Bank-specific and Macroeconomic Determinants of Commercial Bank Credit Risk: Empirical Evidence from Turkey

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ABSTRACT

In this thesis, we analyzed the relationship between the ratio of non-performing loans to total loans as the proxy for credit risk, profitability of banks and macroeconomic factors in the Turkish banking sector, considering 7 banks within a 9-year period from 2007 until 2015. We used a panel data to investigate the relationship, and found out bank-specific factors—bank profitability (ROE and ROA), market power (bank size), capital adequacy, and management quality and liquidity ratio—exert various degrees of influence on non-performing loans, and consequently, credit risk of Turkish banks. We discovered that although both macroeconomic factors and bank-specific factors serve as determinants of credit risk exposure of Turkish banks, bank-specific factors are however the most important determinants of credit risk within Turkish banks. We concluded by recommending some possible solutions to the problems we came across in this thesis.

Keywords: Credit risk, Panel data, Turkey

ÖZ

Bu tezde, 2007-2015 yılları arasında Türk bankacılık sektöründe bankalara özgü faktörler ve makroekonomik faktörler ile kredi riski için gösterge olarak kullanılan takipteki kredilerin toplam kredilere oranı arasındaki ilişki incelenmiştir. Panel veri analizleri sonucunda banka kârlılığı (ROE ve ROA), piyasa gücü (banka büyüklüğü), sermaye yeterliliği, yönetim kalitesi ve likidite oranı gibi bankalara özgü faktörlerin Türk bankalarının kredi riski üzerinde farklı derecelerde etkileri olduğu bulunmuştur. Bunun yanında makroekonomik faktörlerin de kredi riski üzerinde etkili olduğu kanıtlanmıştır. Tezde elde edilen bulgular ışığında bankaların kredi riskine karşı olası çözüm önerileri tartışılmıştır.

Anahtar Kelimeler: Kredi riski, Panel verisi, Türkiye

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

CAR	Capital adequacy ratio
EFF	Management efficiency ratio
E-VIEWS	Econometric views
LGDP	Natural logarithm Gross Domestic Product
LINF	Natural logarithm Inflation
LQR	Liquidity ratio
LSIZE	Natural logarithm of total assets
NPL	Non-performing loan
P-value	Probability Value
ROA	Return on asset
ROE	Return on equity
T-stat	Test Statistic Value

Chapter 1

INTRODUCTION

1.1 Background of the Study

The roles of the banking sector as a financial intermediary, especially the commercial banks in risk management, financial assessment and transactions and in other operating environment, is a significant one. In spite of the growing global trend of disintermediation role of the banking sector, financial activities of commercial banks have continued to be central in financing economic and segments of the sectoral markets.

Over decades, the world has suffered different global financial crises which were perpetually either associated with the banking sector or the banking sector at the receiving end of the impact of such crises (Kaminsky & Reinhart, 1999; Hachicha, 2008; Reinhart & Rogoff, 2009; Barisik & Tay, 2010; Berument & Dogan, 2011; Rjoub, 2011; Shaeri et al., 2016; Sodeyfi, 2016). However, from the back drop of the financial crises across the different regions, several studies have maintained the need for strong financial management as a measure to avoid such financial and economic setbacks (Saunders & Cornett, 2003).

A vibrantly strong and meaningfully low-risk banking sector is perceived to capably withstand negative shocks (as experience during financial and economic crisis), thereby contributing to the stability of the financial system. Hence, the study of bank-

specific and the macroeconomic determinants of commercial bank credit risk features and its performances have continued to attract the interest of academic research, management of banking and financial institutions and financial markets.

Measuring the determinants of commercial bank profitability as studied by Athanasoglou, Brissimis and Delis (2008) is a useful insight into the determinants of commercial banks credit risk assessments. Specifically, the Turkish banking system is maintained an important fragment of the Turkish financial system which equally adopts the universal banking framework that empowers the commercial banks to base its operations on several activities obtainable within financial markets.

Like the banking sectors of the modern and developed economies, the Turkish banking system is perceived to energize the country's financial and economic growth. This is so because, since the country's financial crisis of the year 2000, its banks have been reputed to be among the strongest of the emerging markets, as they are known to hold capital reserves far above global regulations. Notwithstanding, several financial crises caused by poor macroeconomic conditions and fragile banking system are among the consistent negative reports about the Turkish commercial banking environment. Also, report of rising cost of borrowing for banks and causing an accumulated dollar debt that have continued to compound Turkey's foreign debt challenges.

In the same view, Gunes and Yildirim (2016) comprehensively noted the changes in Turkey's banking sector which immediately after its 2001 local financial crisis that troubled the banking sector. Since the aforementioned crisis, far-reaching approaches were launched to cushion the effect of the substantial increase in the non-performing

loans which were caused by the skyrocketed interest and exchange rates, maturity mismatch, inadequate of funding, bad policies and governance and insufficient risk management practices.

Additionally, the country's bank shares as broadly observed from Borsa Istanbul index in the current year 2017 has shown significant depreciation, an indication of the impact of Turkish lira's fall against the US dollar, Euro and other major world currencies. In the study by Jiménez and Saurina (2004), collateral, type of lender and relationship banking were enumerated as main and component determinants of credit risk.

In Turkey, and especially after the country's financial crisis of 2001, the timely implementation of reforms by the regulatory agencies of the government was good enough to reduce the would-be impact of the 2008 subprime mortgage crisis that caused the severe global recession in the same year. The bank restructuring program implemented by the Turkish government through its Banking Regulation and Supervision Agency ensured that short-term liabilities of the state banks were terminated, mergers, acquisition and privatization policy was strongly encouraged, recapitalization, and provision of capital supports were made available to privately-owned banks. These regulatory policies within the Turkish banking system have consistently helped in assessing the country's inflationary environment, ensuring low market interest rates, and such that moderately sustain the creditworthiness of its commercial banks.

This thesis is arranged in the following way; chapter 2 is the review of related literature, chapter 3 presents the data used and the methodology adopted in the thesis,

empirical results are presented in the 4th chapter, while the conclusions reached and recommendations made are discussed in the 5th chapter.

1.2 Aim of the Study

The overall aim of this study is to examine the determinants of Credit risk in Turkish banks. The specific objectives are i) to investigate the role played by bank-specific factors in credit risk exposure of Turkish banks and ii) to determine how macroeconomic factors such as GDP and inflation influence credit risk within Turkish banks. This thesis covers the period 2007-2015. In addition to the previous studies, it will be important to see some effects of recent global crises on Turkish banking sectors in regard to macroeconomic and microeconomic levels.

Chapter 2

LITERATURE REVIEW

Banks, in addition to accepting deposits from customers, also grant credit facilities to borrowers. They are therefore unavoidably exposed to credit risks which are the most significant risks faced by bank managers. Thus, the ability to correctly measure and efficiently manage such risks is a key determinant of how successful a bank will be (Gieseche, 2004; Guo, Jarrow & Zeng, 2009).

Credit risk, also called counterparty risk, is defined as the magnitude of value fluctuations in debt derivatives and instruments resulting from changes in the credit quality of borrowers and counterparties (Chen & Pan, 2012). It has also been explained as the risk that the expected cash flows from loans and securities held by financial institutions may not be paid back in full (Saunders & Cornett, 2008). According to Coyle (2000), credit risk refers to losses suffered due to the inability of creditors to repay what they owe in full and as at when due. Efficient management of credit risk preserves a bank's credit risk exposure within acceptable limits and raises the bank's risk adjusted rate of return (Kargi, 2011).

2.1 Credit Measurement Models

There are several existing theoretical approaches to credit risk modeling. In this section, we review the 2 broad classes of these associated models and explain their basic structures.

2.1.1 Structural approach models (asset value models)

This class of credit risk models utilizes the evolution of structural variables like asset and debt values in determining the default time (Elizalde, 2005). They are centered on a stochastic model of variation in asset-liability ratio. They define default as contingent claim, describe exactly when defaults occur and price defaultable security through derivative security pricing. Two different models (Black-Scholes-Merton model and first-passage model) that fall under this category are considered below.

2.1.1.1 Black-Scholes-Merton model

The structural models can be traced back to the Black-Scholes-Merton model (1974). It is a mathematical model in which the default of a firm is modeled based on the relationship between its assets and liabilities at the end of a given time period. This model assumes that the value of a firm's assets follows a log-normal process and that a firm defaults if at the time of debt servicing, its assets are lower than its outstanding debt (Elizalde, 2005). The Black-Scholes-Merton model is outlined as follows:

A partial differential equation (Black-Scholes equation) which describes the price of option overtime is proposed in the model as:

$$\frac{\delta V}{\delta t} + \frac{1}{2}\sigma^2 S^2 \frac{\delta^2 v}{\delta S^2} + rS \frac{\delta V}{\delta S} - rV = 0 \qquad (2.1)$$

Where S is the stock price, V is the price of the derivative, r represents risk free interest rate and σ represents the standard deviation of stock returns.

This equation suggests that risk can be eliminated by buying and selling a particular asset in the right way.

Then, a Black-Scholes formula which provides a theoretical estimate of option prices and suggests the existence of a single unique price for an option, irrespective of the associated risk and returns, is specified thus:

$$C(S_t, t) = N(d_1)S_t - N(d_2)Ke^{-r(T-t)} \quad (2.2)$$

Where: N (.) refers to the standard normal distribution cumulative function, (T-t) represents the time to maturity, S_t is the spot price of asset, K is the strike price while r is the risk free rate.

Popular studies that have adopted this approach to bank default risk analysis include Acharya, Anginer and Warburton (2014), and Schweikhard, Tsesmelidakis and Merton (2014).

2.1.1.2 First-passage model

First-passage models are extensions to the Merton-model, due to the fact that the original Merton model does not take into account premature default. The simplest passage model is the Black-Cox model. Black and Cox (1976) extend the Black-Scholes-Merton model by introducing the assumption that default may happen before maturity date. According to them, default would happen the first time assets fall below a given time-dependent threshold, irrespective of whether or not the maturity date has been reached.

Other first-passage models which are extensions of the Black-Cox model include Brigo and Tarenghi (2004), Briys and De Varenne (1997), and Leland (1994). The first-passage model is summarized in equation 3. The equation suggests that if default occurs the first time the asset level S_t falls to the threshold K level, the

probability of survival is the probability P(t,T) that the distance to default is not between t and T.

$$P(t,T) = (S_s \geq K, t \leq s \leq T | S_t) = H(S_t, T-t) \quad (2.3)$$

2.1.2 Reduced form models

The use of reduced form models to model credit risk is also referred to intensity-based approach. This approach was proposed independently by Jarrow and Turnbull (1995), and Madan and Unal (1998). These models are based on the assumption that credit events happen suddenly (at an inaccessible time). The reduced form approach thus involves the modeling of time of default as an exogenous variable. This assumption is more realistic since defaults occur suddenly in the real world. Also, according to Nagel and Purnanandam (2015), structural models exclude many features needed for realist modeling of bank defaults such as liquidity concerns, complex capital structure and government guarantees. A reduced form model is thus superior to a structural one.

While the structural approach models assume that default is completely determined by the value of asset subject to a barrier, the reduced-form approach instead assumes that the default event is controlled by an externally specified intensity process that may or may not be related to the value of assets (Ramesh & Kumar, 2017). The reduced form models may be classified into 2 groups on the basis of whether the information of the default free assets was introduced or not (Jeanblanc & Le Cam, 2007). Empirical applications of the reduced form model to the banking sector include Gornall and Strebulaev (2014), Kelly, Lustig and Van Nieuwerburgh (2016), and Nagel and Purnanandam (2015).

2.2 Empirical literature review

Literature on determinants of credit risk makes a clear distinction between 2 different groups of factors that affect credit risk. The first group comprises of factors that influence the systemic credit risk (Castro, 2013). These are external factors that are related to the economic environment (Naceur & Omran, 2011) as some studies proved that macroeconomic conditions impact on banking and finance sectors (Buyuksalvarci & Abdioglu, 2010; Katircioglu, 2012; Kalim et al., 2012; Karacaer & Kapusuzoglu, 2010; Katircioglu et al., 2015; Saqib & Waheed, 2011; Jenkins & Katircioglu, 2010; Siddiqui, 2008; Sodeyfi & Katircioglu, 2016; Soukhakian, 2007; Katircioglu et al., 2007; Soukhakian, 2007; Waheed & Younus, 2010). They are mainly macroeconomic variables (Hoggarth, Sorensen & Zicchino, 2005; Pesola, 2007). These macroeconomic determinants of credit risk are further sub-grouped into 3 classes—the general macroeconomic determinants such as inflation, unemployment rates, the directional determinants such as GDP and the market conditions such as interest rates and stock market performance (Figlewski, Frydman & Liang, 2012).

The second group of factors is made up of factors affecting the unsystematic credit risk (Castro, 2013). These are internal factors that are bank-specific determinants of credit risk (Naceur & Omran, 2011). These factors include restrictiveness of bank's lending policy and risk appetite, market power, management efficiency, bank performance, loan portfolio diversification, income diversification and solvency ratio.

With respect to the macro-determinants of credit risk, empirical evidence has extensively shown that the following variables exert substantial influence on bank credit risk:

Business cycle/GDP: A key determinant of bank credit risks is the business cycle. For example, an examination of the interaction between business cycles and the risk exposure of banks by Jiménez and Saurina (2006) claim that more lenient credit standards are witnessed during booms and this increases the risk of default. Koch and McDonald (2003) also provide additional evidence in support of this, and likewise suggest that during economic boom, borrowers display higher levels of confidence in their ability to pay back loans they took, this causes banks to lower their credit standards and take on greater risk. However, Bhattacharya and Roy (2008), and Salas and Saurina (2002) provide an opposing perspective. These researchers claim that times of economic boom are linked with low credit risks. The reason is that borrowers possess greater loan repayment capability during such periods. This view is also shared by studies of Castro (2012), Das and Ghosh (2007), Gunsel (2008), Thiagarajan, Auuapan and Ramachandran (2011), and Zribi and Boujelbène (2011). All of these studies conclude that GDP impacts the volume of non-performing loans negatively. This is an indication that increased economic activity results in reduced bank credit risk. Jović (2017) further claims that the business-cycle is the most important systemic determinant of credit risk in the corporate sector. Yet, Monokroussos, Thomakos and Alexopoulos (2016) discovered a negative, bi-directional causality between GDP and non-performing loans.

Money supply: Money supply changes have also been strongly touted as a macro-determinant of credit risk of banks. Ahmad and Ariff (2007) show that increases in

money supply lead to decreases in interest rate which in turn result in increased access to cheaper funds. These series of occurrences improve the repayment ability of bank debtors. Because of this, the level of risk exposure experienced by banks is lowered. Ahmad (2003) researched the role played by money supply in credit risk determination within Malaysia. By examining this theme in 65 deposit-taking institutions, he discovered that the relationship is a significantly negative one. He found that when money supply rises, credit risk declines in Malaysian banks. Studies embarked upon by Kalirai and Scheicher (2002), and Vogiazas and Nikolaidou (2011) found similar results. They likewise conclude that money supply exerts a significant and negative influence on credit risk in both Austrian and Romanian banks. A similar study carried out within Italian banks by Bofondi and Ropele (2011) on the inter-linkages among money supply and credit risk however provide a counter-claim that the relationship is a positive one.

Exchange rate: Empirical literature also strongly suggests exchange rate fluctuation as one of the macroeconomic determinants of bank credit risks. For example, Castro (2012) studied 5 European countries (Greece, Ireland, Portugal, Spain and Italy) that were recently affected by unfavorable financial and economic conditions and found negative relationship between real effective exchange rate and credit risk. Zribi and Boujelbène (2011) similarly found a negative relationship between exchange rate and credit risk in Tunisia. The result obtained by Gunsel (2008) on the relationship between exchange rates and credit risk in North Cyprus is similarly a significant and negative one. Fofack (2005) and Vogiazas and Nikolaidou (2011) similarly found that exchange rate and credit risk are negatively related.

Interest rate: Interest rate is yet another widely accepted macro-determinant of bank credit risk. Some authors claim that when the debt burden increases as a result of a rise in interest rates this usually leads to greater levels of credit risk (Aver, 2008; Louzis, Vouldis & Metaxas, 2011; Nkusu, 2011). This position is confirmed by Cebula (1999) who examined and discovered that a significant and negative relationship exists between real interest rate and the level of exposure to credit risk. Fofack (2005), and Jiménez and Saurina (2006) however provide evidence in support of a positive relationship between the 2 variables. Similar results were obtained by Quagliariello (2007) in the Italian banking system. The study by Castro (2012) also aligns with those that claim that a positive relationship exists between interest rate and credit.

Inflation: Inflation is another macro-economic factor suggested as a determinant of bank credit risk. For example, Thiagarajan *et al*. (2011) investigate the inter-relationship amongst past and present rates of inflation and credit risk exposure, what was found is that present inflation affects credit risk positively. They also found past inflation has no effect on credit risk in public sector banks. Other researchers who examined this interaction include Gunsel (2008) for North Cyprus and Rinaldi and Sanchis-Arellano (2006) for the Euro Zone countries. They similarly found that these variables are positively related. Makri (2016) also investigated the determinants of credit risk in the Eurozone and came to the same conclusion that inflation affects credit risk positively. Shu (2002), Vogiazas and Nikolaidou (2011), and Zribi and Boujelbène (2011) are however examples of studies that claim that the relationship between inflation and credit risk is a negative one.

Concerning the specific determinants of credit risk, literature shows these following factors as major influencers of credit risk:

Lending policy: According to Pestova and Mamonov (2013), rapid loans growth is an indication of declining lending standards and may thus result in more problematic loans. Espinoza and Prasad (2010), Jimenez and Saurina (2006), and Quagliariello (2007) all show that pre-crisis credit expansion exerts a significant impact on the size of bank problem loans.

Market power: The market power exerted by a bank is another bank-specific determinant of bank credit risk. Literature provides conflicting results on the exact nature of this relationship. For example, while Berger, Klapper and Turk-Ariss (2008) claim that a positive relation exists between market power and credit risk, Jiménez, Lopez and Saurina (2007) arrive at a conclusion opposite to this.

Bank efficiency: Several studies have shown that bank efficiency is another significant influencer of bank credit risks. Examples of such studies include Berger and DeYoung (1997), Louzis *et al*. (2011), Podpiera and Weill (2008), Quagliariello (2007).

Bank performance: A number of authors have also provided empirical evidence in support of banks past performance or profitability as a key determinant of credit risk. This set of authors includes Chaibi (2016), Gila-Gourgoura and Nikolaidou (2017), Głogowski (2008), Louzis *et al*. (2011), Makri (2016), Quagliariello (2007), and Waqas (2017).

Loan portfolio and income diversification: Empirical evidence also indicates that loan portfolio and income diversification significantly impact credit risk in the banking system. Studies by Berger and DeYoung (1997), and Salas and Saurina (2002) are popular examples.

Chapter 3

DATA AND METHODOLOGY

In this part of thesis, the data, bank specific and macroeconomic determinants factors and methodology, which targeted the Turkish banking system, will be presented for the years from 2007 to 2015, to examine how the factors affecting on commercial banks' credit risks.

3.1 Data

In the empirical part of this thesis, we choose the first 7 largest banks in Turkey according to their bank size ranking, based on the annual financial reports that presented on the banks website that the data was collected, for nine years period of time starting from 2007 till 2015.

Furthermore, Microsoft excel and E-views used as a tools to conduct the regression analysis, while excel used to calculate some needed ratios for the thesis, the statistical program E-views used to run the panel data analysis.

Table 3.1: Targeted Commercial Banks and their Descriptions

Rank	Bank	Foundation	Type of Banks	Ownership
1	Ziraat Bankası	1863	Deposit Bank	State-Owned
2	Türkiye İş Bankası	1924	Deposit Bank	Privately-Owned
3	Garanti Bank	1946	Foreign Banks Founded in Turkey	Foreign Bank
4	Akbank	1948	Deposit Bank	Privately-Owned
5	Yapı ve Kredi Bankası	1944	Deposit Bank	Privately-Owned
6	Halk Bankası	1938	Deposit Bank	State-Owned
7	Vakıf Bank	1954	Deposit Bank	State-Owned

Source: (TBB, 2017; World Atlas, 2015)

3.1.1 Variables

The variables that will be used in this empirical study separated into two main groups of variables: dependent variable and independent variables or what it is called explanatory variables. Hence the study is conducted for 7 banks from Turkey and for the time period of nine years, so the independent variable of bank-specific and macroeconomic of the 7 commercial banks will help to explain as a determinant and show their effects on the non-performing loan which is represent the dependent variable of our study.

3.1.1.1 Dependent Variables

Since the thesis is related to commercial banks credit risk, the ratio of non-performing loans to total loans will be the dependent variable to represent the credit risk related to our targeted banks. Credit risk is the loss that it is expected to occur for credit financial institutions when borrowers fail to make payment of principal and/or interest on due date as applied in commercial banks (Duong & Huong, 2016).

The ratio of non-performing loans to total loans (NPLs):

According to research carried out by some authors (Salas & Saurina, 2002; Jimenex & Saurina, 2007; Louzis *et al*., 2012) on credit risk in commercial banking system, non-performing loan ratios are often used in indicating the commercial banks' credit quality (Duong & Huong, 2016).

Loan, according to Basel, is said to be non-performing when the debtor is behind scheduled contractual payment by 90 days or more or when the debtor is not likely to pay his/her credit responsibilities in full to the bank, with no recourse action by the bank like comprehending the security. However, due to the "improbable to pay" part in the definition, which is discretionary in nature, the market between jurisdiction has been a bit diverse (Das, 2017).

3.1.1.2 Independent Variables

Independent or explanatory variables in this thesis are categorized into internal determinants, which are bank-specific such as Capital Adequacy, Efficiency, Bank-size, Liquidity and Profitability and external or macroeconomic determinants such as Annual Real Gross Domestic Product Growth rate and Annual Inflation Rate.

Capital Adequacy:

Capital adequacy is defined as the equity to total assets ratio which is considered to be one of the rudimentary ratios required for capital strength. There is an expectation

that when this ratio is high, there will a lower or reduced need for external funding and the banks' profitability will be increased as well. This insinuates that the bank has the ability to handle risk exposure and absorb losses with their shareholders. It is expected that the ratio if equity to total assets should have a positive relationship with bank performance such that well-capitalized banks are faced with lower risks of bankruptcy which will reduce their cost or risks and funding as mentioned by Anbar and Alper (2011), Berger (1995), Bourke (1989), and Hassan and Bashir (2003).

Management Efficiency Ratio: can be calculated by interest income divided by interest expenses; this ratio shows the ability of the bank and financial institutions to use their assets and obligations. Efficiency ratio is applicable to banks; for instance, the efficiency ratio of the bank measures it overhead as a ratio of its returns which allows financial analyst to be able to assess investment and commercial bank performance. In the banking sector, efficiency ratio is a very easy means of measuring the banks' ability to convert assets to revenue. Due to the fact that the operating expenses of banks are in the numerator while the denominator is the revenue, a low efficiency ratio indicates that the bank is operating better. The maximum optimal efficiency ratio is believed to be 50% which means that when the efficiency ratio increases, the bank's revenues are decreasing or their expenses are increasing (Investopedia, 2017).

Bank-size: The bank-size determinant can determine by the total assets of the bank**.** To run the regression analysis the natural logarithm (log A) of total assets will be taken to represent the bank-size. Propositions that are too big to fail believes that large banking institution that shoulder excessive risk by extending loans to borrowers who are of lower quality and by excessively increasing their leverage which means

more non-performing loans. Contradictory, some researchers like Salas and Saurina (2002) discovered that there is a negative relationship between non-performing loans and bank size and made an argument that a bank with bigger size gives room for diversification opportunities which means there is a positive influence of size on non-performing loans (Rajha, 2016).

Liquidity: can be calculated by dividing liquid assets such as cash, cash equivalents and other assets that can be converted into cash by easily way over total assets. Banks need to maintain and hold enough liquidity to face and cover the expected demand from depositors, creditors and counterparties.

Profitability

Return on Asset (ROA):

ROA is a general measure for bank profitability reflects bank ability to achieve return on its sources of fund to generate profits. It's calculated by the firm's net income over total assets and the results shows by percentages.

Return on Equity (ROE):

ROE is typically calculated by net income divided by the book value of equity. Hence from the equation the ROE can be changed by changing in net income or by operating with less or more equity, is a measure of the profitability each dollar unit invested in equity of a firm. ROE is typically expressed in percentages (Anbar & Alper, 2011; Daniels & Kamalodin, 2016).

Gross Domestic Product (GDP) growth rate:

The GDP growth rate generally measures the economic outcome of a country, Also, show the pace of growing of the economy. It is obtained by subtracting the previous gross domestic value form the current one (GDP2 – GDP1)/GDP1 (Amadeo, 2017).

According to empirical research carried out by (Farhan *et al*., 2012), there is a negative relationship between economic growth and NPLs. Also, Carey (1998) reasoned that the diversified debt portfolio loss rate is greatly affected by the most imperative factor which is the state of the economy. Confirming this is Salas and Saurina (2002), who discovered that there is a momentous negative influence of Gross Domestic Product growth on NPLs.

Inflation Rate:

Inflation rate generally can be defined as the increase in prices of commodities or what called consumption basket. Inflation rate can be measured by consumer price index (CPI). Inflation (I) = (P0-P1)/P1*100, Whereas P0 is price of targeted year and P1 is the price of last year (Orenge, 2013).

There is an empirical confirmation by Fofack (2005) that appositive relationship exist between the inflation in an economy and the NPLs. Farhan (2012) in congruence with aforementioned authors mentioned that the borrowers' positive or negative loan payment capacity is affected by inflation in that the borrower's loan payment capacity is enhanced with higher inflation by dipping the outstanding debt's real value. Also, the borrower's loan capacity is weaken with increased inflation by decreasing the real income because salaries and wages become 'sticky'; furthermore, the role of inflation is highlighted when there is variable interest rate. This inflation scenario as explained by Nkusu (2011) also reduced loan holders' debt servicing capacity as lenders by adjusting the lending interest rate for the purpose of adjusting

their actual return. Therefore, it can be concluded that there can be a positive or negative relationship between inflation and non-performing loans depending on the economy of operations (Orenge, 2013).

3.2 Methodology

In order to examine for determinants of non-performing loans (credit risk) in this study for the selected commercial banks in Turkey, Panel Data Regression Analysis model will be run by using E-Views program.

Panel Data Regression Analysis

Panel data or what it is called longitudinal data in general defined as dataset of observation in which entities such as banks, states, companies, countries, etc. are observed across time. Panel data combines between both Time-Series and Cross-Sectional properties of data. In this thesis, Time Series represent the period of time (2007-2015) and 7 banks as a Cross-Sectional data. The panel regression model adopted in this study is specified thus:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \varepsilon_{it} \quad (3.1)$$

Where:

Y_{it} Is the explained variable, β_0 is the intercept of the model, X_{it} represents the vector of independent variables and ε_{it} represents error term.

For our analysis the model is specifically formulated as follows:

$$Y_{it} = f(CAR_{it}, EFF_{it}, SIZE_{it}, LQR_{it}, GDP_{it}, INF_{it}) \quad (3.2)$$

$$Y_{it} = \beta_0 + \beta_1 CAR_{it} + \beta_2 EFF_{it} + \beta_3 SIZE_{it} + \beta_4 LQR_{it} + \beta_5 \, logGDP_{it} + \beta_6 \, logINF_{it} + \varepsilon_{it} \quad (3.3)$$

The Fixed Effect Model

As stated by Nwakuya and Ijomah (2017), the fixed-effects model hegemonies for all time-invariant differences that exist between individuals, therefore the projected coefficients for fixed-effects models will not be prejudiced due to the omitted time-invariant physiognomies.

Random-Effects Model

A random-effects model considers the possibility of heterogeneity in the data series, it assumes that the individual-specific effects αi, are distributed independently of the regressors. The random effects model has a common mean value for the intercept. α_i is included in the error term and each cross-section has the same slope parameter and a composite error term with 2 parts.

Granger causality

According to Statistics How To (2017), Granger causality is a means of investigating two differing variables in a time series. Granger causality method is probabilistic description of causality which uses empirical data to detect correlation pattern. Causality and cause-and-effect are closely related construct but they are not the same. For instance, variable X can be a causal to variable Y if Y is the cause of X or if X is the cause of Y.

Chapter 4

EMPIRICAL RESULTS

This section of the thesis presents and discusses the results obtained from the regression estimations. Two econometric models were formulated. The key difference between these two models is that while model one uses return on assets as an indicator of profitability, model two uses return on equity as the indicator of profitability instead. The correlation coefficients and descriptive statistics for the variables included in our estimations are summarized in Table 1.

Table 4.1: Pairwise correlation table

Variables	NPL	CAR	EFF	LSIZE	LQR	ROA	ROE	LGDP	LINF
NPL	1								
CAR	0.001	1							
EFF	-0.103	0.237	1						
LNSIZE	-0.636	0.008	0.452	1					
LQR	-0.156	-0.216	0.049	0.354	1				
ROA	0.007	0.125	-0.095	-0.523	-0.523	1			
ROE	-0.039	-0.399	-0.234	-0.466	-0.440	0.849	1		
LGDP	-0.425	-0.081	0.304	0.803	0.556	-0.649	-0.566	1	
LINF	-0.062	-0.013	-0.426	-0.165	0.049	-0.031	-0.004	0.009	1
MEAN	0.033	0.111	1.817	18.627	0.084	0.019	0.170	9.365	2.087
(SD)	0.014	0.017	0.214	0.501	0.034	0.005	0.059	0.111	0.156
SKEWNESS	0.639	0.179	-0.286	-0.288	-0.093	0.509	1.313	0.186	-0.222
KURTOSIS	2.754	3.020	2.146	2.300	1.926	2.555	4.191	1.634	2.158
JARQUE-BERA	4.457	0.339	2.772	2.161	3.118	3.237	21.822	5.259	2.376
(P-VALUE)	0.108	0.844	0.250	0.339	0.210	0.198	0.000	0.072	0.305

4.1 Fixed-Effects versus Random-Effects

We carry out the Hausman test on the 2 econometric models specified in order to determine the most suitable panel estimation technique for our study. The Hausman test is employed to determine the most appropriate of the 2 panel data estimators—fixed effect and random effect. The Hausman test specifically examines if there is any significant difference between the fixed and random effect estimators. When these 2 models are not significantly different, then the random effect estimator is deemed preferable because it is more efficient. If however there is a significant difference between them, then the fixed effect estimator is preferable since it is always consistent. The Hausman test tests the null hypothesis that the random effect model is preferable against the alternative that the fixed effect model is preferable.

The Hausman test results for each of the 2 econometric models are reported in Tables 2 and 3. The significant probability values 0.000 in both results lead to the rejection of the null that the random effect is preferable for both estimations. We therefore proceed to estimating both econometric models using the fixed effects panel estimation technique. The results for models one and two are presented in Tables 4.2 and 4.3 respectively.

4.2 Regression Results

Concerning model one, the findings reveal that return on equity has a negative and significant impact on the credit risk of Turkish banks. The result shows that a percentage point increase in return on equity leads to 0.17 percentage point decline in non-performing loans. This result is significant at 1 percent significance level. This shows that when the profitability of Turkish banks increase their credit risk exposure falls. Capital adequacy is shown to also have a negatively significant effect on credit

risk of Turkish banks. Specifically, for every percentage point increase in capital adequacy, non-performing loans fall by 0.441 percentage point. This result is significant at 1 percent significance level. They may thus infer that as the ratio of bank's capital to its risk increases, the credit risk exposure reduces. The relationship between liquidity ratio and credit risk is also negative and significant. When liquidity ratio increases by 1 percentage point, non-performing loans decrease by 0.125 percentage point. This outcome is significant at 1 percent significance level. This suggests that as the ratio between the liquid assets and the liabilities of Turkish banks increase, their credit risk exposure declines. The outcomes suggest that bank size has a negative and significant effect on credit risk of the banks as well. The result indicates that 1 percent increase in LNSIZE leads to 0.00025 percentage point decrease in the size of non-performing loans. This finding is significant at 1 percent significance level. Our estimation also shows that inflation has a negative effect on credit risk. When inflation increases by 1 percentage point, non-performing loans decrease by 0.018 percentage point. Thus when inflation rises within the economy, Turkish banks will be exposed to lower credit risks.

The results however show that a positive and significant relationship exists between management quality and credit risk in Turkish banks. For every percentage point rise in management quality, non- performing loans rises by 0.016 percentage point. This result is significant at 5 percent significance level. Although the coefficient for GDP suggests that its impact on credit risk is negative, we cannot however make any inference on the relationship since the result is insignificant. From the reported R^2 value, we may infer that 49.7% of the variation in credit risk is explained by the variables in the model.

Table 4.2: Fixed effects estimation result for model 1

VARIABLES	M1
ROE	-0.170***
	(0.008)
CAR	-0.441***
	(0.025)
LQR	-0.125***
	(0.014)
EFF	0.010**
	(0.005)
LSIZE	-0.025***
	(0.002)
LGDP	-0.014
	(0.016)
LINF	-0.018***
	(0.007)
C	0.493***
	(0.074)
No of observations	63
R2	0.554
F-stat	82.93***
F-stat (P-value)	0.000
Hausman test stat	16.478***
Hausman test (P-value)	0.000

*Notes: (1) *, ** and *** mean statistic relationship significant at 10%, 5%, 1%, respectively; (2) M1 represents the regression model 1; (3) Standard errors of the corresponding coefficients are shown in parentheses*

Concerning model 2, the estimation outcome reveals the following: A negative and significant relationship exists between the return on assets and credit risk of Turkish banks. If return on assets rise by 1 percentage point, non-performing loans are expected to reduce by 1.69 percentage point. The result is significant at 1 percent significance level.

Capital adequacy likewise exerts a negatively significant effect on credit risk of Turkish banks. For every percentage point increase in capital adequacy, non-performing loans fall by 0.19 percentage point. This result is significant at 1 percent significance level. The relationship between liquidity ratio and credit risk is again

negative and significant. The results suggest that if liquidity ratio increases by 1 percentage point, non-performing loans decrease by 0.156 percentage point. This outcome is significant at 1 percent significance level.

The result also shows that bank size has a negative and significant impact on credit risk. The result indicates that when LSIZE increases by 1 percent, non-performing loans will decrease by 0.00028 percentage point. GDP and inflation also negatively affect credit risk in Turkish banks. When GDP and inflation increase by one percent, non-performing loans decrease by 0.00021 0.00020 percentage point respectively. Both results are significant at 1 percent.

Management quality again exerts a significantly positive influence on bank credit. If management quality increases by a percentage point, non-performing loans are expected to increase by 0.01 percentage point. The result is significant at 5 percent significance level. The R^2 result indicates that 94.2 percent of the variation in NPL is explained by model 2.

Table 4.3: Fixed effects estimation result for model 2

VARIABLES	M2
ROA	-1.690***
	(0.066)
CAR	-0.190***
	(0.015)
LQR	-0.156***
	(0.015)
EFF	0.010**
	(0.004)
LNSIZE	-0.028***
	(0.003)
LGDP	-0.021***
	(0.003)
LINF	-0.020***
	(004)
C	0.465***
	(0.072)
No of observations	63
R2	0.942
F-stat	129.7***
F-stat (P-value)	0.000
Hausman test stat	18.022***
Hausman test (P-value)	0.000

*Notes: (1) *, ** and *** mean statistic relationship significant at 10%, 5%, 1%, respectively; (2) M2 represents the regression model 2; (3) Standard errors of the corresponding coefficients are shown in parentheses.*

4.3 Panel causality test results

In order to extract further details about the patterns of relationship between the variables included in both models, we apply the pairwise panel Granger causality tests. Table 4.4 reports the panel causality test results. Bi-directional causality is found only between return on asset and NPL and liquidity and management quality.

One-way causality was revealed running from capital adequacy to NPL, management quality to NPL, return on equity to NPL, bank size to NPL, capital adequacy to management quality, capital adequacy to liquidity, management quality to return on

asset, management quality to return on equity, bank size to management quality, bank size to return on asset and bank size to return on equity.

No causality was found between liquidity and NPL, return on asset and capital adequacy, return on equity and capital adequacy, bank size and capital adequacy, return on asset and liquidity, return on equity and liquidity, bank size and liquidity and return on equity and return on asset.

Table 4.4: Results from Pairwise Granger causality tests

Hypothesis	Statistic	P-Value	Conclusion
CAR→NPL	2.612	0.112	No causality between CAR and NPL
NPL→CAR	0.121	0.728	
EFF→NPL	16.955	0.000	One-way causality from EFF to NPL
NPL→EFF	0.151	0.698	
LQR→NPL	0.175	0.677	No causality between LQR and NPL
NPL→LQR	1.856	0.178	
ROA→NPL	4.853	0.032	One-way causality from ROA and NPL
NPL→ROA	1.629	0.207	
LNSIZE→NPL	3.880	0.054	One-way causality from LNSIZE to NPL
NPL→LNSIZE	0.147	0.702	
LINF→NPL	16.27	0.000	One-way causality from LINF to NPL
NPL→LINF	0.007	0.931	
LGDP→NPL	0.845	0.362	No causality between LGDP and NPL
NPL→LGDP	0.019	0.888	
EFF→CAR	0.691	0.409	No causality between CAR and EFF
CAR→EFF	0.196	0.659	
LQR→CAR	0.999	0.322	No causality between CAR and LQR
CAR→LQR	2.495	0.120	
ROA→CAR	2.938	0.092	One-way causality from ROA to CAR
CAR→ROA	1.279	0.263	
LNSIZE→CAR	0.363	0.549	No causality between LNSIZE and CAR
CAR→LNSIZE	1.230	0.272	
LINF→CAR	7.233	0.009	One-way causality from LINF to CAR
CAR→LINF	0.011	0.916	
LGDP→CAR	0.266	0.607	One-way causality from CAR to LGDP
CAR→LGDP	5.286	0.025	

Table 4.4 (Continued): Results from Pairwise Granger causality tests

Hypothesis	Statistic	P-Value	Conclusion
LQR→EFF	0.530	0.469	No causality between LQR and EFF
EFF→LQR	2.268	0.138	
ROA→EFF	3.050	0.086	Two-way causality between EFF and ROA
EFF→ROA	3.196	0.079	
LINF→EFF	0.393	0.533	One-way causality from EFF to LINF
EFF→LINF	7.512	0.008	
LGDP→EFF	0.204	0.653	No causality between LGDP and EFF
EFF→LGDP	72.37	-5.564	
LNSIZE→EFF	0.075	0.785	No causality between LNSIZE and EFF
EFF→LNSIZE	1.480	0.229	
ROA→LQR	0.905	0.345	No causality between ROA and LQR
LQR→ROA	2.373	0.129	
LNSIZE→LQR	0.197	0.658	No causality between LNSIZE and LQR
LQR→LNSIZE	1.395	0.242	
LINF→LQR	1.836	0.181	No causality between LINF and LQR
LQR→LINF	0.439	0.510	
LGDP→LQR	0.580	0.449	No causality between LGDP and LQR
LQR→LGDP	0.343	0.560	
LNSIZE→ROA	5.317	0.025	One-way causality from LNSIZE to ROA
ROA→LNSIZE	1.945	0.168	
LINF→ROA	0.000	0.981	No causality between ROA and LINF
ROA→LINF	2.180	0.145	
LGDP→ROA	17.10	0.000	One-way causality from LGDP to ROA
ROA→LGDP	1.376	0.246	
LINF→LSIZE	2.802	0.100	No causality between LINF and LSIZE
LSIZE→LINF	2.110	0.152	
LGDP→LSIZE	1.863	0.178	One-way causality from LSIZE to LGDP
LSIZE→LGDP	11.82	0.001	
LGDP→LINF	1.099	0.299	No causality between LINF and LGDP
LINF→LGDP	17.91	9.E-0	

*Notes: (1) *, ** and *** mean statistic relationship significant at 10%, 5%, 1%, respectively*

Chapter 5

CONCLUSION AND RECOMMENDATION

Efficient management of credit risk is vital to the performance, survival and shareholder value of commercial banks. The current study therefore investigated the determinants of credit risk within Turkish banks. We utilized the ratio of non-performing loans to total loans as the proxy for credit risk in banks.

Our findings support the consensus widely reached by empirical literature that both macroeconomic factors and bank-specific factors serve as important drivers of credit risk in Turkish banks. Our findings specifically reveal that the macroeconomic factors—inflation and GDP—negatively impact the size of non-performing loans and as a consequence, credit risk. This is in tandem with the findings of Bhattacharya and Roy (2008), Castro (2012), Das and Ghosh (2007), Gunsel (2008), Salas and Saurina (2002), Thiagarajan, Auuapan and Ramachandran (2011), Shu (2002), Vogiazas and Nikolaidou (2011), and Zribi and Boujelbène (2011). Our inference is that when inflation increases the size of non-performing loans decline because the loss in real value of money as due to inflation makes it easier for borrowers to pay back their debt. When economic situation of the country improves. Borrowers are again able to meet their debt obligations and the likelihood of default drops. We also find that the bank-specific factors—bank profitability (ROE and ROA), market power (bank size), capital adequacy, and management quality and liquidity ratio—exert various degrees of influence on non-performing loans and consequently credit risk of Turkish banks.

This shows the following: when the profitability of Turkish banks increase their credit risk exposure falls, as the ratio of Turkish bank's capital to thier risks increase, the credit risk exposure reduces, as the ratio between the liquid assets and the liabilities of Turkish banks increase, their credit risk exposure declines and as the size of Turkish banks increase their exposure to risk drops.

This is in consonance with the conclusions reached by Berger and DeYoung (1997), Jiménez, Lopez and Saurina (2007), Louzis *et al*. (2011), Podpiera and Weill (2008), and Salas and Saurina (2002). In order to obtain further details about the pattern of relationship between these factors and credit risk in Turkish banks, we applied causality tests. The findings from these tests confirm majorly the existence of unidirectional causality from bank management quality, bank profitability, bank size, and inflation, to non-performing loans. This further buttresses the claim that these factors exert strong influences on credit risk exposure of banks.

In addition, we discovered that although both macroeconomic factors and bank-specific factors serve as determinants of credit risk exposure of Turkish banks, bank-specific factors are however the most important determinants of credit risk within Turkish banks. Of all the bank-specific factors, the capital adequacy ratio was the most significant determinant of credit risk. This is understandable since the capital adequacy ratio in itself reflects a typical bank's capacity to absorb risk.

Based on the outcome of this research, we come to the following conclusions:
There is a need for the creation of well-defined risk policy and reporting structure, with special consideration given to the macroeconomic conditions prevailing within the country. For example, it is important for Turkish banks to implement macro-

prudential policies during economic booms so as to limit the size of their adopted risks.

With regards to the regulatory authorities:

There is the need to ensure that Turkish banks comply strictly with the financial institutions regulatory laws of Turkey. The regulatory authorities need to also pay critical attention to risk management processes, and managerial quality of banks. The regulatory authorities should also develop efficient methods of identifying banks with potential credit risk.

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APPENDICES

Appendix A: Simple Regression Results for ROA

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	18.022197	(6,49)	0.0000

Cross-section fixed effects test equation:
Dependent Variable: NPL
Method: Panel EGLS (Cross-section SUR)
Date: 01/05/18 Time: 15:57
Sample: 2007 2015
Periods included: 9
Cross-sections included: 7
Total panel (balanced) observations: 63
Use pre-specified GLS weights
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.839240	0.089608	9.365721	0.0000
CAR	-0.190943	0.014613	-13.06706	0.0000
EFF	0.010106	0.003929	2.571990	0.0128
LQR	-0.155911	0.014648	-10.64367	0.0000
ROA	-1.690135	0.065617	-25.75752	0.0000
LNSIZE	-0.027731	0.003147	-8.810988	0.0000
LNINF	-0.020331	0.003993	-5.092135	0.0000
LNGDP	-0.021324	0.010624	-2.007136	0.0497

Weighted Statistics

R-squared	**0.942891**	Mean dependent var	-5.986638
	0.935622	S.D. dependent var	14.14235
S.E. of regression	1.811081	Sum squared resid	180.4008
F-statistic	129.7238	Durbin-Watson stat	1.652776
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.425114	Mean dependent var	0.032651
Sum squared resid	0.006718	Durbin-Watson stat	1.307098

Appendix B: Simple Regression Results for ROE

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	16.478193	(6,49)	0.0000

Cross-section fixed effects test equation:
Dependent Variable: NPL
Method: Panel EGLS (Cross-section SUR)
Date: 01/05/18 Time: 16:01
Sample: 2007 2015
Periods included: 9
Cross-sections included: 7
Total panel (balanced) observations: 63
Use pre-specified GLS weights
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.745077	0.146644	5.080847	0.0000
CAR	-0.441484	0.025198	-17.52030	0.0000
EFF	0.010265	0.004888	2.099978	0.0403
LQR	-0.125495	0.013856	-9.056865	0.0000
ROE	-0.170422	0.008090	-21.06613	0.0000
LNSIZE	-0.025297	0.002047	-12.35770	0.0000
LNINF	-0.018069	0.006742	-2.680282	0.0097
LNGDP	-0.014089	0.015777	-0.892967	0.3758

Weighted Statistics

R-squared	0.913461	Mean dependent var	-3.522504
Adjusted R-squared	0.902447	S.D. dependent var	8.854899
S.E. of regression	1.775639	Sum squared resid	173.4092
F-statistic	82.93583	Durbin-Watson stat	1.643649
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.554412	Mean dependent var	0.032651
Sum squared resid	0.005207	Durbin-Watson stat	1.544598