C^Q_{it}(Q_{it}, \ldots) + C^L_{it}(L_{it}, \ldots) + C^S_{it}(S_{it}, \ldots) + \bar{C}_{it} \tag{2}$$

where $\bar{C}_{it}$ represents fixed costs and other components of the total cost function represent operating variable costs for corresponding activities (deposits, loans and securities).

Omitting the time subscripts for notational convenience, the profit function of each bank can be written as

$$\pi_i = p^L_i L_i + p^S S_i - (p^Q_i - \lambda r)Q_i - C_i(L_i, Q_i, S_i) \tag{3}$$

where $p^L_i$ and $p^Q_i$ represent the interest rates charged on loan and deposits, respectively, $p^S$ represents the security market rate, $S_i$ is the net amount of securities of bank $i$, $r$ is the required reserve ratio and $\lambda$ the rate of return on reserves.

Due to the separability assumption and the balance sheet equality[7] $L_i + S_i + rQ_i + \overline{A}_i = Q_i + \overline{L}_i$, the total profit function can be decomposed as $\pi_i = \pi^L_i + \pi^Q_i + \overline{\pi}_i$
where

$$\begin{aligned} \pi^Q_i &= [p^S(1-r) + \lambda r - p^Q_i]Q_i - C^Q_i(Q_i, \ldots) \\ \pi^L_i &= (p^L_i - p^S)L_i - C^L_i(L_i, \ldots) \\ \overline{\pi}_i &= p^S(\overline{L}_i - \overline{A}_i) - C^S_i(S_i, \ldots) - \overline{C}_{it} \end{aligned} \tag{4}$$

Now, one can analyse competition exclusively in the deposit market by examining the profit function, $\pi^Q_i$, due to the separability assumption. Each bank maximises $\pi^Q_i$ with respect to $p^Q_i$

$$\frac{\partial \pi^Q_i}{\partial p^Q_i} = -Q_i + \left[p^S(1-r) + \lambda r - p^Q_i - MC^Q_i\right]\left(\frac{\partial Q_i}{\partial p^Q_i} + \frac{\partial Q_i}{\partial p^Q_j}\frac{\partial p^Q_j}{\partial p^Q_i}\right) = 0 \tag{5}$$

where $MC^Q_i(.) = \frac{\partial C^Q_i}{\partial Q_i}$ is the marginal operating cost function. Note that marginal operating costs of securities are assumed to be relatively small, and thus can be ignored. After rearranging equation (5), I obtain the following price-cost margin equation:

$$\left[p^S(1-r) + \lambda r - MC^Q_i\right] - p^Q_i = \frac{p^Q_i}{\varepsilon_{ii} - \theta_i \varepsilon_{ij} \frac{p^Q_i}{p^Q_j}} \tag{6}$$

Here, $(\varepsilon_{ii} = \left(\frac{\partial Q_i}{\partial p^Q_i}\right)\left(\frac{p^Q_i}{Q_i}\right)$ and $\varepsilon_{ij} = \left(\frac{\partial Q_i}{\partial p^Q_j}\right)\left(\frac{p^Q_j}{Q_i}\right)$ are the own-price and the cross-price elasticity of supply, respectively, and $\theta_i = \frac{\partial p^Q_j}{\partial p^Q_i}$ is the conjectural variation parameter of bank $i$, which captures bank $i$'s conjecture about the competitors' pricing response for any change in its own price. Given that banks have a positively sloped supply of deposits, the price-cost margin equation (6) essentially characterises the deposits demand function of bank *i*. The left-hand side of the price-cost margin equation represents the deviation between the net revenue from each unit of deposits collected and the interest rate paid to depositors. The net revenue, in turn, is equal to the return on deposits in the security market, $p^S(1-r)$, and the return on reserve requirements, $\lambda r$, and the net of marginal operating costs of deposits, $MC_i^Q$.

The conjectural variation parameter, $\theta_i$, expresses the degree of coordination of banks. Positive values of $\theta_i$ suggest collusive behaviour among banks, since a bank expects rivals to match its price. In particular, a unit value of $\theta_i$ indicates perfect collusion. The conjectural derivative being equal to zero indicates a Nash equilibrium in prices, that is, each bank does not react to its rivals' actions. As the third case, a negative $\theta_i$ suggests more competitive behaviour than the Nash equilibrium in the industry. Specifically, when $\theta_i = -\infty$, the industry is perfectly competitive, as the interest rate on deposits is equal to the net return on deposits.

To estimate the relevant parameters, in particular including $\theta_i$, we construct the structural model, which consists of the supply equation (1) and the price-cost margin equation (6). We assume the following linear specifications for the deposits' supply and marginal cost functions:

$$Q_i = \alpha_0 + \alpha_1 p_i^Q + \alpha_2 p_j^Q + \alpha_3 GDP + \alpha_4 EMP_i + \alpha_5 (p_i^Q EMP_i) + \varepsilon_i \tag{7}$$

$$MC_i^Q = \beta_0 + \beta_1 Q_i + \beta_2 w_i^K + \beta_3 w_i^E + \beta_4 \left(\frac{EMP_1}{BRA_i}\right) \tag{8}$$

Here, $Q_i$ is the deposits collected by bank *i*, $p_i^Q$ is the interest rate paid on deposits by bank *i*, $p_j^Q$ is the weighted average of interest rates paid on deposits collected by bank *i*'s rivals, GDP is the gross domestic product, $EMP_i$ is the number of employees of bank *i*, $MC_i^Q$ is the marginal cost of deposits in bank *i*, $w_i^K$ is the price of physical capital in bank *i*, $w_i^E$ is the price of labour in bank *i*, and $\frac{EMP_1}{BRA_i}$ is the number of employees per branch in bank *i*.

In specification (7), $\alpha_1$, the own-price effect is expected to be positive, whereas $\alpha_2$, the cross-price effect, is expected to be negative, while other things are equal. To account for overall economic activity, GDP is included and $\alpha_3$ is expected to be positive since people tend to save and thus deposit more as the economy grows. To control for the network size effect, the number of employees is utilised not only individually but also multiplicatively, interacting with the own-price. It is important to note that the interaction term $p_i^Q EMP_i$ ensures that all parameters are identified in the model. Specifically, equations (1), (6) and (5) identify the conjectural variation parameter $\theta_i$ (Bresnahan, 1982). The overall impact of the number of employees, $\alpha_4 + \alpha_5 p_i^Q$, on deposits supply is expected to be positive. Regarding the marginal cost function in equation (8), $\beta_1$ could be positive or negative depending on the returns to scale of the sample. Microeconomic theory suggests that input price parameters, $\beta_2$ and $\beta_3$, are expected to be positive. Positive values of $\beta_4$ would indicate that there are scale diseconomies at the branch level. In other words, more employees per branch may suggest inefficiency, and thus, higher marginal costs. On the other hand, negative values of $\beta_4$ would imply scale economies at the branch level.

## 3. Data and estimation

We use an unbalanced panel dataset of 139 annual observations for the estimation. The sample spans from 2002 to 2011 and includes 14 commercial banks and hence we observe nine cross-sectional units over 10 years in the panel. I restrict my sample to include only domestic and foreign commercial banks, and participation banks, investment banks and other very small banks have been excluded from the sample. The sample, which accounts for more than 90% of total banking assets, includes the following banks: Akbank, Denizbank, Finansbank, Fortisbank, HSBC, INGBank, Sekerbank, TEB, Ziraat Bank, Garanti, Halkbank, Is Bank, Vakifbank, and Yapi Kredi Bank.[8] Note that all of the banks in the sample, except for Sekerbank and Fortisbank, were fined by the Competition Board on March, 8, 2013.

The relevant variables in this study were constructed using data provided by the Turkish Banking Association's website. Variables such as interest rates and input prices are proxied using banks' balance sheets, since they are otherwise not publicly available. In particular, the deposits interest rate is calculated as the ratio between interest expenses on deposits and total deposits. I use the interbank money market rate as a proxy for the security market rate. The price of labour is calculated as the ratio between personnel expenses and the number of employees, and the price of physical capital is calculated as the ratio between the non-interest expenses aside from labour costs and total assets. Table 1 presents some summary statistics of the variables in the sample. All relevant variables are deflated by the consumer price index and expressed in 1998 TL values.

I estimate three different systems of equations to address three different issues. First, I consider a single conjectural variation parameter for the whole sample to investigate the average competitive conduct in the deposits market. In all three specifications, I also examine whether the presence of Ziraat Bank, the largest bank in terms of assets, deposits and the number of branches, has an effect on competitive conduct in the industry. To that end, I include a dummy variable, the Ziraat Bank dummy ZD, in which both deposit supply and marginal cost function as follows:

$$Q_i = \alpha_0 + \alpha_{ZD}ZD + \alpha_1 p_i^Q + \alpha_2 p_j^Q + \alpha_3 GDP + \alpha_4 EMP_i + \alpha_5 (p_i^Q EMP_i) + \varepsilon_i \quad (9)$$

$$MC_i^Q = \beta + \beta_{ZD}ZD + \beta_1 Q_i + \beta_2 w_i^K + \beta_3 w_i^E + \beta_4 \left(\frac{EMP_1}{BRA_i}\right) \quad (10)$$

Here, $\alpha_{ZD}$ is expected to be positive due to the dominant position of Ziraat Bank in the Turkish banking industry. However, $\beta_{ZD}$ could be negative or positive depending on the relative positions of the marginal cost curves of the banks. After rearranging the price-

Table 1. Summary statistics of variables.

| Variable | Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|
| $p^Q$ | 0.092 | 0.048 | 0.036 | 0.390 |
| $w^E$ | 33.363 | 4.816 | 18.258 | 44.564 |
| $w^K$ | 0.040 | 0.018 | 0.015 | 0.144 |
| $Q$ | 174029.65 | 153703.27 | 19775.21 | 705134.53 |
| $EMP$ | 9771.90 | 5950.57 | 1,673 | 24,887 |
| $BRA$ | 512.827 | 330.595 | 75 | 1,448 |
| $p^S$ | 0.189 | 0.1135 | 0.030 | 0.495 |

Source: Author's own calculations using data provided by the Central Bank of the Republic of Turkey (CBRT).

cost margin equation (6), I get the following demand equation for deposits to estimate the parameters in the system:

$$p_i^Q = p^S(1-r) - MC_i^Q - \frac{Q_i}{\alpha_1 + \alpha_2\theta_i + \alpha_5 EMP_i} \tag{11}$$

Using the supply equation (9), and the demand equation (11), the first model is constructed for estimation. I incorporate the marginal costs functions (8) or (10) separately into the demand equation. Note that, as in the literature, the return on required reserves $\lambda$ is assumed to be zero in the demand equation (11) for estimation.

Since I estimate a system of nonlinear equations, I need a systems estimator due to the presence of dependent regressors in both sides of the supply and demand equations. In other words, the simultaneous equation bias should be addressed first or else the parameter estimates could be biased. There are three possible candidates for this estimator: full information maximum likelihood (FIML), nonlinear three stage least squares (N3SLS) and GMM. The error terms in both equations turned out to be not normally distributed and hence the FIML method is not utilised in the estimation, since it requires normality of error terms. I selected the GMM method from among the remaining two methods for two reasons. First, I employ different combinations of exogenous variables and their cross products as instruments. Although the estimation results are similar, the variation in GMM parameter estimates is less than the one obtained through N3SLS. Second, the error terms in the model suffer from the problem of heteroscedasticity, and the GMM method is known to provide efficient estimates under heteroscedasticity. It is for this reason that all specifications are estimated through GMM using SAS 9.1 in the paper. Table 2 displays the estimation results.

In the supply of deposits, the estimation results suggest that the own-price effect ($\alpha_1$) is positive and significant in the first two specifications of the first model. As expected,

Table 2. Estimation results for the single conjectural variation parameter model.

| Model | No ZD Dummy | | $\alpha_{ZD}$ | | $\alpha_{ZD}$ & $\beta_{ZD}$ | |
|---|---|---|---|---|---|---|
| | Estimate | t-value | Estimate | t-value | Estimate | t-value |
| Supply | | | | | | |
| $\alpha_0$ | −332,201 | −1.29 | −333,199 | −1.21 | −304,872 | −1.21 |
| $\alpha_{ZD}$ | | | −27,540.2 | −0.14 | −20,016.4 | −0.12 |
| $\alpha_1$ | 8,062,516 | 3.12*** | 8,042,117 | 1.72* | 6,835,438 | 1.35 |
| $\alpha_2$ | −3,197,498 | −2.77*** | −3,219,404 | −1.33 | −2,746,954 | −1.14 |
| $\alpha_3$ | −0.00013 | −0.48 | −0.00013 | −0.43 | −0.00009 | −0.34 |
| $\alpha_4$ | 56.35489 | 5.16*** | 56.83348 | 3.33*** | 52.85266 | 2.84*** |
| $\alpha_5$ | −428.369 | −3.10*** | −428.588 | −2.18** | −372.14 | −1.67* |
| Demand | | | | | | |
| $\beta_0$ | −0.19971 | −0.55 | −0.22577 | −0.56 | −0.17242 | −0.33 |
| $\beta_{ZD}$ | | | | | −0.39485 | −1.07 |
| $\beta_1$ | 5.569E-7 | 1.78* | 5.253E-7 | 1.48 | 1.16E-6 | 1.31 |
| $\beta_2$ | −0.01204 | −1.74* | −0.01076 | −1.44 | −0.01192 | −1.21 |
| $\beta_3$ | 1.37599 | 0.41 | 2.10799 | 0.57 | 4.78655 | 0.79 |
| $\beta_4$ | 0.02999 | 2.20** | 0.02729 | 1.98* | 0.01630 | 0.92 |
| Conduct | | | | | | |
| $\theta$ | 0.95874 | 4.69*** | 0.94391 | 4.02*** | 0.90773 | 3.47*** |

Note: ***, **, * represent 1, 5 and 10% significance, respectively.
Source: Author's own calculations.

the cross-price ($\alpha_2$) is negative in all specifications and significant only in the first one. The slope of the supply function is also positive ($\frac{dQ}{dp^Q} = \alpha_1 + \alpha_2\theta + \alpha_5 EMp > 0$). Larger banks are shown to supply more deposits, as $\frac{dQ}{dEMP} = \alpha_4 + \alpha_5 p^Q$ is positive. However, the impact of GDP on deposits supply captured by $\alpha_3$ and intercept parameters $\alpha_{\mathrm{ZD}}$ are not significant in the above specifications.

Regarding the demand equation, the estimated parameter of the output variable, $\beta_1$, in the marginal cost specification is positive in all three specifications but significant at a level of 10% only in the first model. The parameter $\beta_4$, which represents the impact of the number of employees by branch on marginal costs, is positive and significant in the first and the second model, indicating decreasing returns to scale relative to branch size. $\beta_{\mathrm{ZD}}$ is estimated to be insignificant. The price of the labour parameter, $\beta_2$, is significant at the 10% level only in the first specification but is unexpectedly negative, which is not consistent with microeconomic theory. This contradictory result may have to do with the quality of the data used in the estimation or a high degree of substitution among input factors in delivering deposits (see Canhoto, 2004, and Roller & Sickles, 2000, for a similar unexpected result). The estimates of the other variables have expected but insignificant signs.

As regards the conduct parameter, the estimation results suggest that Turkish banks have exercised cartel pricing during the sample period in all three specifications, as evidenced by $\theta$ being close to one. The hypothesis test of $\theta$ equalling one indicates that the conduct parameter is not significantly different from one revealing perfect collusion or cartel formation among banks. This result is consistent with earlier findings in the empirical banking literature, including Neven and Roller (1999) who demonstrated cartel-like behaviour in the 1980s in a sample of European banking markets. Aydemir (2013) also reveals the same collusive outcome, although perfect collusion was not shown for the Turkish loan market during the period 1988–2009.

The second model is designed to address the question of whether the size distribution of the banks plays a significant role in competitive conduct in the industry. For that purpose, I divide the banks in the sample into three categories: small, medium and large.[9] I assign a size dummy for each category, and hence have three corresponding conduct parameters. For example, the $\mathrm{size_l}$ dummy takes a value of one for banks belonging to the large category, and otherwise it is zero. Other size dummy variables are defined similarly. Larger banks are expected to act more competitively than smaller banks. In other words, their conduct parameters are expected to be lower and closer to Nash behaviour than those of smaller ones. Large banks such as Ziraat Bank or Akbank are older than their smaller rivals, and hence might enjoy a stronger and more loyal relationship with their customers. Therefore, their response to any change in prices set by rivals would be moderate. In this sense, their behaviour may be closer to Nash behaviour in which banks take prices as given. However, smaller banks, as they are new in the market, would take into full consideration their rivals, since they are more eager to grow and capture a larger market share (see Bikker & Haaf, 2002, for a similar argument). The effect of size distribution on competitive conduct is examined by the second model, which is comprises the supply equation (9) and the demand equation (12), which is as follows:

$$p_i^Q = p^S(1-r) - MC_i^Q - \frac{Q_i}{\alpha_1 + \alpha_2(\theta_s size_s + \theta_m size_m + \theta_l size_l) + \alpha_5 EMP_i} \tag{12}$$

Table 3. Estimation results for size distribution and global crisis models.

| Model | Size distribution | | Global crisis | |
|---|---|---|---|---|
| | Estimate | t-value | Estimate | t-value |
| Supply | | | | |
| $\alpha_0$ | −194,106 | −2.11** | −223,759 | −2.28** |
| $\alpha_{ZD}$ | 108,400.6 | 4.22*** | 114,714.7 | 4.31*** |
| $\alpha_1$ | 3,087,112 | 3.21*** | 3,480,012 | 3.99*** |
| $\alpha_2$ | −1,143,864 | −2.69*** | −1,107,587 | −2.81*** |
| $\alpha_3$ | −7.14E-6 | −0.06 | −0.00002 | −0.18 |
| $\alpha_4$ | 38.04042 | 9.07*** | 41.22921 | 11.7*** |
| $\alpha_5$ | −199.083 | −3.76*** | −236.464 | −5.03*** |
| Demand | | | | |
| $\beta_0$ | 1.42590 | 1.04 | 3.32728 | 2.24** |
| $\beta_{ZD}$ | −1.22389 | −1.94* | 0.21297 | 0.29 |
| $\beta_1$ | 2.726E-6 | 2.25** | 2.345E-6 | 1.03 |
| $\beta_2$ | −0.00792 | −0.34 | −0.05791 | −1.95* |
| $\beta_3$ | −0.731 | −0.07 | 37.952 | 1.78* |
| $\beta_4$ | −0.05488 | −1.71* | −0.19777 | −3.54*** |
| Conduct | | | | |
| $\theta_l$ | 0.779541 | 3.75*** | | |
| $\theta_m$ | 0.86299 | 3.66*** | | |
| $\theta_s$ | 1.10652 | 4.94*** | | |
| $\theta_1$ | | | 0.81541 | 3.68*** |
| $\theta_2$ | | | 0.61998 | 2.67*** |

Note: ***, **, * represent 1%, 5% and 10% significance, respectively.
Source: Author's own calculations.

The first two columns in Table 3 display the estimation results of the second model. To compare the results with the single conjectural variation parameter model, I present the results from the first specification where no Ziraat dummy is used in either the supply or marginal cost functions. Note that all three specifications (No ZD, $\alpha_{ZD}$, and $\alpha_{ZD}$ & $\beta_{ZD}$) yield similar results in terms of signs and significance of the estimates. All parameters in the supply equation have expected signs and most of them are statistically significant. Here, $\alpha_{ZD}$, which is positive and highly significant, indicates that the supply curve of Ziraat Bank is shifted outward relative to the other banks, as expected. Regarding the demand equation, the estimated parameter for the output variable in the marginal cost specification is positive and significant. But the other parameters, except for $\beta_{ZD}$ and $\beta_4$, are insignificant. The negative value of $\beta_{ZD}$ suggests that Ziraat has a lower marginal cost schedule relative to the other banks in the sample. On the other hand, the negative value of $\beta_4$, which captures the efficiency of branches, indicates an increasing returns to scale relative to this efficiency measure.

The highly significant estimates for the three conduct parameters suggest that banks' size matters in explaining the differences in conduct patterns. In fact, if we compare the first model (single conduct parameter) and the second one (size specific conduct parameters) using log likelihood ratio tests, the restricted model (the single parameter model) turns out to be significantly different from the non-restricted one (the size distribution model).[10] In other words, the estimation results suggest that smaller banks have acted more collusively than larger ones during the sample period, as posited in the argument mentioned above. This result is also consistent with the findings of Bikker and Haaf (2002).

Finally, we investigate the impact of the 2008 global crisis on the Turkish banking industry to see how competitive conduct evolves over time. We define a time dummy variable to allow for different conduct parameters before and after 2008. For example, the dummy variable $time_1$ takes a value of one for year being less than or equal to 2008, and otherwise it takes value of zero. The dummy variable $time_2$ is similarly defined. Due to the challenges in global finance associated with the crisis, one would expect that the banking industry has behaved more competitively after the crisis than before. The third model is constructed to examine this issue, where now the demand equation is written as

$$p_i^Q = p^S(1 - r) - MC_i^Q - \frac{Q_i}{\alpha_1 + \alpha_2(\theta_1 time_1 + \theta_2 time_2) + \alpha_5 EMP_i} \tag{13}$$

where $\theta_1$ and $\theta_2$ are the conduct parameters for the corresponding time dummies. Hence, the third specification comprises the supply equation (9), and the demand equation (13), with the marginal cost function as in equation (8) or equation (10). The last two columns of Table 3 display the estimation results of the third model (no ZD specification).

The estimation results in the last two columns of Table 3 indicate that the parameter estimates for the supply and the demand equation are very similar to the previous case. Concerning the conduct parameters, I find that the 2008 global financial crisis had a significant impact on the Turkish banking industry, as evidenced by $\theta_2 = 0.61998 < \theta_1 = 0.81541$. This is not a surprising result. We know from the theoretical and empirical industrial organisation literature that collusion is easier to sustain during economic booms. The reason is that if collusion breaks down, the loss in profits is larger during booms. However, during recessions it is harder to sustain collusion (Green & Porter, 1984). The Turkish economy fell into deep recession after the global crisis as the GDP growth rate was –4.8% in 2009. Hence, consistent with the findings in the literature, banks in the sample tend to behave less collusively after the 2008 global crisis. According to the log likelihood test, the global crisis model is significantly different from the single parameter model since the actual $\chi^2$ test statistic is 9.62, which is larger than the critical value at a 1% significance level.

I also calculate mark-up in the deposits market as the ratio between the interest rate paid to depositors and the net return obtained by the bank for each unit of deposits, as in Canhoto (2004).

$$Mark - up = \frac{p^Q}{p^S(1 - r) - MC^Q} = \frac{\eta}{1 + \eta} \tag{14}$$

As the industry becomes more competitive, mark-up tends to increase. In the extreme case of perfect competition, the interest rate paid to depositors equals the net revenue

Table 4. Elasticities and mark-up values.

| | Single parameter | Size dispersion | Global crisis |
|---|---|---|---|
| $dQ/dp^Q$ | 811,507.8 | 2,969,396.1 | 331,557.5 |
| $\varepsilon_{ii}$ | 2.050 | 0.604 | 0.618 |
| $\varepsilon_{ij}$ | −1.894 | −0.677 | −0.656 |
| $\eta$ | 0.429 | 0.051 | 0.175 |
| Mark-up (Model) | 0.300 | 0.049 | 0.149 |
| Mark-up (Nash) | 0.672 | 0.377 | 0.382 |

Source: Author’s own calculations.

received from each unit of deposits. If banks behaved as per the Nash equilibrium, the mark-up value would be given as $\varepsilon_{ii}/(1+\varepsilon_{ii})$. Table 4 presents the estimated mark-up values of the model and the hypothetical Nash case. As is expected, the mark-up values estimated in each model are smaller than one. For example, in the size dispersion model, a mark-up value equalling 0.049 indicates that banks pay 5% of their net returns from each unit of deposits to depositors as interest. Furthermore, mark-up values estimated from the models are much lower than those obtained from the Nash conduct case. This is another way of saying that the Turkish banks in the sample behaved collusively in the deposits market during the period 2002–2011.

## 4. Conclusion

In this paper, I estimate a structural model to examine the competitive conduct of the Turkish banks in the deposits market for the period 2002–2011. I find that the Turkish banks appear to have exercised collusive pricing during the sample period. This result justifies the fines imposed by the Competition Authority after its recent investigation of the banking industry. I also investigate the effect of the size distribution of banking in conduct patterns. I show that smaller banks have acted more collusively than larger ones during the sample period. This expected result is due to the fact that large banks in Turkey, being older than their smaller rivals, enjoy a stronger and more loyal relationship with their customers. Therefore, their response to any change in competitors' prices would be moderate. In this sense, their behaviour may be closer to Nash behaviour where banks take prices as given. That is, they are more competitive than smaller banks. The estimation results also detect less collusive behaviour among the Turkish banks after the 2008 global financial crisis. The Turkish economy fell into deep recession after 2008 and we know from the literature that it is harder to sustain collusion during economic downturns. Hence, consistent with the earlier findings, the Turkish banks seem to act less collusively after the crisis.

Overall, the estimation results suggest that the Turkish banking industry is conducive to collusive behaviour because of historical and legal reasons. As a policy conclusion, the antitrust authorities and the banking regulators should be vigilant against the actions of the Turkish banks and increase systematic screening efforts. The authorities might also consider antitrust policies such as leniency programmes, which grant complete or partial exemption from fines for banks that collaborate with them.

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## Notes

1. *Hurriyet Daily News* article can be accessed from http://www.hurriyetdailynews.com/12-turkish-banks-fined-for-adopting-anti-competitive-loan-policy.aspx?pageID=238&nid=42,640. (Hurriyet Daily News, 2013).
2. Backing these fines, small banks have also raised concerns that large banks have undertaken efforts to prevent competition in the industry. For example, Halis Ozdemir, CEO of Aktif Bank of Turkey, argues that the fundamental problem in the Turkish banking industry is a lack of competition among large banks. (Finans Gundem, 2012). See http://www.finansgundem.com/haber/Buyuk-bankalar-rekabeti-engelliyor/88,410

3. BRSA Report can be accessed from http://www.bddk.org.tr/WebSitesi/english/Reports/Structural_Developments/10132byg5_eng_final_230911.pdf. (BRSA, 2012).
4. The empirical literature on the measurement of competition can be divided into two major streams: structural (the SCP paradigm) and non-structural (the Panzar-Rosse model and the Bresnahan model) approaches. The SCP paradigm argues that higher concentration in the banking market leads to less competitive bank conduct and higher bank profitability (see Berger, Demirguc-Kunt, Levine, & Haubrich, 2004, for a critical review). Owing to the theoretical and empirical deficiencies of this approach, however, non-structural methods have been developed. The P-R model presents a reduced form approach to discriminate between perfect competition, monopolistic competition, and monopoly. A test statistic (the H statistic), corresponding to the sum of elasticities of bank revenues with respect to factor input prices, serves as a measure of market competition (see Bikker & Haaf, 2002, for a broad review). The Bresnahan model estimates an unknown parameter (known as the conjectural variation parameter), which is derived through first order conditions of the profit maximisation of firms in an oligopolistic market (Bresnahan, 1989). It is based on the idea that when a bank chooses its price (or output), it takes into account the reaction of competitors. While avoiding making indirect inferences about market power based on indicators of concentration is a major advantage, these non-structural approaches require detailed information about cost and demand conditions.
5. Kasman (2001), Gunalp and Celik (2006) and Aktan and Masood (2010), using a different methodology, the Panzar-Rosse method, have found that the Turkish banking industry overall is monopolistically competitive (see Panzar & Rosse, 1987). However, Bikker, Finnie, and Spierdijk (2007) demonstrate that the level of competition in the Panzar Rosse literature is overestimated and that this empirical methodology suffers from problems of misspecification.
6. This so-called industrial approach to banking is based on studies by such authors as Klein (1971), Monti (1972) and Dermine (1984). The modelling framework in this paper is similar to the one adopted by Canhoto (2004) who investigated competition in the Portuguese deposits market.
7. The left-hand side of the equality represents uses of funds including other assets $\bar{A}_i$ such as physical capital. The right-hand side of the equality represents other liabilities $\bar{L}_i$ such as equity capital.
8. TEB and Fortisbank merged in 2011 under the auspices of TEB.
9. Large-sized banks: Ziraat, Is Bank, Akbank, Garanti, Yapi Kredi, Halkbank. Medium-sized banks: Vakifbank, Finansbank, Denizbank.Small-sized banks: INGBank, HSBC, Fortisbank, TEB, Sekerbank.
10. The actual $\chi^2$test statistic is 6.36 which is larger than the critical value at a 5% significance level.

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