

Determinants of Capital Structure in Financial Institutions: The Case of Turkey

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Abstract

This study analyzes the determinants of capital structure in the Turkish banking sector. We propose an empirical model in order to identify the factors that explain why banks hold capital beyond the amount required by the regulation. We used a panel data set that employs bank-level data from the Turkish banking sector covering the period 2002–2006 and estimated the model with generalized method of moments (GMM). The findings of this study suggest that lagged capital, portfolio risk, economic growth, average capital level of the sector and return on equity are positively correlated with capital adequacy ratio and share of deposits are negatively correlated with capital adequacy ratio.

Keywords: Capital Adequacy, Turkish Banking Sector, GMM.

JEL Classification: G21, G28, C23.

Özet - Finansal Kurumlarda Sermaye Yapısını Belirleyen Faktörler: Türkiye Örneği

Bu çalışmada Türk bankacılık sektöründe sermaye yapısının belirleyicileri analiz edilmektedir. Bankaların düzenlemelerdeki daha fazla sermaye tutmasını açıklayacak değişkenleri belirlemek için deneye dayalı bir model sunulmuştur. Türk bankacılık sektöründen 2002–2006 dönemini kapsayan banka düzeyinde veriler ile bir panel veri seti oluşturulmuştur. Model bu veriler kullanılarak genelleştirilmiş momentler metodu (GMM) ile tahmin edilmiştir. Bulgular gecikmeli sermayenin, portföy riskinin, ekonomik büyümenin, sektörün ortalama sermayesinin, ve sermaye getirisinin tutulan sermaye ile pozitif ilişkili olduğunu; buna karşılık varlık büyüklüğünün ve mevduat payının negatif ilişkili olduğunu göstermektedir.

Anahtar Kelimeler: Sermaye Yeterliliği, Türk Bankacılık Sektörü, GMM.

JEL Sınıflaması: G21, G28, C23.

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1. Introduction

Determinants of capital structure in financial institutions differ from non-financial institutions due to issues peculiar to these institutions. For banks, which constitute the largest portion of financial institutions in Turkey, liabilities relating to legal capital regulations are the most important factors determining the capital structure.

Banks generally hold more capital than the minimum capital ratios required by capital regulations that banks are obliged to meet. In general, this is explained by the fact that banks tend to operate in a prudential manner against probable shocks. However, recent studies demonstrate that factors that determine the capital adequacy ratio are not only limited to legal liabilities, but variables specific to banks are important in determining the level of capital.

We analyze the factors that determine the capital adequacy ratio in the Turkish banking sector in this study. Turkish banks currently hold considerably more capital than the regulatory minimum. By using a panel of bank-level data, we will empirically investigate the determinants of the capital adequacy ratio. We employ a dynamic model and estimate it with generalized method of moments. The level of risk assumed by a bank, asset size, alternative cost of capital, the share of deposits in non-equity liabilities, the average capital adequacy of the whole sector, and growth rates of the Turkish economy are the main variables that we employed in our regression analysis. We find that most of these variables are significant in explaining why banks hold excess capital.

The rest of this study is organized as follows. In the second section of this study, we will examine the concept of capital structure in financial institutions. In the third section, we will review the literature on the determinants of capital adequacy ratio in banks and provide detail on the development of capital adequacy regulations. In the fourth section, we will empirically analyze the determinants of capital adequacy in the Turkish banking sector using regression analyses for private deposit banks for the period 2002-2006. Finally we draw conclusions in the fifth section.

2. Capital Structure in Financial Institutions

Since the seminal paper of Modigliani & Miller (henceforth, M&M) in 1958, capital structure in companies has been among the most important topics in finance area. However, the issue of capital structure in companies has not been resolved. There is not a comprehensive theory that is able to explain the decisions of companies on financial structure. For financial companies, the literature on capital structure is very limited and the issue has not been addressed for these companies for long years (Marques and Santos, 2003).

Miller (1995), states in his study that the determinants of decisions relating to financing structure in banks have not been established through empirical analysis.

M&M theory argues that financing decisions cannot change the value of a company and the income of its shareholders under the assumption that markets are complete, perfect and frictionless. The important point is that the theory focuses on why the capital structure cannot change the value of the company rather than explaining its capital structure. Berger et al. (1995) study capital theory in financial institutions and examine why markets are not frictionless in detail. They lay out the fundamental reasons for markets not being frictionless as follows: a) Taxes and cost of financial distress, b) Transaction costs and asymmetric information.

These factors are valid for all companies, whether financial or not. For example, since interest payments reduce tax payments, but dividends do not have a similar effect, banks will be encouraged to have more borrowing in financing structure. Increased borrowing and accordingly, cost of financial distress will change the optimal capital structure. In such a case, capital structure will adjust such that the tax impact of a 1-unit borrowing increase is equal to the cost of financial distress. In another example from Berger et al. (1995), the authors demonstrate how asymmetric information and transaction costs affect the decisions relating to internal versus external finance. In this example, the information that bank managers have is not known by investors and therefore, investors may be reluctant to financing through new share issue. Transaction costs of issuing new shares may exacerbate this reluctance. In another words, transaction costs together with asymmetric information may affect the capital structure in a similar fashion to the cost of financial distress.

Berger et al. (1995) identify the above factors that affect the financing structure of all companies, financial and non-financial alike. They identify "safety net" as a factor that is functional on the capital structure of financial institutions only. Differently from non-financial companies, financial institutions are under protection by a safety net (practices such as deposit insurance system, payment guarantees, liquidity window they have on the occasion of sudden liquidity shortage etc.) that enables them to operate in a sound manner and they point to the importance of external factors that affect the capital structure of financial institutions.

Although the safety net can explain the difference in the capital structure of financial institutions and other companies, probably the most important factor that affects the capital structure of financial institutions is the legal capital requirements, or the "capital adequacy ratio."

There are various studies in the literature that emphasize the importance of capital adequacy ratio on the capital structure of financial institutions. For example, Osterberg and Thomson (1990) state that the capital structure of financial institutions differs from that of non-financial institutions and the impact of legal regulations on such a difference cannot be ignored. Furthermore, they point out that the theoretical framework that is applied to the capital structure of non-financial institutions cannot be applied one-to-one to financial institutions due to regulations relating to capital in financial institutions. Berger et al. (1995) state that the impact of legal capital requirements on capital held by banks is very important. They provide empirical evidence from the United States. The capital adequacy ratio, which was 6,21% the end of 1989 increased to 8,01% in 1993 following the enforcement of the legal framework. Haubrich and Wachtel (1993) state that the United States banks increased the proportion of low-risk government securities in their portfolios following the introduction of legal capital requirements.

Consequently, financial institutions, unlike non-financial institutions, have significant differences in capital structure for safety net reasons or their legal capital requirements. Thus, the fundamental issue is to understand the capital structure in financial institutions and more importantly, capital adequacy ratio and the determinants of this ratio.

3. Capital Adequacy Ratio and Its Determinants

3.1. Improvements in Capital Adequacy Regulations

Factors such as technological change, increased competition, and changes in customer demand forced financial institutions to expand the range of products they offer and improve their institutional structures. As a result, banks' balance sheets have become more complex and they are exposed to a wider set of risk.

Within this scope, it is critically important for stability that banks, which primarily extend funding to the real sector using external resources they obtained mainly from depositors, have the ability to manage these resources and the risks that emanate from their operations. It can be argued that there is a suggestive relationship between the quality of risk management of banks and the stability of the financial system. Negative consequences of bad management of a bank could possibly jump to other sectors of the economy and trigger economy-wide financial crises or deepen ongoing fluctuations. Therefore, it is important that banks manage their risks properly for the health of the whole economy. It has been adopted internationally that banks abide by minimum prudential regulations and strengthen their risk ma-

nagement for the sustained stability of the financial sector and the overall economy.

Capital adequacy regulations are deemed the most important quantitative instrument used by supervisory authorities to protect the rights of customers and to enhance the stability of the financial system. Their functions are such as covering possible unexpected losses emanating from the risks undertaken, increasing credibility, reducing the risk of systemic crises and creating a competitive environment.

Within this scope, Basel Committee on Banking Supervision (BCBS), a substructure under the Bank for International Settlements (BIS), set to work in order to evaluate the risks of banks that are active in international markets. In 1988, the “Capital Accord” named Basel I was published. It focused on the minimum capital to be held by banks in order to minimize the costs to depositors in case a bank goes bankrupt.

This regulation paved the way for the creation of international standards for capital adequacy. The Capital Accord defined capital for a bank and grouped its assets according to their risk into four groups. These groups were given risk weights of 0%, 20%, 50% and 100% from least risky to most risky assets. The accord determined a lower limit of 8% for “Capital to Risk Weighted Assets Ratio”. The accord was adopted beyond internationally active banks and contributed dramatically to increasing the capital adequacy ratios of banks throughout the world.

Over the course of time, the accord has been criticized by academics and large banks from various aspects. Its one-size-fits-all approach to capital adequacy made it difficult to apply it to banks with different fields of activities in the same manner. Its risk susceptibility is low due to the limited risk weights it employed. However, the simplicity of its standards facilitated the adoption of the accord especially by developing countries. It contributed to the modernization of regulations and increased competition in financial sectors of these countries.

The capital adequacy ratio, also known as Cooke Ratio, has initially been able to associate capital and risk and could measure capital both in monetary terms and as a ratio. Nevertheless, this ratio has proved insufficient as derivative instruments became more diversified and intensified, and off-balance sheet transactions were used more commonly. As a consequence, the Basel Committee established a capital adequacy sub group in order to address these issues. A report named as “The Supervisory Treatment of Market Risks” was published in April 1993 as a result in order to eliminate the deficiencies. The report stressed the necessity that banks hold sufficient capital for market risks they incur on- and off-balance sheet that stem from the changes in prices. Following the 1994 Mexican crisis, “Market Risk Assessment” was

published by the Basel Committee in January 1996. This study incorporated market risks from open positions, securities, and derivative products into the definition of capital adequacy. Market risks due to options were added for standard approaches and internal models based approaches in April 1998. The first accord became more sensitive to risk as a result of these efforts.

These amendments did not resolve all issues with Basel I. The notion of capital that was used in the risk based capital approach could not adequately explain a bank's capacity to compensate expected or unexpected losses. Risk criteria that were employed were not satisfactory. The accord disregarded the differences in credit risk in the risk assessment of assets. The Basel Committee's efforts to resolve these issues resulted in the publication of Consultation Paper 1 in 1999, which included proposals on the new capital adequacy, and this study led to the Basel II Accord.

The Basel Committee published the "New Basel Capital Accord (Basel II)" in June 2004 and revised it in November 2005. Basel II proposes fundamental improvements in the calculation of capital adequacy in comparison to Basel I. On the other hand, it emphasizes issues of supervision by authorities and market discipline. Implementation of Basel II requires special effort for both banks and supervisory authorities. The new accord basically aims at establishing a stronger supervisory infrastructure, strengthening risk management, increasing market discipline and achieving a globally sustainable financial stability. Within this scope, the New Accord is not solely a set of rules to achieve international convergence of capital adequacy definition, but also an approach that encourages banking supervisory authorities to view their financial systems with a wider perspective.

The new approach has three pillars: minimum capital requirements, prudential supervision of supervisory authorities, and market discipline. The Basel committee has modified some parts of the Basel Accord on minimum capital, and emphasized that risk profiles of banks should be defined in a detailed fashion. One important modification in this context is that, risk was defined more comprehensively to include interest rate risk and operation risk.

The second pillar of the capital adequacy framework is the supervision of the authority. This requires that the supervisory authority audits in such a way that banks' capital is adequate in comparison to its risk profile and its strategies. The supervisory authority is expected to intervene early in case a bank has insufficient capital to cover its risks. The supervisory authority could require certain banks to maintain levels of capital above the minimum capital adequacy ratio. Furthermore, the new framework indicates that bank management should develop internal assessment of capital and that it should set target capital levels parallel to the risk profile of the

bank. It is suggested that supervisory authorities be responsible from ensuring the adequacy of the internal assessment procedures and conformity with the rules.

The third pillar of the new accord is market discipline. It stipulates that market participants should be able to assess the situation of a bank. In order for such an assessment to be significant, banks should be sufficiently transparent to reveal the necessary information in time. It is the responsibility of the supervisory authorities to provide transparency.

Turkey acted quickly to include the first capital adequacy regulations into its national legislation and the Capital Adequacy Standard Ratio was put into effect gradually starting in 1989. The market risk regulations that were introduced in 1996 and 1998 by the Basel Committee were put into practice in 2001 and 2002.

The Banking Regulation and Supervision agency has taken important steps for compliance with the Basel II and announced that Turkish banks will calculate capital adequacy according to the Basel II rules starting in 2009.⁽¹⁾

3.2. Determinants of Capital Adequacy

Although many studies in the literature addressed the issue of determinants of capital adequacy of firms in general, there is not much research on the capital structure of banks. This is probably due to the fact that banks are structurally and functionally different from the non-financial sector. More recently, the determinants of capital adequacy ratios have received attention rather than the capital structures of banks.

Below, we summarize the factors that affect capital, based on the findings in the literature.

(a) Risk Level:

In banking, one of the most important determinants of capital is related to the risk that banks have taken. Legal regulations relate the level of capital that banks must maintain with the level of risks that they carry. The main reason of this is that capital is viewed as a shield against unexpected losses and bankruptcy. The level of risk taken in banking can be measured by the share of the risk weighted assets in the bank's total assets ($RISK = \text{Risk Weighted Assets} / \text{Total Assets}$).

The relation between portfolio risk and capital adequacy in banking is expected to be negative. Normally, increasing risk level would require a higher level of capital. However, the difference between the perception of risk of banks and the perception of risk of supervisory authorities can sometimes cause that this relation to

(1) See the announcement at http://www.bddk.org.tr/turkce/Duyurular/Basin_Aciklamalari/349623_07_2007.pdf

be positive. In other words, the assets that regulators find risky for banks could be seen not as risky by the managers (Wong et al. 2005). One other factor that can cause this negative relationship is the deposits insurance system. This system can increase the risk appetite of banks (Alfon et al. 2004).

(b) Asset Size:

In banking, level of risk is a relative concept. In order to understand in which level a bank takes risks, the asset size of a bank should also be taken into account. The general opinion is that asset size is inversely related to capital adequacy. For example, Kleff and Weber (2003) assert that large banks could maintain less capital due to their advantage in covering their capital requirements from external sources relatively easily. They also claim that capital requirements of large banks are lower, because they have less investment opportunities and that their portfolios are diversified to a large extent.

Wong et al. (2005) assert that risk management techniques of banks with large asset size are more developed than those of smaller banks. This provides some advantages to large banks in measuring the risks of borrowers through scale effect, and thus, they require less capital.

Alfon et al. (2004) claim that the main reason for small banks to maintain higher capital levels than larger banks is their aim to finance their long run business strategy. Since it is more costly for small banks to adjust their capital in case of a sudden capital requirement, they choose to carry more capital.

Therefore, inflation-adjusted asset size will be used as an independent variable for the regression analyses of the Turkish banking sector.

(c) Capital Adequacy of Previous Period:

The adjustment cost described above does not only vary across size. The capital adequacy of previous period is one of the factors that determine the cost of adjustment. Keeping too much capital can be a matter of concern in terms of profitability and efficiency, but an insufficient amount of capital could generate more negative results. Consequently, banks adjust capital by more than the minimum required amount. Therefore, the capital amount banks want to maintain in the current period can be associated with the capital amount of the previous period.

(d) Alternative Cost of the Capital:

One of the main determinants of capital that firms hold is the alternative cost of capital, in banking sector and the rest of the economy.

An increase in the alternative cost of capital decreases the willingness of banks to hold more capital. Holding excess capital does not have a large effect on profitability when cost of capital is low. As the most suitable indicator of alternative cost of the capital for banks is return on equity (ROE), it will be used in the regression analyses. ROE is adjusted for inflation using the consumer price index.

(e) Share of Deposits in Non-equity Liabilities:

Deposits are generally considered cheaper sources of funds compared to borrowing and similar financing instruments (such as financing by bond or syndication and securitization loans) for banks (Kleff and Weber 2003). Therefore, a decrease in the share of deposits in total liabilities creates a cost effect by increasing share the borrowed financing sources. As increasing cost can decrease the profitability of banks, banks will be in need of capital to compensate for this decrease.

Moreover, since creditors determine the risk premia by taking the capital adequacy ratio into consideration while lending to banks, this causes an increase in the amount of capital held by banks. Banks that do not want to experience an increase in the risk premia and a possible decrease in profitability generally prefer to have a capital adequacy ratio that is above the rate determined by regulations (Alfon et al. 2004).

Accordingly, one of the factors determining the capital adequacy for the banks is the share of deposits in their liabilities. In order to understand the effect of the share of deposits on capital adequacy, the share of deposits in non-equity liabilities is used as a variable in the regression analysis.

(f) The Average Capital Adequacy of the Sector:

It is not possible for the market participants to have the detailed information that supervisory authorities and private supervision companies have. For this reason, it can be argued that high capital adequacy will act as a signaling mechanism for the banks that want to change the perception of the market participants and rating companies positively (Alfon et al. 2004).

In order to see this signaling effect, we will use the average capital adequacy of the sector as an explanatory variable.

(g) Capital Adequacy Regulatory Pressure

In the literature, regulatory pressure is mentioned as another factor that may affect the capital adequacy ratio of banks. Capital adequacy regulatory pressure is the obligation to comply with the minimum capital adequacy ratios determined by regulatory and supervisory authorities.

In this framework, an important factor in determining the capital adequacy of banks is the regulatory pressure of the capital adequacy. However, while there is only one minimum capital adequacy ratio for all the banks in Turkey, in some countries banking regulation and supervision agencies determine minimum capital adequacy ratios on a bank by bank basis. For example, the study of Alfon et al. (2004) indicate that banks in the United Kingdom face an individual capital adequacy requirement, and Wong et al. (2005) state that the capital adequacy ratio for the banks in Hong Kong banking system is determined in a similar fashion.

There is only one obligatory capital adequacy ratio in Turkey and most banks operate with excess capital. Therefore, this variable is not employed in our regression analyses of the Turkish banking sector.

(h) Economic Growth:

The last factor to be considered in explaining the capital adequacy ratio is economic growth. In periods of positive economic growth, expectations are positive for banks as well as most other sectors of the economy and risks are relatively low. However, when economic growth rate is negative, banks may suffer sudden capital losses as a result of possible risk realizations. For this reason, banks generally tend to work with more capital in periods when expectations on the economy turn to negative. Having more capital may reduce the negative effects of the economic environment by signaling a strong capital structure. It may also limit the negative effects of adjustment costs that tend to increase in these periods. We employed the growth rate of gross domestic product in our regression analyses.

4. Empirical Analysis of the Determinants of Capital Adequacy in the Turkish Banking Sector

4.1. Data

We employed bank-level monthly data from the Turkish banking sector for the period December 2002-April 2006. Banking data for the pre-December 2002 period are unreliable. There were not good accounting standards among banks before this time. Financial statements of the banks were not transparent and the regulatory and supervisory environment was not developed sufficiently to be comparable with international financial system. This factor makes it difficult, if not impossible, to adjust the previous data to make them comparable to the data collected afterwards. In addition, we excluded banks with excessively high capital adequacy

ratios.⁽²⁾ We also excluded the three public banks that operate in the sector. These banks have been restructured by injecting government debt instruments after the economic crisis of 2001. Therefore, the factors that determine their capital adequacy are different from the rest of the sector because of this intervention. After this selection, our final sample contains 20 banks.

Descriptive statistics for the variables of interest are displayed in Table 1. The average bank in the sample has a capital adequacy ratio of 19 percent and the share of its risk-weighted assets in total assets is 64.6 percent. The share of deposits in total non-equity liabilities is around 65 percent. The average real return on equity was close to -6 during the sample period. The average quarterly growth rate in the sample period was 1.74 percent. The average capital adequacy ratio of the all banking sector (including those that are excluded from our estimation sample) was around 27 percent.

Table 1: Summary Statistics

Variable	Mean	Std. Deviation
Capital adequacy ratio	19.21	8.07
GDP growth rate of the economy	1.74	0.60
Share of deposits	65.20	19.32
Average capital adequacy ratio of the sector	26.70	3.58
Portfolio risk	64.64	16.93
Return on equity	-5.74	21.44
Average assets of the sector	8.247	11.200
Number of observations	920	

Means of variables are presented in Table 2 by year. Average capital adequacy of the banks in the sample has been decreasing over time. It was around 21 percent in 2002 and around 16 percent at the end of 2006. The share of deposits in non-equity liabilities decreased from 72 percent to 63 percent from 2002 to 2006. Although the real return on equity is negative for most of the sample period, we observe an improvement over time. Portfolio risk, measured as the share of risk-weighted assets in total assets, has increased from 54 percent in 2002 to 69 percent in 2006. We also see an increase in the real size of assets of the sector in the sample period.

⁽²⁾ In particular, banks with capital adequacy ratio greater than 40 are excluded from the sample.

Table 2: Means of variables by year

Variable	2002	2003	2004	2005	2006	Overall
Capital ad. ratio	21.10	21.79	19.93	18.41	15.65	19.21
Gross domestic product growth rate	2.72	1.41	2.18	1.79	1.40	1.74
Share of deposits	71.95	69.50	64.58	62.63	62.97	65.20
Average assets of the sector (million YTLs)	6.631	6.400	7.514	8.985	10.900	8.247
Average capital adequacy ratio of the sector	25.12	29.46	28.45	26.17	21.55	26.70
Portfolio Risk	54.31	59.44	63.37	68.55	69.18	64.64
Return on equity	-16.48	-15.47	-7.44	4.11	-2.41	-5.74

Table 3 displays the correlation matrix of the variables used in the regression analyses. Portfolio risk, size of assets, share of deposit and the return on equity are negatively correlated with our dependent variable, capital adequacy ratio. Lagged capital, growth rate of gross domestic product (GDP) of the economy and capital adequacy of whole sector (deposit banks) is positively correlated with capital adequacy.

Table 3: Correlation matrix for the variables

	Capital	Lagged capital	GDP growth	Non-deposit liabilities	Size of assets	Average Capital of the sector	Risk	Return on equity
Capital	1.000							
Lagged capital	0.976	1.000						
GDP growth	0.027	0.061	1.000					
Share of deposits	-0.106	-0.112	-0.019	1.000				
Size of assets	-0.023	0.038	0.095	-0.084	1.000			
Average capital of the sector	0.287	0.264	0.109	0.110	0.067	1.000		
Portfolio Risk	-0.315	-0.304	-0.017	0.018	0.068	-0.168	1.000	
Return on equity	-0.088	-0.095	-0.016	0.035	0.016	-0.086	0.100	1.000

4.2. The Model

Banks adjust capital so as to achieve a desired level of capital. Following Kleff and Weber (2006), this can be written as

$$\Delta \text{capital}_{j,t} = \alpha [\text{capital}^*_{j,t} - \text{capital}_{j,t-1}] + \epsilon_{j,t} \quad (1)$$

where $\Delta \text{capital}_{j,t} = \text{capital}_{j,t} - \text{capital}_{j,t-1}$

This equation shows how the adjustment is made. If the managers observe that capital in the last period ($\text{capital}_{j,t-1}$) falls below the desired level ($\text{capital}^*_{j,t}$) they will increase the capital in the current period so that $\Delta \text{capital}_{j,t}$ is positive. The coefficient in front of the adjustment term (α) measures the speed of adjustment. If the value of α high, it means that managers respond strongly to deviations from the desired level of capital.

We can write the above equation as

$$\text{capital}_{j,t} = (1-\alpha) \text{capital}_{j,t-1} + \alpha \text{capital}^*_{j,t} + \varepsilon_{j,t} \quad (2)$$

Since the target level of capital is not observed, we use proxy variables for the unobserved variable capital*. We use portfolio risk, return on equity, growth rate of gross domestic product, asset size, and ratio of deposits in total non-equity liabilities as proxy variables for the target level of capital.

4.3. Empirical Specification

We specify the desired level of capital as follows:

$$\text{capital}^*_{j,t} = \delta_0 + \delta_1 \text{risk}_{j,t} + \delta_2 \text{roe}_{j,t} + \delta_3 \text{deposit}_{j,t} + \delta_4 \text{gdp}_t + \delta_5 \text{avcap}_t + \delta_6 \text{asset}_{j,t} + u_{j,t} \quad (3)$$

where capital is the capital adequacy ratio for bank j at time t , risk is the share of risk-weighted assets in total assets, roe is the inflation-adjusted return on equity, deposit is the share of deposits in non-equity liabilities, gdp is the quarterly growth rate of gross domestic product, avcap is the average capital adequacy ratio of the sector, and asset is the size of assets adjusted by the consumer price index.

The error term in the adjustment equation (Equation 1) is split into two parts. The first part is a bank specific component that is constant across time for a bank. The second part is a random term that varies across time and banks. We treat the bank-specific terms as fixed effects. We differenced out these fixed effects so that the problem of the correlation between the bank specific term and the endogenous explanatory variables can be remedied. After differencing out the bank fixed effect the error term and the endogenous explanatory variables are still correlated. Therefore, we need valid instruments for these variables. Three explanatory variables, portfolio risk, return on equity and the lagged value of the dependent variable are treated as potentially endogenous. There may be two-way causality between these variables and the capital that a bank holds. A bank may decide how much risk to take and how much capital to carry simultaneously. Similarly, a bank with higher capital may have lower profitability, which in turn causes lower return on equity. The instrumentation procedure that we followed in this study is due to Arellano and Bond (1991). We instrument for the endogenous variables using their lagged values from two lags to four lags. Although it is possible to use more lags as instruments, it is not usually recommended since using too many instrumental variables can increase the bias in the estimates (Hahn and Hausman 2002).

In order to check the relevance of our instrumental variables, we did a series of first stage regression diagnostics. Results from the first stage estimation suggest that our instruments are relevant in explaining the endogenous explanatory vari-

ables. One important issue about the instruments is the requirement that the instruments and the error terms be uncorrelated. When we have more instruments than endogenous explanatory variables, we can test this using Hansen's J statistic. The null hypothesis is the correct specification of the model and the orthogonality conditions. Hansen's J statistic reveals that the model and the instruments are admissible. There is no significant correlation between lagged explanatory variables and the residuals. Therefore, we can use the lagged values of the explanatory variables as instruments.

Standard errors of coefficient estimates are robust to within-bank clustering and heteroscedasticity. Within-bank clustering may be, among other forms, in the form of serial correlation of observations for a particular bank and its form can vary from bank to bank. A limitation on the error term is that it cannot be correlated across banks. This requirement will be violated if, for example, a period-specific shock affects the whole sector in a similar fashion. We included year dummies in our regressions to capture contemporaneous correlation of this sort.

The model is estimated with generalized method of moments. A Pagan-Hall test of homoscedastic disturbance reveals that the disturbance is heteroscedastic. In the presence of heteroscedasticity, the GMM estimator is more efficient than the instrumental variables (IV) estimator. Therefore, it is preferable to use GMM as opposed to IV estimator in this setting. Furthermore, when we have more moment conditions than the number of endogenous explanatory variables, the GMM approach allows us to make use of moment conditions optimally.

If we denote the parameter estimates of the GMM by λ_j , λ_1 being the coefficient of the lagged capital, we can obtain the coefficients of the target level of capital equation as follows:

$$\begin{aligned} capital^*_{j,t} = & \frac{\lambda_2}{1-\lambda_1} risk_{j,t} + \frac{\lambda_3}{1-\lambda_1} roe_{j,t} + \frac{\lambda_4}{1-\lambda_1} deposit_{j,t} + \frac{\lambda_5}{1-\lambda_1} gdp_t + \frac{\lambda_6}{1-\lambda_1} avcap_t \\ & + \frac{\lambda_7}{1-\lambda_1} asset_{j,t} \end{aligned} \quad (4)$$

4.4. Results

Estimation results are displayed in Table 4 through Table 7. We treated portfolio risk and return on equity as endogenous variables in Table 4 and Table 6, whereas we treated them as exogenous in Table 5 and 7. Instruments start with lag 2 in Tables 4 and 5, whereas they start with lag 3 in Tables 6 and 7. The left-hand panel

of these tables displays the coefficient estimates from the estimation equation. The coefficients of the target level of capital equation (Equation 3) are displayed in the right-hand panel of these tables. The parameter estimates measure how much effect a change in the first differenced right-hand-side variable has on the first differenced left hand side variable.

Our findings are in line with our predictions from the theory. In particular, lagged capital has a significant effect on current capital, which shows that the dynamic model is a good choice in explaining capital. Portfolio risk, the share of deposits and asset size are negatively correlated with the capital adequacy ratio. On the other hand, the average capital adequacy ratio of the sector and the growth rate of gross domestic product are positively correlated with the capital adequacy ratio.

The negative impact of asset size on capital is an evidence of larger banks holding less capital. This can be explained by the fact that larger banks have more sophisticated systems to use capital more efficiently. Large banks are also able to access capital from financial markets at more favorable terms.

The negative sign of the coefficient of the share of deposits is also reasonable. As explained in section 2 in detail, banks that have higher ratios of deposits in their non-equity liabilities have cheaper source of funds and are considered less risky, which in turn decreases their buffer capital.

According to the result of our regression analyses, banks that carry a higher portfolio risk have a smaller capital adequacy ratio. This is a reasonable finding since, by definition, the capital adequacy ratio is algebraically negatively correlated with risk weighted assets. Therefore, it can also be expected that the share of risk weighted assets in total assets is negatively correlated with capital adequacy. Banks with higher portfolio risk need to carry more capital to provide a buffer against expected and unexpected losses.

Banks seem to hold more capital when economic growth is stronger. This is somewhat counterintuitive. However, banks usually suffer in terms of capital during periods of economic slowdown in Turkey. Economic growth periods, therefore, are times for replenishing depleted capital for the Turkish banks. When economic growth is strong, banks make more profit, and some of this profit contributes to their capital.

As the average capital of the sector increases individual banks feel that they should also increase their capital to stay competitive. This makes sense from the perspective of a bank operating in the same sector since the capital adequacy ratio of a bank could serve as a signaling mechanism for market participants.

Return on equity is found to be insignificant in explaining the dependent variable in Table 4 and Table 5 and it is positive and significant in Table 6 and 7. We would expect a negative relationship between this variable and capital adequacy. However, ROE is not only an indicator of the cost of capital for banks. It is also an indicator of profitability, and profitability has a positive impact on the amount of capital that a bank holds, we think the profitability effect surpassed the cost of capital effect for the banks that are included in our analyses.

In order to test the validity of our assumption on the endogeneity of risk and return on equity variables, we performed several Hausman tests. Results of these tests indicate that these variables, jointly and separately, can be treated as exogenous.⁽³⁾ Treating these variables as exogenous can improve the efficiency of our estimates. As a result, it is possible to obtain smaller standard errors for our estimates. Table 5 displays the results of GMM estimation when these variables are treated as exogenous. The results are similar to those in Table 4. All variables that are significant in the first specification are significant in this specification and the estimates are similar in magnitude to those in the first specification.

We checked for autocorrelation in the error term. Since the residual is first order related mathematically we find significant negative first order serial correlation. We also find evidence of second order serial correlation. For the GMM method to produce consistent estimates, our instruments should start with deeper lags. Therefore, we used 3rd and 4th lags of the exogenous variables as instruments. Table 6 and Table 7 display the results from this specification. The difference between Table 6 and Table 7 is that in producing Table 7, we assumed that only lagged capital is exogenous, since endogeneity tests suggested that we can treat other variables as exogenous.⁽⁴⁾ Our results are similar in these two cases. All of the variables are significant in these tables. The magnitudes of the coefficients are also similar in Table 6 and Table 7. The coefficient estimates in these tables are also similar to those in Table 4 and Table 5, with the exception of return on equity. Instrumenting with deeper lags rendered the return on equity variable significant.

⁽³⁾ *The null hypothesis is that the variables tested are exogenous. Test statistic is 0.824 for joint exogeneity of risk and return on equity; associated P-value is 0.662. Results for separate exogeneity tests are similar.*

⁽⁴⁾ *The null hypothesis is that the variables tested are exogenous. Test statistic is 1.265 for joint exogeneity of risk and return on equity; associated P-value is 0.531. Results for separate exogeneity tests are similar.*

Table 4: GMM results: return on equity and risk treated as endogenous

Variable	Estimation equation		Target capital level equation	
	Estimate	St. error	Estimate	St. error
Capital	0.288***	0.024		
Portfolio Risk	-0.205***	0.027	-0.288***	0.036
Return on equity	0.007	0.007	0.010	0.010
GDP growth	0.111***	0.024	0.155***	0.035
Average capital of the sector	2.653***	0.797	3.725***	1.049
Share of deposits	-0.047***	0.002	-0.067***	0.002
Size of assets	-12.763***	1.145	-17.920***	1.468

(***) significant at 1% level

Estimates are from two-step efficient GMM estimation. All regressions include year dummies.

Standard errors are corrected for heteroscedasticity and within group clustering.

Hansen J statistic is 9.8 with associated p-value of 0.46.

Pagan-Hall statistic is 53.6 with associated p-value of 0.000.

Number of excluded instruments is 13, instruments starting with lag 2.

Table 5: GMM results: return on equity and risk treated as exogenous

Variable	Estimation equation		Target capital level equation	
	Estimate	Std. Err.	Estimate	St. error
Capital	0.407***	0.038		
Portfolio risk	-0.230***	0.049	-0.389***	0.085
Return on equity	-0.014	0.016	-0.024	0.028
GDP growth	0.162***	0.060	0.273**	0.113
Average capital of the sector	1.471	1.037	2.481	1.700
Share of deposits	-0.044***	0.003	-0.074***	0.004
Size of assets	-13.471***	2.015	-22.716***	3.518

(***) significant at 1% level; (**) significant at 5% level

Estimates are from two-step efficient GMM estimation. All regressions include year dummies.

Standard errors are corrected for heteroscedasticity and within group clustering.

Hansen J statistic is 7.4 with associated p-value of 0.42.

Number of excluded instruments is 13, instruments starting with lag 2.

Table 6: GMM results: return on equity and risk treated as endogenous

Variable	Estimation Equation		Target capital level equation	
	Estimate	St. error	Estimate	St. Error
Capital	0.307***	0.017		
Portfolio risk	-0.180***	0.005	-0.260***	0.008
Return on equity	0.006***	0.002	0.009***	0.002
GDP growth	0.130***	0.021	0.188***	0.032
Average capital of the sector	3.430***	0.622	4.949***	0.847
Share of deposits	-0.045***	0.001	-0.064***	0.001
Size of assets	-11.287***	0.355	-16.289***	0.472

(***) significant at 1 percent level; (**) significant at 5 percent level

Estimates are from two step efficient GMM estimation. All regressions include year dummies.

Standard errors are corrected for heteroscedasticity and within group clustering.

Hansen J statistic is 11.7 with associated p-value of 0.47.

Pagan-Hall statistic is 64.1 with associated p-value of 0.000.

Number of excluded instruments is 10, instruments starting with lag 3.

Table 7: GMM results: return on equity and risk treated as exogenous

Estimation equation Variable	Estimate	St. error	Target capital level equation Estimate	St. Error
Capital	0.440 ***	0.027		
Portfolio risk	-0.162 ***	0.006	-0.290 ***	0.012
Return on equity	0.004 **	0.002	0.007 **	0.003
GDP growth	0.193 ***	0.027	0.344 ***	0.058
Average capital of the sector	1.351 *	0.747	2.412 *	1.267
Share of deposits	-0.039 ***	0.002	-0.070 ***	0.004
Size of assets	-10.512 ***	0.497	-18.764 ***	0.640

(***) significant at 1% level; (**) significant at 5% level; (*) significant at 10% level

Estimates are from two step efficient GMM estimation. All regressions include year dummies.

Standard errors are corrected for heteroscedasticity and within group clustering.

Hansen J statistic is 9.6 with associated p-value of 0.39.

Number of excluded instruments is 10, instruments starting with lag 3.

5. Conclusion

We estimated a model of capital adequacy for the Turkish banking sector. This study contributes to the literature by estimating a panel data model of capital adequacy ratio for the Turkish banking sector. It is the first study of this sort for this sector, to our knowledge. The findings of the empirical study are generally in line with other empirical evidence from other countries. There are some variables that affect the capital adequacy ratio differently in Turkey. We think that this can be explained by the circumstances of the Turkish banking sector in the period covered in this study. The study covers a period in which the overall economy was expanding and banks were in the process of recovering from an earlier economic crisis. Therefore, the results might change in a different time period. On the other hand, the Basel II framework will be implemented in Turkey in the near future. It will be interesting to see how these findings change as new capital adequacy regulations introduced by the Basel II are implemented as this will certainly change the way banks assess their capital adequacy.

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