MACROECONOMIC DETERMINANTS OF NON-PERFORMING LOANS: EVIDENCE FROM TURKISH BANKING SECTOR

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Abstract- This paper analyzes the macroeconomic determinants of credit risk (i.e., non-performing loans) in the Turkish banking sector over the period 2002 and 2015. By using data from 23 commercial banks, the study conducts a panel data analysis via pooled-OLS, fixed effects and random effects and finds evidence for a statistically significant relation between macroeconomic factors and credit risk. Accordingly, increase in growth rate of GDP (business cycle) and stock market index (BIST 100) decrease the level of non-performing loans.

Keywords - Credit risk, macroeconomic factors, panel data.

I. INTRODUCTION

This study aims to examine the macroeconomic determinants of non-performing loans in the Turkish deposit banking sector during period 2003 - 2015. The ex-post of credit risk in banks takes the form of non-performing loans (Louzis, Vouldisve Metaxas 2012). The level of non-performing loans in deposit banks could originate from different factors. On the one hand, external sources such as borrowers, macroeconomic environment and even natural disasters might affect the level of default rates in bank's loan portfolio. On the other hand, internal factors, which arise directly from the lenders, might affect the degree of non-performing loans (Altıntas 2012).

In this study we examine how macroeconomic factors influence the level of credit risk in Turkish deposit banking sector. The time period includes the first quarter of 2003 and the third quarter in 2015. This time period covers the late post-crises (the twin crises) period and the global financial crisis. Our sample data includes the 23 deposit banks that almost include 95 % of the total deposit banking sector in Turkey. The set macroeconomic factors are the growth rate of gross domestic products (GDP), unemployment rate, nominal interest rates, inflation, stock market index and exchange rates. We employed traditional pooled-OLS and panel data approach (fixed affects and random affects) to estimate the level of non-performing loans. The results of the study indicate that macroeconomic factors can have significant impact on the level of non-performing loan in deposit banks. The remaining part of this study is organized as follow. Section II provides a summary on the literature review. Section III and IV describes data and methodology respectively. Section Vprovides the empirical results and finally the last section concludes the study.

II. LITERATURE REVIEW

Ali and Daly (2010) in their comparative study, investigated the credit risk determinants for USA and Australia banking to answer which macroeconomic variables (GDP, interest rates, industrial production and debt to GDP ratio) are important for both countries? They found that the same set of macroeconomic variables display different default rates for the two counties. Additionally, the results of the study indicate that compared to Australia, the US economy is much more vulnerable to the adverse macroeconomic shocks (Ali and Daly 2010).

Fainstein and Novikov (2011) examined the influence of GDP, unemployment, growth of real estate market and aggregate debt variables on the level of non-performing (i.e. credit risk) in the three Baltic states (Estonia, Latvia and Lithuania) by employing vector error correction model. They found that the most significant reason for the growth of non-performing loans was caused by the changes in the real GDP in all the three Baltic States. Rapid growth of the real estate market also played an important role in Latvia and Lithuania, but it was not as crucial as it has been previously assumed in Estonia.

In parallel with these studies, Castro (2013) examined the link between macroeconomic developments and credit risk in particular group of countries (Greece, Ireland, Portugal, Spain and Italy) by employing dynamic panel data and found negative relationship between credit risk and GDP, share price index and housing prices. In addition, he found positive link between credit risk and unemployment rate, interest rate and credit growth. Other studies that focus on determinants of credit risk from macroeconomic perspective are indicated as follow; (Rinaldi ve Arellano 2006), (Berge and Boye 2007), (Nkusu 2011) and (JakubikveReininger 2013).

What this study contributes to the credit risk literature is that the studies that conducted for Turkish banking sector (KarabulutveBilgin 2007), (Cifter, YilmazerveCifter 2009), (Yurdakul 2014) use aggregated data and employ time series methods (VAR, SVAR etc.) to examine the macroeconomic determinants of credit risk. Based on our comprehensive literature review we could not find any study that examines the level of credit risk using bank-level panel data. Thus, in order to fill the gap, in this study we use macroeconomic variables with bank-level data rather than applying time series approach to explain the changes in the credit risk Turkish banks.

III. DATA

We gathered the data from different sources. The bank specific data (i.e., non-performing loans for each bank) in the sample is obtained from Banks Association of Turkey (BAT). We obtained the macroeconomic data from Central Bank of Turkey (CBT) and Organization for Economic Cooperation and Development (OECD). In this study, the sample consists of 23 deposit banks which in average constitutes the 90% (ranked by total assets) of the total banking sector between 2003 and 2015. Investment and interest-free (participation) banks are not included in the sample.
We use non-performing loans (NPL) as the measure of the credit risk. The ratio of non-performing loans to the total loans will be used as a dependent variable in the study. The macroeconomic variables and their expected impact on the level of non-performing loans are summarized as follows:

Business Cycle (State of the Economy): The position of the economy in the business cyclephase is enormously important to a financial institution in assessing the probability of borrower default (Saunders and Cornett 2011). The majority studies found negative relationship between credit risk and economic growth (Beck, JakubikvePiloiu 2013). We used the GDP (during the period, Q1 2003 – Q3 2015) as a proxy for the business cycle and expect negative relationship between credit risk and economic growth. This indicator is seasonally adjusted and it is measured in percentage change from previous quarter and from same quarter previous year (OECD 2016).

Unemployment Rate: The unemployment rate also could affect the level of non-performing loansin commercial banks. An increase in unemployment rate may surge the level of non-performing since the cash flow to the households (individuals) decreases. With regards to firms, increases in unemployment may signal a decrease in production as consequences of drop in effective demand. All those cause to a decrease in revenues and increase in debt burden (Castro 2013). The unemployment was proxied by the quarterly unemployment rate for Turkey during the period, Q1 2003 – Q3 2015 and we assume positive link between credit risk and unemployment[1].
Interest Rates: The lending rates may also affect the level of credit risk in the banking sector.High interest rates indicate restrictive monetary policy actions by the central banks. Financial institutions not only find funds to finance their lending decision scarcer and more expensive but also must recognize that high interest rates are correlated with higher credit risk in general since the higher cost of debt worsen the financial situation of debtors (Caporale, Collive Lopez 2014). High interest rate levels may also encourage borrowers to take excessive risk and or encourage only the most risky customers (Saunders and Cornett 2011). We expect positive relationship between interest rates and credit risk.

To test the effect of the interest rates on the credit risk we used average nominal interest rates charged for consumer or individual (IRI) and commercial (corporate) borrowers (IRC) respectively. The interest rates for individual borrowers include the rates charged for car, mortgage and consumer loans. The interest rates for commercial loans include the weighted average annual rates charged for firms.
Inflation: Price stability is another factor that might be effective on the level credit risk. Theviews in the effect of inflation on the credit risk are not straight forward. On the one hand it is argued that the increase in overall price of services and goods may weaken borrower's ability to service debt by reducing their real income. On the other it is assumed that inflation might make debt servicing easier by reducing the real value of outstanding loans. Thus, the relationship between inflation and credit risk can be in both directions (Castro 2013). We use consumer price index (CPI) based on the quarterly price changes as a measure for inflation.

Stock Market Index: The stock market also may affect the credit risk. In general the growthof the stock indexes indicates improvements in the current and future conditions of the listed companies even including the companies are not listed on the index (Caporale, Collive Lopez 2014). In other word, the increase in overall prices of stocks in the market is usually regarded as a positive sign for the economy's itself and it may contribute a reduction in the credit defaults. Therefore there is usually negative relationship between increase in stock market index (i.e., increase in share prices of major firms in the economy) and credit risk (Castro 2013). The quarterly percentage return on the BIST 100 index, which is a capitalization-weighted index composed of

[1] Unemployment rate is thenumber of unemployed people as a percentage of the labor force, where the latter consists of the unemployed plus those in paid or self-employment.

national market companies except investment trusts, is employed as an indicator of the stock market in Turkey.

Exchange Rates: Exchange rates may also affect the level of the credit risk in banks. On the one hand, depreciation in foreign currency might increase the level of non-performing loans in banks. For example, when the value of home currency increases against the foreign currency (i.e., home currency appreciates) the price of the goods and services becomes more expensive for the importer in other countries. This decreases the demand for the home products and services and unfavorably affects the competitiveness of the local export-oriented firms. All these adverse conditions reduce the ability of debt servicing of the firms (Nkusu 2011) and (Castro 2013). On the other hand, the falling foreign currency prices can decrease the default rates on the foreign currency dominated loans. In Turkish commercial banking system foreign currency dominated loans roughly accounts 30% of the total loans. Thus the effectof the exchange rates on the non-performing loans can be both directions. We use the quarterly price changes per 1 USD and EUR against the Turkish Lira.

We have 1112 total number of observations (except unemployment) in the sample. Macroeconomic variables are given as ratio and percentage change. Except UNEMPLOYMENT and interest rates (both IRI and IRC) all other macroeconomic variables, (GDP, CPI, BIST100 USD and EURO) presents the percentage changes. The stock market index (BIST-100) has the highest volatility rate (standard deviation 14.45) compared to the other macroeconomic indicators.

We performed unit root test for macroeconomic variables. Since macroeconomic data is not in the panel format (i.e., we have only time dimension for each bank in the sample), we employed the traditional Augmented Dickey–Fuller test (Dickey and Fuller 1979). The null hypothesis in ADF test is that series contain a unit root, and the alternative is that the variable was generated by a stationary process.
Table Ipresents the ADF test results; here we can reject the null hypothesis for the CPI, BIST100, EURO and USD variables at all common significance levels. Both commercial and consumer interest rates are found non-stationary at the trend level. Unemployment variable is found non-stationary for all trend structures. In order to transform the unemployment and interest rates to stationary process, we take percentage change (denominated by Δ) of each variable in respect previous quarter[2]. As seen from the table, the null hypothesis is rejected at all levels for the ΔUNEMPLOYMENT,ΔIRI and ΔIRC variables.

[2] Thealternativewayfortransformingvariablestothestationaryprocess is totakethefirstdifference. Since the other variables in the sample are in the percentage format we prefer to have unemployment and interest rates to be in the same format.

IV. METHODOLOGY

We employ the traditional panel data estimators: pooled OLS, fixed-effects (FE) and random effects (RE) to measure the level of credit risk in commercial banks. The model specification is given in the equation below (Castro 2013).

$$Y_{i,t} = \beta 0 + \beta 1\ X1_{i,t} + \beta 2\ X2_{i,t} + \cdots \beta nXn_{i,t} + n_i + \varepsilon_{i,t}$$

Where:

$Y_{(i,t)}$: is the level of credit risk.
β1: is the vector of coefficient.
$X_{(1,\ i,\ t)}$: is the vector of explanatory variables.
n_i: are the unobserved bank-specific effects.
$\varepsilon_{(i,t)}$: is the error term.

thei subscript represents the cross-sectional dimension across banks, and t represents the time dimension. The econometric models for macroeconomic variables are given in the model 1 and 2.

Model 1: $\Delta NPL_{i,t} = \beta 0 + \beta 1 GDP_t + \beta 2\ \Delta IRC_{t-2} + \beta 3\ BIST100_t + \beta 4 EURO_t + \varepsilon_{i,t}$

Model 2: $\Delta NPL_{i,t} = \beta 0 + \beta 1\ \Delta UNEMPLOYMENT_{t-2} + \beta 2\ \Delta\ IRI_{t-2} + \beta 3\ CPI_t + \beta 4\ USD_t + \varepsilon_{i,t}$

The econometric model with macroeconomic variables was designed with two different alternatives to avoid the multicollinearity problem between the alternative variables. In the model 1 and 2 above, we transformed dependent variable (ratio of non-performing loans to total loans) to percentage change. In addition, we also used percentage in variables unemployment rate and interest rates. As seen from both models, the macroeconomic models do not satisfy the requirement for panel data. Although the dependent variable (NPL) has both cross section and time dimension, the macroeconomic variables have only the time dimension.

TABLE I: AUGMENTED DICKEY-FULLER (ADF) UNIT ROOT TEST FOR MACROECONOMIC VARIABLES.

Variables	No-Trend	Trend	Trend (Lag1)
GDP	-5.427	-5.714	-3.694
	0	0	(0.0228)
UNEMPLOYMENT	-1.523	-1.478	-2.331
	(0.522)	(0.8365)	(0.417)
ΔUNEMPLOYMENT	-4.266	-4.24	-4.371
	(0.0005)	(0.0039)	(0.0024)
CPI	-7.986	-7.931	-7.652
	0	0	0
BIST100	-6.673	-7.284	-5.349

	0	0	0
IRI	-3.554	-2.893	-6.21
	(0.0067)	(0.1644)	0
ΔIRI	-4.85	-5.061	-4.523
	0	(0.0002)	(0.0014)
IRC	-4.688	-3.004	-4.212
	(0.0001)	(0.1309)	(0.0043)
ΔIRC	-4.672	-5.043	-3.901
	(0.0001)	(0.0002)	(0.0121)
EURO	-6.186	-6.102	-4.628
	0	0	(0.0009)
USD	-6.124	-6.071	-4.288
	0	0	(0.0033)

*MacKinnon p-value for Z (t) is given in parenthesis.

V. EMPIRICAL FINDINGS

The results with macroeconomic variables are shown in Table IIand Table III. Accordingly, we first performed the Breusch-Pagan Lagrange Multiplier (LM) to decide between pooled-OLS and random effect (RE) estimators. If the null hypothesis is rejected the pooled-OLS is not found as the proper estimator for this analysis. As seen in both tables, we cannot reject the null hypothesis for model 1 and 2 and conclude that the basic pooled-OLS is more appropriate estimator for this analysis (Breusch& Pagan, 1980).

Once the most appropriate estimator (pooled-OLS) is selected, we run the diagnostic tests for autocorrelation and heteroscedasticity problems in the pooled-OLS models. We first perform the White and Breusch-Pagan statistics which tests the heteroscedasticity.

The null hypothesis in White test assumes homoscedasticity in the model (Greene 2002). The test results both for model 1 and 2 are presented below. We reject the null hypothesis at 1 % and 10 % significant levels for model 1 and 2 respectively and conclude that models are not homoscedastic. Breusch-Pagan tests results however, indicate that model 1 and 2 have constant variance.

We later performed the Bhargava et al. Durbin-Watson and Baltagi-Wu LBI tests for autocorrelation problem. The test results for all models is found very close to the critical value 2 which indicates that our model does not seriouslysuffer from autocorrelation problem (Baltagive Wu 1999) and (Bhargava, FranziniveNarendranathan 1982).

Finally, to control the heteroscedasticity problem we added the vce (robust) option to the pooled-OLS and run the models 1 and 2 again. The robust option, which is also known Huber/White/sandwich estimator, produces different standard errors and t statistics, yet thecoefficients estimates does not change in both models (Huber 1967) and (White 1980). Although Breusch-Pagan Lagrange Multiplier (LM) test result specify that the basic pooled-OLS is the most appropriate model, we also added robust estimation results obtained from fixed effects (FE) and random effects (RE) models. As indicated in the Table IIthe coefficients of GDP (growth rate of real gross domestic products) including the lag-1 was found negative and significant at all levels. The results confirm that when GDP grows the level of non-performing loans decreases considerably[3].

Likewise, we have the expected outcome when we use the growth rate of unemployment rate (denominated by ΔUNEMPLOYMENT) as an alternative macroeconomic indicator. As seen from Table II the coefficient of the unemployment rate is found positive and statistically significant at 99% and 99.9% confidence level for all estimators including pooled-OLS, fixed and random effects respectively[4]. The level of non-performing loans increases as unemployment rate increases and conclude that the credit risk moves in line with the unemployment rate. The results for GDP and Unemployment in our study are consistent with the majority of the literature such as (Nkusu2011) (Louzis, Vouldisve Metaxas 2012) and (Castro 2013).

We used percentage change of bank's nominal interest rates for commercial and consumer loans separately as a proxy for interest rates. As presented in Table IIand Table III the coefficient estimates of both commercial (ΔIRC) and consumer (ΔIRI) interest rates are found positive and significant ranging between 5% and 0.1 % significance level. Based on the result for all methods (pooled OLS, random and fixed effects), the consumer loan interest rates (mortgage, car, credit cards etc.) are found to have more impact on the non-performing loans compared to commercial loan rates. For example, 1 % increase in commercial loan rates increase the ratio of non-performing loan by 0.00163 % whereas the consumer (individual) loan rates increase the level of non-perming loans by 0.002264 % or vice versa.

The coefficient estimates of foreign currency rates (exchange rates) are found positive both for USD and EURO rates. The exchange rate for USD is found statistically significant at 95 % confidence level (it is is also found positive and significant including lag-1). The EURO rate however, is not found significant at all levels including all model[5].The potential reason for the positive relationship between USD rates and

[3] Thecoefficients of GDP is alsofoundnegativeandsignificant (at 99% confidencelevel) whenwetaketwolags.

[4]Wetookthetwolags of unemployment rate andinterestrates, since anyshockfromunemploymentandinterestratesmighthaveimpact on thelevel of non-performingloansaftercertain time period.

[5]Weobtainedthesameresultswhenwetakethelag 1, lag 2 andlag 3 for Euro rate.

non-performing loans is that because, approximately 65 % of the foreign currency dominated loans in Turkish commercial banking sector are granted by US dollars. Thus, any increase in USD rates will have negative impact on the capability of the debt servicing of the borrowers and will rise the default rates of USD loans.

No significant link is found between consumer price index (CPI) and non-performing loans. Although the coefficient of CPI is positive the significance level does support the related hypothesis indicated in the previous section. The coefficient of BIST 100 index is found positive and insignificant for the pooled-OLS and random effects but significant for fixed models. If we use the 2nd and 3rd lag, the coefficient of BIST 100 index is found negative, as expected, and statistically significant at 99 % and 99.9% confidence level in pooled-OLS model. Increase in the stock price index is a sign of improvement in the financial conditions of the major firms in Turkey and we can conclude that such increase might reduce the level of non-performing loans in Turkish commercial banking sector. Our empirical findings for stock market index are in line with Castro (2013) and Jakubik and Reininger (2013).

TABLE II: EMPIRICAL RESULTS FOR MODEL-1 WITH MACROECONOMIC VARIABLES.

	1	2	3	4	5	6
	P-OLS	P-OLS	P-OLS	P-OLS	FE	RE
GDP	-0.0303***		-0.0265**	-0.0262***	-0.0304**	-0.0303***
	(-3.46)		(-3.28)	(-3.38)	(-3.48)	(-3.48)
GDP(t-1)		-0.0254***				
		(-5.67)				
ΔIRC(t-2)	0.163*	0.0682	0.0785	-0.00389	0.144	0.163**
	(2.48)	(0.89)	(0.92)	(-0.04)	(2.06)	(2.72)
BIST100	0.00101	0.0000109			0.00113*	0.00101
	(1.44)	(0.02)			(2.33)	(1.92)
BIST100(t-2)			-0.00201**			
			(-2.87)			
BIST100(t-3)				-0.00286***		
				(-3.36)		
EURO	0.00160	0.00418	0.00132	0.000439	0.00114	0.00160
	(0.58)	(1.56)	(0.42)	(0.14)	(0.43)	(0.57)
_cons	0.0490***	0.0430***	0.0591***	0.0634***	0.0489***	0.0490***
	(3.83)	(3.87)	(4.30)	(4.22)	(4.31)	(3.62)
N	1033	1033	1033	1033	1033	1033
adj. R^2	0.043	0.032	0.049	0.056	0.045	
Breusch& Pagan LM test						0.0000
						-10.000
White						32.74
						(0.0031)
Breusch-Pagan						2.02
						(0.1551)
Durbin-Watson test						18.985
Baltagi-Wu test						19.375

tstatistics in parentheses
p < 0.05,** p < 0.01, p < 0.001**

TABLE III: EMPIRICAL RESULTS FOR MODEL-2 WITH MACROECONOMIC VARIABLES

	1	2	3	4	5
	P-OLS	P-OLS	P-OLS	FE	RE
ΔUNEMPLOYMENT(t-2)	0.676**	0.640**	0.669**	0.636***	0.676***
	(3.26)	(2.88)	(3.20)	(3.93)	(3.96)
ΔIRI(t-2)	0.226**	0.240**	0.195*	0.219**	0.226**
	(3.10)	(3.10)	(2.58)	(2.86)	(3.11)
CPI	-0.00424		0.00406	-0.00301	-0.00424
	(-0.59)		(0.50)	(-0.38)	(-0.54)
USD	0.00726*	0.00703*		0.00644*	0.00726*
	(2.42)	(2.34)		(2.12)	(2.36)
CPI(t-1)		-0.00555			
		(-0.82)			
USD(t-1)			0.00332*		
			(2.14)		
_cons	0.0257	0.0289	0.0175	0.0249	0.0257
	(1.85)	(1.83)	(1.35)	(1.56)	(1.81)
N	889	889	889	889	889
adj. R^2	0.040	0.040	0.024	0.037	
Breusch& Pagan LM test					0.0000
					(1.00)
White					23.01
					(0.06)
Breusch-Pagan					410.69
					(0.00)
Durbin-Watson test					18.750
Baltagi-Wu test					19.132

tstatistics in parentheses
*p < 0.05,** p < 0.01,*** p < 0.001

CONCLUSION

The objective of this paper is to analyze the macroeconomic determinants of the credit risk (i.e., non-performing loans) of the commercial banks operate in Turkey over the period 2003 and 2015. For this purpose, we selected 26 deposit banks from Turkish commercial banking sector. In order to have more consistent data we eliminated 3 banks from the sample. The final data sample consists of 23 deposit banks and roughly represents the 90 percent of the total banking sector in Turkey.

We found strong evidence that external factors especially, the macroeconomic environment, may also affect the credit risk in commercial banking sector. The overall deteriorations in the macroeconomic indicators trigger the level of non-performing loans. For example, as the growth rate of GDP increase and unemployment rate decrease the level of non-performing loans reduce considerably. In terms of policy implications, the regulatory authorities and policy-makers should adopt policies and regulations to promote sustainable economic growth rate that create also employment for sound and stable banking system.

The lending rates are also another macroeconomic factor that affects the credit risk in banks. We found positive link between loan interest rate (both for commercial and consumer loans) and non-performing loans. The increasing levels of interest rates usually reduce the debt servicing capability of the borrowers particularly for those who have outstanding loans on floating rate. The result is very important for the monetary policy makers, especially Central Bank of Turkey, since they can directly and indirectly intervene to the interest rates.

We found strong positive link between exchange rates (specifically USD) and non-performing loans. As indicated above the overall growth rate of loans did not increase the level of non-performing loans in Turkish banking system at same pace. However, the possible increasing in the amount of USD

denominated loans, which constitutes 65 % of total foreign currency loans (USD loans roughly make up 20 % of total loans), along with appreciating USD rates against Turkish Lira (TL) can increase loan defaults and level of non-performing loans considerably. Thus, adopting the low volatile exchange rate regime (specifically for US dollar) is very important to reduce the level of non-performing loans in Turkish banking sector.

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