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Defining Influential Factors of Capital Adequacy Ratio: An Examination upon Turkish Banking Sector (2006/Q1-2019/Q1)

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Abstract

Capital adequacy ratio (CAR) of the Turkish Banking Sector (TBS) decreased dramatically from 30.9% in 2003 to 17.1% as of May 2019. This figure shows that although TBS has still a relatively high CAR compared to many countries, unfortunately there is a decreasing trend. A downward trend in CAR constitutes risks due to the limit of providing credits. Therefore, the level of CAR has importance for making a positive contribution to sustainable economic growth. So, influential factors of CAR should be determined first. In this context, Multivariate Adaptive Regression Splines (MARS) method, 14 explanatory variables, and quarterly data are used for the period of 2006/Q1-2019/Q1. It is determined that credits/total assets ratio, legal equities, risk weighted assets, nonperforming loans (NPL), NPL/total credits ratio, and credit/deposit ratio are influential factors on CAR in Turkey.

Keywords: Banking Sector, CAR, Influential Factors, MARS, Turkey



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Defining Influential Factors of Capital Adequacy Ratio:

An Examination upon Turkish Banking Sector (2006/Q1-2019/Q1)

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I. Introduction

Countries have different financial systems from each other. As general, there are two types of financial systems, which are the bank-based and the market-based systems. Most of the countries, including emerging countries and Turkey, has a bank-based financial system which means that these countries provide most of the needs of funding for economic activities from banks (Kartal et al., 2018, Kartal, 2019). For this reason, banks and banking are important in such countries (Dinçer et al., 2016).

There is too much legislation regulating banking sectors and banks due to the fact that they are so much important for countries. That is why developments in financial systems and banking sectors have importance for the macroeconomics of countries (Kar et al., 2008). Similarly, Banking Law (BL) numbered 5411 regulates Turkish Banking Sector (TBS) strictly. Also, with the authorization of BL, Banking Regulation and Supervision Agency (BRSA) has made a variety of secondary regulation on TBS (Kartal & Çoban Çelikdemir, 2019). In addition to BRSA, also other regulatory bodies could make secondary regulation on TBS.

Although all regulation, unfortunately, there have been crises because of the fact that regulation and supervision system on banking sector does not function (Mishkin, 1999; Kılıcı, 2017; Çam & Özer, 2018). Depending on the crisis like 2000 and 2001 crisis in Turkey and 2008 global crisis which started in the United States of America, national authorities and international institutions have intensified their efforts and published additional principles named as Basel III criteria which regulate the banking sector in a much more efficient manner. The most important issue in Basel III regulation is how to calculate adequate capital, i.e. CAR. Basel Committee on Banking Supervision would increase tier 1 capital/ risk weighted assets (RWA) ratio to 4.5% and tier 2 capital/RWA to 7% (BIS, 2010). This is a challenging process for some countries, because of increasing capital or decreasing RWA requirement. With the varying of transition period according to countries, Basel III process was initiated in 2013, regulations have been made in time, the transition period has been completed, and Basel III has gone into effect in 2019 fully in Turkey.

All countries have been in stress because of this hard transition period. When examining the development trend of CAR in Turkey, it can be seen that it has decreased from 30.9% in 2003 to 17.1% as of May 2019 (BRSA, 2019). As mentioned, CAR is important because it affects the capacity of providing credits of banking. When CAR is decreasing and reaching the legal limit which is 12% in Turkey, then any bank should decrease providing credits if the bank cannot increase their capital. For this reason, having a high CAR for both TBS and Turkish banks is crucial and definitely keeping the CAR high is very important.

Because of providing most of the financing source by banks in Turkey, decreasing trend of CAR has a risk. To be able to sustain financing support of banks to the economy, stopping decreasing in CAR is a requirement. On the other hand, increasing CAR is very important if much more credit providing by banks is desired. However, influential factors of CAR should be determined firstly. For this aim, MARS method, 14 explanatory variables, and quarterly data are used for the period of 2006/Q1-2019/Q1 to determine influential factors on CAR in Turkey. As far as it is known, MARS method is used first time in defining influential factors on CAR. So, it is thought that this study is a pioneer research in terms of this characteristic.

This study consists of four parts. After the introduction, part 2 reviews the related literature upon capital adequacy ratio in Turkey and some other selected countries. Part 3 includes the data, methodology and research results. Part 4 summarizes the results.

II. Literature Review

There are studies in the literature handling CAR in Turkey and other countries. A variety of independent variables such as asset growth, asset quality, bank size, credits, credits/total assets, foreign exchange rates (FER), inflation, interest rates, leverage, liquidity, net interest margin (NIM), NPL, provisions, provisions/total credits, return on assets (ROA), return on equity (ROE), RWA and total assets are taken into consideration in these studies.

Some studies in Turkey examined the whole banking sector while some of the others analyzed some selected banks. Sayılğan & Yıldırım (2009) examined TBS for the period of 2002 and 2007 via regression and concluded that CAR has a positive relationship with profitability (ROA, ROE). Büyükşalvarcı & Abdioğlu (2011) analyzed TBS for the period of 2006 and 2010 via panel data analysis and defined that provisions and ROA make positive effects on CAR while credits, ROE and leverage make a negative effect. Reis & Köttöğlu (2016) observed TBS for the period of 2009 and 2015 via regression and stated that profitability (ROA, ROE), liquidity and NPL have a positive effect on CAR. Koç & Karahan (2017) studied TBS for the period of 2005 and 2015 via panel data analysis and stated that total assets, ROA and liquidity have positive effects on CAR.

In addition to studies examining whole TBS, some of the studies examined a part of the banks

operating in Turkey in terms of CAR. Okuyan (2013) examined 23 banks for the period of 2002 and 2012 via panel data analysis and concluded that economic growth and ROA have positive effects. On the other hand risk, size, deposits/total liabilities and credits/total assets have negative effects on CAR. Işık (2017) analyzed TBS for the period of 2009 and 2016 via panel data analysis and defined that CAR does not have a meaningful effect on ROA. Acar Balaylar & Özdemir (2018a) observed foreign deposit banks for the period of 2004 and 2016 via ARDL bounding test and stated that ROA is positively associated with CAR. Similarly, they (2018b) found parallel results for national deposit banks for the period of 2004 and 2016 via the ARDL bounding test. Afşar & Karaçayır (2018) studied 9 banks for the period of 2002 and 2017 via panel data analysis and stated that, ROA has positive effects on CAR while credits/total assets, deposits and total asset size have a negative effect. Aydın (2019) examined 23 banks for the period of 2002 and 2017 via panel data regression and concluded that CAR is positively associated with ROA until a point. After this point, it leads to negative effects.

In other studies, Berger (1995) examined the USA for the period of 1983 and 1992 via granger causality test and concluded that CAR is positively related with ROE between 1983 and 1989, whereas it is negatively related with ROE between 1990 and 1992. Iannotta et al. (2007) analyzed 181 large banks in 15 European countries for the period of 1999 and 2004 via regression and defined that profitability (income-costs) is positively related to CAR. Hoffmann (2011) analyzed 11,777 banks in USA for the period of 1995 and 2007 via the generalized method of moments (GMM) and stated that, CAR is positively associated with ROA until a point. After this point, it leads to negative effects. Polat & Al-khalaf (2014) examined publicly held banks in Saudi Arabia for the period of 2008 and 2012 via panel regression and concluded that size, leverage, and ROA have positive effects on CAR while credit/total assets have negative effects. Aktaş et al. (2015) examined 71 commercial banks in 10 countries for the period of 2007 and 2012 via regression and concluded that size, ROA, liquidity, NIM, leverage, and economic growth are determinants of CAR. El-Ansary & Hafez (2015) analyzed 36 banks in Egypt for the period of 2004 and 2013 via regression and defined that liquidity, size, and management quality are the most important variables leading to an effect on CAR for the whole period. Klepczarek (2015) analyzed 49 banks in 22 European countries for the period of 2013 via regression and stated that size, RWA/total assets and credits/total assets are determinants of tier 1 CAR. Yüksel et al. (2018) studied 13 post-soviet countries for the period of 1996 and 2016 via panel regression and GMM, and stated that there is a negative but meaningless relationship between ROE and CAR.

When evaluating studies taking place in the literature and summarized above, it is defined that the effects of several independent variables on CAR are examined and these variables have either positive or negative effects. On the other hand, determinants of CAR are the focal point of a variety of different researchers. Furthermore, it is also identified that various

methodologies were used in these studies such as ARDL Bounding Test, Fourier Approach, Granger Causality Test, GMM, Regression, Panel Data Regression, and Panel Data Analysis. This situation indicates that, a new method could be used to identify the determinants of CAR. With the help of this issue, it can be possible to contribute to the literature. So, MARS method is preferred in this study.

III. Defining Influential Factors of CAR in Turkey

a. Data and Methodology

To determine which factors have an influence on CAR in Turkey, MARS method, 14 explanatory variables, and quarterly data are used for the period of 2006/Q1-2019/Q1. This period is selected, because data of credit/deposit ratio are not available before 2006, which is evaluated as an important independent variable in the analysis. Data regarding dependent and independent variables are gathered from BRSA (2019) and Central Bank of the Republic of Turkey (CBRT) (2019).

b. MARS Method

MARS Method is developed by Friedman in 1990s. MARS method is a non-parametric method and one of the machine-learning techniques. So, it does not include any restrictive assumptions (Friedman, 1991).

There are no assumptions among dependent and independent variables in the MARS method. In searching the effects of independent variables on dependent variables, MARS also uses interactions between variables, and the effects of these interactions on dependent variables (Goh et al., 2017; Liu, 2018).

MARS model is formulated below:

$$Y = B_0 + \sum_{k=1}^K a_n B_n(X_t) + \varepsilon \quad (1)$$

In equation (1), “Y” represents the dependent variable, whereas independent variables are shown as X. On the other side, B_0 demonstrates the constant term and $B_n(X_t)$ describes basis function. Therefore, a_n represents the coefficient of n. basis functions (Friedman, 1991).

MARS method consists of two steps. In the first step, all possible models are produced by using independent variables until reaching maximum basis functions. In the second step, the best model is selected by eliminating some basis functions from the most complex model. The best model is the one that has the lowest Generalized Cross Validation (GCV) value and the highest GCV R^2 (Sephton, 2001).

c. Independent Variables

In the literature, a variety of independent variables have been used to determine which factors affect CAR. Some of these variables are summarized in Table 1.

Table 1: Independent Variables

Independent Variables	References
Asset Quality	El-Ansary & Hafez (2015), Us (2015), Koç & Karahan (2017)
Credits	Büyükşalvarcı & Abdioğlu (2011), Hazar et al. (2018)
Credits/Total Assets	Mpuga (2002), Okuyan (2013), Polat & Al-khalaf (2014), Klepczarek (2015), Mili et al. (2015), Mili et al. (2017), Afşar & Karaçayır (2018)
Deposits	Büyükşalvarcı & Abdioğlu (2011)
Deposits/Total Liabilities	Kleff & Weber (2008), Okuyan (2013), Klepczarek (2015), Us (2015), Mili et al. (2017), Afşar & Karaçayır (2018)
FER	Williams (1998), Us (2015), Mili et al. (2017)
Growth	Ruckes (2004), Asarkaya & Özcan (2007), Okuyan (2013), Aktaş et al. (2015), Mili et al. (2017), Afşar & Karaçayır (2018)
Interest Rates	Demirgüç-Kunt & Detragiache (1998), Mili et al. (2017)
Leverage	Büyükşalvarcı & Abdioğlu (2011), Polat & Al-khalaf (2014), Aktaş et al. (2015)
Liquidity	Büyükşalvarcı & Abdioğlu (2011), Aktaş et al. (2015), El-Ansary & Hafez (2015), Us (2015), Reis & Köttöğlu (2016), Koç & Karahan (2017)
NIM	Demirgüç-Kunt & Detragiache (2002), Demirhan (2010), Büyükşalvarcı & Abdioğlu (2011), Aktaş et al. (2015), Mili et al. (2017), Kılıcı (2019)
NPL	Reis & Köttöğlu (2016), Silaban (2017)

Independent Variables	References
Provisions	Büyükşalvarcı & Abdioğlu (2011), El-Ansary & Hafez (2015)
ROA	Sayılgan & Yıldırım (2009), Demirhan (2010), Büyükşalvarcı & Abdioğlu (2011), Hoffmann (2011), Okuyan (2013), Jasevičienė & Jurkšaitytė (2014), Aktaş et al. (2015), Reis & Köttöğlu (2016), Belke & Ünal (2017), Işık (2017), Koç & Karahan (2017), Silaban (2017), Afşar & Karaçayır (2018), Aydın (2019)
ROE	Berger (1995), Asarkaya & Özcan (2007), Sayılgan & Yıldırım (2009), Demirhan (2010), Büyükşalvarcı & Abdioğlu (2011), Almazari (2013), Okuyan (2013), Klepczarek (2015), Reis & Köttöğlu (2016), Afşar & Karaçayır (2018), Yüksel et al. (2018), Kılıcı (2019)
RWA/Total Assets	Abba et al. (2013), Jasevičienė & Jurkšaitytė (2014), Klepczarek (2015)
Total Assets	Asarkaya & Özcan (2007), Okuyan (2013), Klepczarek (2015), Shingjergji & Hyseni (2015), Reis & Köttöğlu (2016), Koç & Karahan (2017), Afşar & Karaçayır (2018)

Taken into consideration data availability for independent variables, equity; RWA, credits, NPL, provisions, net profit, ROA, ROE, USDTL, interest rate, NPL/total credits, credits/total assets, RWA/total assets, are selected as independent variables. Also, with the thought that credit/deposit ratio has importance for TBS, it is included as an independent variable. Hence, a total of 14 variables are included in the study. Details of variables are included in Table 2.

Table 2: Details of Independent Variables

Variables	Abbreviation	Description	Exp. Eff.	Data Source
Legal Equity	EQITY	Legal Equity (Tier 1+ Tier 2- Deductions)	+	BRSA
RWA	RWA	Total RWA (Credit Risk + Operational Risks + Market Risk)	-	BRSA
Credits	CRDTS	Credit Volume	-	BRSA
NPL	NPL	Gross NPL (not deducted provisions)	-	BRSA
General Provisions	PRVSN	General Provisions (Stage 1 + Stage 2 Provisions Included, but not stage 3)	-	BRSA
Net Profit	NTPRFT	Net Profit	+	BRSA
ROA	ROA	Net Profit/Total assets	+	BRSA
ROE	ROE	Net Profit/Total legal equity	+	BRSA
Credit/Deposit Rate	CDR	Credit Volume/Deposit Volume	+,-	BRSA
USDTL	USDTL	USD/TL FER	+,-	CBRT
Interest Rates	IR	Weighted Average of Commercial Credit Interest Rates	+,-	CBRT
NPL/Total Credits	NPLTC	Gross NPL/Total Credit Volume	-	BRSA
Credits/Total Assets	CRDSTA	Total Credit Volume/Total Assets	-	BRSA
RWA/Total Assets	RWATA	RWA /Total Assets	-	BRSA

d. Analysis and Empirical Results

i. Descriptive Statistics

In this study, quarterly data for the period of 2006/Q1-2019/Q1 are used. So, the number of observations is 53 and descriptive statistics are included in Table 3.

Table 3: Descriptive Statistics

Variables	n	Min	Max	Average	Standard Deviation
CAR ^{1,2}	53	14.640	23.090	17.550	1.882
CRDSTA ₃	53	40.560	65.290	55.983	7.100
EQITY ²	53	46.970	532.960	216.519	136.422
RWA ²	53	1.000	993.400	260.327	316.008
NPL ²	53	7.940	106.390	33.113	24.040
NPLTC ³	53	2.730	5.640	3.522	0.743
CDR ³	53	65.130	123.900	99.548	19.116

¹ shows the dependent variable.

² shows percentage.

³ shows billion TL.

ii. CAR Estimation Model Findings

In the first step of MARS analysis, all possible basis functions are produced by using 6 independent variables which affect CAR. In this process, 18 functions are produced totally, which includes the best complex function. Details of produced 18 functions are included in Annex 1.

In the second step of MARS analysis, 12th model is determined as the best one which has the lowest GCV value and the highest GCV R² value. Important splines between CAR and independent variables are included in Annex 2. In the best model, there are 14 basis functions using 6 independent variables and details of the best model are included in Table 4.

Table 4: CAR Basis Functions

Basis Functions	Details	Coefficient
	Constant	23.551
BF2	max(0, 54.490 - CRDSTA)	-
BF3	max(0, EQITY - 129.880)	0.072
BF4	max(0, 129.880 - EQITY)	-0.065
BF5	max(0, NPL - 18.650)	-0.360
BF8	max(0, 121.610 - CDR)	-
BF9	max(0, EQITY - 103.230) * BF2	0.032
BF10	max(0, 103.230 - EQITY) * BF2	-0.029
BF11	max(0, RWA - 559.080) * BF2	-0.004
BF12	max(0, 559.080 - RWA) * BF2	0.005
BF14	max(0, 3.420 - NPLTC) * BF3	-0.028
BF15	max(0, RWA - 259.530)	-0.012
BF16	max(0, 259.530 - RWA)	-0.032
BF17	max(0, CRDSTA - 60.060) * BF8	-0.119
BF19	max(0, NPLTC - 3.430) * BF16	0.022
F Test: 152,581 (0.000)		Adjusted R ² : 0.972

As it can be seen from Table 4, the probability value of the F test is 0.000, which means that the model is statistically significant. On the other hand, the explanatory value (R²) of the model is well above the acceptable limits with the value of 0.972.

As a result of the analysis, the importance level of independent variables in terms of explanation of CAR change in Turkey as included in Table 5.

Table 5: Importance Level of Independent Variables

Variables	Importance Level	GCV
CRDSTA	100,000	1,930
EQITY	96,122	1,816
RWA	92,329	1,709
NPL	53,725	0,864
NPLTC	50,156	0,808
CDR	38,004	0,648

As it can be seen from Table 5, the most important variable in terms of CAR in Turkey is credits/total assets ratio. Other important variables are equity, RWA, NPL, NPL/total credits, and credits/deposit ratio respectively. On the other hand, other variables which are included in the analysis do not have an effect on CAR for the period of 2006/Q1-2019/Q1.

First explanatory variable on the change of CAR is CRDSTA. The details of the basis functions regarding CRDSTA are included in Table 6.

Table 6: Basis Functions of CRDSTA

Basis Functions	Details	Coefficient
BF2	max(0, 54.490 - CRDSTA)	-
BF8	max(0, 121.610 - CDR)	-
BF17	max(0, CRDSTA - 60.060) * BF8	-0.119

Table 6 shows that, the variable takes place in 3 basis functions. BF17 has a negative coefficient (-0.119). When CRDSTA is above 60.06% and CDR is below 121.61%, CRDSTA has a negative effect on CAR. On the other, when CRDSTA is below 60.06%, CRDSTA does not affect CAR.

Another independent variable that affects CAR is EQITY. The details of the basis functions regarding EQITY are included in Table 7.

Table 7: Basis Functions of EQITY

Basis Functions	Details	Coefficient
BF2	max(0, 54.490 - CRDSTA)	-
BF3	max(0, EQITY - 129.880)	0.072
BF4	max(0, 129.880 - EQITY)	-0.065
BF9	max(0, EQITY - 103.230) * BF2	0.032
BF10	max(0, 103.230 - EQITY) * BF2	-0.029

Table 7 shows that, the variable takes place in 5 basis functions. BF3 has a positive effect (coefficient: 0.072) if EQITY has a value above 129.88 billion TL. On the other side, BF4 provides information that, this effect becomes negative when EQITY is between 129.88 billion TL and 103.23 billion TL, in addition to CRDSTA being below 54.49%. Also, according to BF9, the effect of EQITY on CAR is positive because of the positive coefficient (0.032). However, if EQITY is under 103.23 billion TL and CRDSTA is above 54.49%, EQITY does not affect CAR.

Third independent variable that affects CAR is RWA. The details of the basis functions regarding RWA are included in Table 8.

Table 8: Basis Functions of RWA

Basis Functions	Details	Coefficient
BF2	$\max(0, 54.490 - \text{CRDSTA})$	-
BF11	$\max(0, \text{RWA} - 559.080) * \text{BF2}$	-0.004
BF12	$\max(0, 559.080 - \text{RWA}) * \text{BF2}$	0.005
BF15	$\max(0, \text{RWA} - 259.530)$	-0.012
BF16	$\max(0, 259.530 - \text{RWA})$	-0.032

Table 8 shows that, the variable takes place in 5 basis functions. BF12 has a positive effect (coefficient: 0.005) if EQITY has a value below 559.08 billion TL and CRDST is below 54.49%. On the other side, BF11 provides information that this effect becomes negative when RWA is between 559.08 billion TL and 259.53 billion TL. However, if RWA is under 259.53 billion TL, RWA does not affect CAR.

Fourth independent variable that affects CAR is NPL. The details of the basis functions regarding NPL are included in Table 9.

Table 9: Basis Functions of NPL

Basis Functions	Details	Coefficient
BF5	$\max(0, \text{NPL} - 18.650)$	-0.360

Table 9 shows that, the variable takes place only in 1 basis function. BF5 has a negative effect (coefficient: -0.360) if NPL has a value above 18.65 billion TL. However, if NPL is under 18.65 billion TL, NPL does not affect CAR.

Fifth independent variable that affects CAR is NPLTC. The details of the basis functions regarding NPLTC are included in Table 10.

Table 10: Basis Functions of NPLTC

Basis Functions	Details	Coefficient
BF3	$\max(0, \text{EQITY} - 129.880)$	0.072
BF14	$\max(0, 3.420 - \text{NPLTC}) * \text{BF3}$	-0.028
BF16	$\max(0, 259.530 - \text{RWA})$	-0.032
BF19	$\max(0, \text{NPLTC} - 3.430) * \text{BF16}$	0.022

Table 10 shows that, the variable takes place in 4 basis functions. BF14 has a negative effect (coefficient: -0.028) if NPLTC has a value below 3.42% and EQITY is above 129.88 billion TL. On the other hand, BF19 has a positive effect (coefficient: 0.022) if NPLTC has a value above 3.43% and RWA is below 259.53 billion TL.

Last independent variable that affects CAR is CDR. The details of the basis functions regarding CDR are included in Table 11.

Table 11: Basis Functions of CDR

Basis Functions	Details	Coefficient
BF8	$\max(0, 121.610 - \text{CDR})$	-
BF17	$\max(0, \text{CRDSTA} - 60.060) * \text{BF8}$	-0.119

Table 11 shows that, CDR takes place in 1 basis function. However, BF8 does not have a coefficient. On the other hand, BF8 interacts with BF17, meaning that when CDR is below 121.61%, CRDSTA has a negative effects on CAR. Otherwise, CRDSTA does not affect CAR.

As a result of analysis, the estimation model for CAR is formulated below:

$$\begin{aligned}
 \text{CAR} = & 23.551 + 0.072 * \text{BF3} - 0.065 \\
 & * \text{BF4} - 0.360 * \text{BF5} \\
 & + 0.032 * \text{BF9} - 0.029 \\
 & * \text{BF10} - 0.004 * \text{BF11} \\
 & + 0.005 * \text{BF12} - 0.02 \quad (2) \\
 & * \text{BF14} - 0.012 * \text{BF15} \\
 & - 0.032 * \text{BF16} - 0.119 \\
 & * \text{BF17} + 0.022 * \text{BF19}
 \end{aligned}$$

IV. Conclusion

Determining influential factors of capital adequacy ratio has crucial importance for the security of the banking sector and financial system, and also for sustainable economic growth and financial stability. The main cause underlying these is that, banks are the main financing source in some countries which have a bank-based financial system structure. So, countries try to make the banking system stronger so that they can continue to finance economic activities. However, a downward trend in CAR produces risks due to the limit of providing much more credits of banks. Therefore, countries should determine influential factors on CAR firstly.

This study aimed at defining influential factors of CAR in Turkey. In this context, 14 independent variables are selected by benefitting from similar studies taking place in the literature. Also, quarterly data for the period of 2006/Q1-2019/Q1 are gathered and analyzed by MARS method.

As a result of the analysis, it is defined that credits/total assets ratio, legal equities, risk weighted assets, nonperforming loans (NPL), NPL/total credits ratio, and credit/deposit ratio have an effect on CAR in Turkey. According to the analysis, the most important factor is the credits/total assets ratio. CAR decreases when credits increase much faster than legal equities.

Also, there is a similar relationship between legal equities and risk weighted assets.

Another important variable is NPL. It can be said that, CAR decreases if NPL exceeds 18.65 billion TL. However, the current NPL is around 106 billion TL in Turkey. Unfortunately, this condition causes decreases in CAR. Also, NPL/total credits ratio has negative effects on CAR. On the other hand, when it is below 121.61%, credit/deposit ratio has a negative effect on CAR by interacting with credits/total assets ratio.

With the evaluation of analysis results, it can be concluded that some negative developments in analyzed independent variables have been causing a negative effect on CAR. To prevent CAR from decreasing much more from the current level, which is 17.1% as of May 2019, negative effects should be prevented in the mentioned variables. For instance, an increase in NPL should be stopped or the sale of NPLs by banks should be eased. Hence, the negative effects of NPL on CAR could be prevented. Also, the negative effects of credit/deposit ratio on CAR could be prevented by easing the collection of deposits of banks. Also, it is an important point to be stated that the accumulation of legal equities should be sustained so that the balance between legal equities and risk weighted assets could be kept. Also, some new precautions could be developed by banks and regulatory authorities. Of course, those precautions should be deployed in time so that the Turkish banking sector could benefit from these. Hence, banks could provide more credits for financing and supporting economic growth in Turkey.

Besides this study, new studies such as examining why NPLs have been increasing so much in recent times in Turkey could be studied and it is thought that these studies could be beneficial in developing the literature. Also, new statistical and econometrical methods could be used in these forthcoming studies.

References

- Abba, G. O., Zachariah, P., & Inyang, E. E. (2013). Capital Adequacy Ratio and Banking Risks in the Nigeria Money Deposit Banks. *Research Journal of Finance and Accounting*, 4(17), 17-25.
- Acar Balaylar, N., & Özdemir, M. O. (2018a). Capital Adequacy and Profitability Relationship for Foreign Deposit Banks in Turkey. *Sosyoekonomi*, 26(36), 209-224.
- Acar Balaylar, N., & Özdemir, M. O. (2018b). The Relationship between Profitability and Capital Adequacy of Domestic Commercial Banks in Turkey. *Accounting & Auditing Review*, 18(54), 57-76.
- Afşar, A., & Karaçayır, E. (2018). Determinations of Capital Adequacy Ratio in Turkish Banking Sector. *Anadolu University Journal of Social Sciences*, 18(2), 149-160.
- Aktaş, R., Açıklın, S., Bakın, B., & Çelik, G. (2015). The Determinants of Banks' Capital Adequacy Ratio: Some Evidence from South Eastern European Countries. *Journal of Economics and Behavioral Studies*, 7(1), 79-88.
- Almazari, A. A. (2013). Capital Adequacy, Cost Income Ratio and the Performance of Saudi Banks. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, 3(4), 284-293.
- Asarkaya, Y., & Özcan, S. (2007). Determinants of Capital Structure in Financial Institutions: The Case of Turkey. *Journal of BRSA Banking and Financial Markets*, 1(1), 91-109.
- Aydın, Y. (2019). The Relationship between Bank Capital and Profitability: Evidence from Turkish Banking Sector. *Journal of International Social Research*, 12(62), 1174-1181.
- Belke, M., & Ünal, E. A. (2017). Determinants of Bank Profitability: Evidence from Listed and Non-Listed Banks in Turkey. *Journal of Economics Finance and Accounting*, 4(4), 404-416.
- Berger, A. N. (1995). The Relationship between Capital and Earnings in Banking. *Journal of Money, Credit and Banking*, 27(2), 432-456.
- BIS. (2010). Phase-in Arrangements (Shading Indicates Transition Periods), <https://www.bis.org/press/p100912b.pdf>, 25.07.2019.
- BRSA. (2019). Monthly Bulletin, <https://www.bddk.org.tr/BultenAylık/En>, 25.07.2019.
- Büyüksalvarcı, A. & Abdioğlu, H. (2011). Determinants of Capital Adequacy Ratio in Turkish Banks: A Panel Data Analysis" *African Journal of Business Management*, 5(27):11199-11209.
- CBRT. (2019). EVDS, <https://evds2.tcmb.gov.tr>, 25.07.2019.
- Çam, Ü., & Özer, H. (2018). Analysis of Market Structure of the Turkish Banking Sector in Terms of Competition and Contestability: Panzar-Rosse Model. *Cumhuriyet University Journal of Economics and Administrative Sciences*, 19(1), 336-360.
- Demirhan, D. (2010). The Effects of Capital Structure Decisions on the Profitability of Deposit Banks in Turkey. *The Journal of Accounting and Finance*, (45), 157-168.
- Demirgüç-Kunt, A., & Detragiache, E. (1998). The Determinants of Banking Crises in Developing and Developed Countries. *Staff Papers*, 45(1), 81-109.
- Demirgüç-Kunt, A., & Detragiache, E. (2002). Does Deposit Insurance Increase Banking System Stability? An Empirical Investigation. *Journal of Monetary Economics*, 49(7), 1373-1406.

- Dinçer, H., Hacıoğlu, Ü., & Yüksel, S. (2016). Performance Assessment of Deposit Banks with CAMELS Analysis Using Fuzzy ANP-MOORA Approaches and an Application on Turkish Banking Sector. *Asian Journal of Research in Business Economics and Management*, 6(2), 32-56.
- El-Ansary, O., & Hafez, H. M. (2015). Determinants of Capital Adequacy Ratio: An Empirical Study on Egyptian Banks. *Corporate Ownership & Control*, 13(1), 806-816.
- Friedman, J. (1991). Multivariate Adaptive Regression Splines. *The Annals of Statistics*, 19, 1-141.
- Goh, A. T. C., Zhang, Y., Zhang, R., Zhang, W. & Xiao, Y. (2017). Evaluating Stability of Underground Entry-Type Excavations Using Multivariate Adaptive Regression Splines and Logistic Regression. *Tunnelling and Underground Space Technology*, 70, 148-154.
- Hazar, A., Babuşçu, S., Tekindal, M. A., & Köksal, M. O. (2018) The Risk Analysis Which Specify The Capital Adequacy Ratio in Banking Sector. *International Journal of Economic & Administrative Studies*, (20), 135-150.
- Hoffmann, P. Saona (2011). Determinants of the Profitability of the US Banking Industry. *International Journal of Business and Social Science*, 2(22), 255-269.
- Iannotta, G., Nocera, G., & Sironi, A. (2007). Ownership Structure, Risk and Performance in the European Banking Industry. *Journal of Banking & Finance*, 31(7), 2127-2149.
- Işık, Ö. (2017). Internal Determinants of Profitability of State, Private And Foreign Owned Commercial Banks Operating in Turkey. *Journal of Economics, Finance and Accounting*, 4(3), 342-353.
- Jasevičienė, F., & Jurkšaitytė, D. (2014). The New Capital Adequacy Framework (Basel III) Options and Issues in Commercial Banks of Lithuania. *Ekonomika*, 93(4), 119-134.
- Kar, M., Taş, S., & Ağır, H. (2008). Financial System and Development. Development Economics, Editors: Sami Taban, Muhsin Kar, 2th Edition, Ekin Publications, Bursa, Turkey.
- Kartal, M. T. (2019). The Importance of Harmonious Monetary and Fiscal Policies: An Examination upon Credit Interest Rate in Turkey. *Journal of Economics Business and Finance Research*, 1(2), 88-102.
- Kartal, M. T., & Çelikdemir, N. Ç. (2019). Coordination of Internal Control and Internal Audit Activities in Banks: An Examination upon Branch Audit Activities. *TIDE Academia Research*, 1(1), 33-53.
- Kartal, M. T., İbiş, C., & Çatıkkaş, Ö. (2018). Adequacy of Audit Committees: A Study of Deposit Banks in Turkey. *Borsa İstanbul Review*, 18(2), 150-165.
- Kılıcı, Esra N. (2017). An Assessment of the Relationship between Balance Sheet Deteriorations and Financial Crises; Turkish Case, 2000-01 Crises. *Financial, Political and Economic Comments*, 54(631): 55-64.
- Kılıcı, Esra N. (2019). Analysis of the Relationship between Capital Adequacy and Profitability in Turkish Banking Sector over the Period of 1980-2017; Fourier Approach. *Dumlupınar University Journal of Social Science*, (59), 61-73.
- Kleff, V., & Weber, M. (2008). How Do Banks Determine Capital? Evidence from Germany. *German Economic Review*, 9(3), 354-372.
- Klepaczarek, E. (2015). Determinants of European Banks' Capital Adequacy. *Comparative Economic Research*, 18(4), 81-98.
- Koç, Y. D., & Karahan, F. (2017). Financial Stability Indicators of Turkish Banking Sector. *International Journal of Academic Value Studies*, 3(15), 148-153.
- Liu, T. (2018). Multivariate Adaptive Regression Splines in Standard Cell Characterization for Nanometer Technology in Semiconductor. Chapter 3 in Topics in Splines and Applications, Edited by Young Kinh-Nhue Truong, 47-62.
- Mili, M., Sahut, J. M., & Trimeche, E. (2015). The Role of Islamic Banks in the Transmission of Liquidity Shocks Across Countries. *Journal of Economic Issues*, 49(1), 197-225.
- Mili, M., Sahut, J. M., Trimeche, H., & Teulon, F. (2017). Determinants of the Capital Adequacy Ratio of Foreign Banks' Subsidiaries: The Role of Interbank Market and Regulation. *Research in International Business and Finance*, (42), 442-453.
- Mishkin, Frederic S. (1999). Lessons from the Tequila Crisis. *Journal of Banking & Finance*, (23), 1521-1533.
- Mpuga, P. (2002). The 1998-99 Banking Crisis in Uganda: What Was the Role of the New Capital Requirements? *Journal of Financial Regulation and Compliance*, 10(3), 224-242.
- Okuyan, H. A. (2013). Capital Structure in Turkish Banking Sector. *Ege Academic Review*, 13(3), 295-302.
- Polat, A., & Al-khalaf, H. (2014). What Determines Capital Adequacy in the Banking System of Kingdom of Saudi Arabia? A Panel Data Analysis on Tadawul Banks. *Journal of Applied Finance and Banking*, 4(5), 27-43.

- Reis, G., & Kötüoğlu, R. (2016). Capital Adequacy Behavior of Turkish Banking Sector. *Journal of Management and Economics Research*, 14(3 (Special Issue)), 101-110.
- Ruckes, M. (2004). Bank Competition and Credit Standards. *Review of Financial Studies*, 17(4), 1073-1102.
- Sayılgan, G., & Yıldırım, O. (2009). Determinants of Profitability in Turkish Banking Sector: 2002-2007. *International Research Journal of Finance and Economics*, 28, 207-214.
- Sephton, P. (2001). Forecasting Recessions: Can We Do Better on MARS? *Review Federal Reserve Bank of Saint Louis*, 83(2), 39-49.
- Shingjergji, A., & Hyseni, M. (2015). The Determinants of the Capital Adequacy Ratio in the Albanian Banking System during 2007-2014. *International Journal of Economics, Commerce and Management*, 3(1), 1-10.
- Silaban, P. (2017). The Effect of Capital Adequacy Ratio, Net Interest Margin and Non-Performing Loans on Bank Profitability: The Case of Indonesia. *International Journal of Economics & Business Administration* (3), 58-69.
- Us, V. (2015). Banking Sector Performance in Turkey Before and After the Global Crisis. *The Journal of Economy, Business and Finance*, 30(353), 45-74.
- Williams, B. (1998). A Pooled Study of the Profits and Size of Foreign Banks in Australia. *Journal of Multinational Financial Management*, 8(2-3), 211-231.
- Yüksel, S., Mukhtarov, S., Mammadov, E., & Özsarı, M. (2018). Determinants of Profitability in the Banking Sector: An Analysis of Post-Soviet Countries. *Economies*, 6(3), 41.

Annexes

Annex 1. Outputs of CAR Estimation Model

Basis Functions	Number of Total Variables	GCV	GCV R ²
18	6	3.012	0.166
17	6	1.690	0.532
16	6	1.110	0.693
15	6	0.789	0.782
14	6	0.615	0.830
13	6	0.518	0.857
12*	6	0.431	0.881
11	6	0.450	0.875
10	6	0.454	0.874
9	5	0.611	0.831
8	5	0.881	0.756
7	4	0.867	0.760
6	3	0.785	0.783
5	3	0.717	0.802
4	3	0.855	0.763
3	3	1.108	0.693
2	3	1.264	0.650
1	2	2.149	0.405

*shows the best model.

Annex 2. Important Splines between CAR and Independent Variables

