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Determinants of Credit Risk in the Turkish Banking Sector: Does Ownership Matter?

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Türk Bankacılık Sektöründe Kredi Riskinin Belirleyicileri: Sahiplik Yapısı Önemli Mi?

Abstract

This study aims to determine the internal and external factors affecting credit risk in the Turkish banking sector from 2003-2018. Unlike previous literature, we employ the Augmented Mean Group estimator with allowance for heterogeneity and cross-sectional dependence to analyse the effect of external factors within a dynamic framework. Findings indicate that internal and external factors affect credit risk, and the impact of these factors varies dramatically across ownership structures. These results suggest that one regulation does not fit all to overhaul credit risk management in the Turkish banking sector.

Keywords : Credit Risk, Turkish Banking Sector, Ownership Structure, Panel Data, Heterogeneity.

JEL Classification Codes : G21, G32, C23.

Öz

Bu çalışmanın amacı, 2003-2018 döneminde Türk bankacılık sektöründe kredi riskini etkileyen içsel ve dışsal faktörleri araştırmaktır. Diğer çalışmalardan farklı olarak, mevcut çalışma makroekonomik faktörlerin kredi riski üzerindeki etkisini dinamik bir çerçeve içinde ölçmek için heterojenlik ve kesit bağımlılığını dikkate alan Genişletilmiş Ortalama Grup tahmincisi kullanmaktadır. Bulgular hem içsel hem de dışsal faktörlerin kredi riskini etkilediğini ve bu faktörlerin etkisinin sahiplik yapısına göre önemli ölçüde değiştiğini göstermektedir. Bu sonuçlar, Türk bankacılık sektöründe sahiplik yapısı göz önüne alınmadan yapılan düzenlemelerin tüm sektör için uygun olmayacağını ve dolayısıyla kredi riski yönetiminin gözden geçirilmesi gerektiğini göstermektedir.

Anahtar Sözcükler : Kredi Riski, Türk Bankacılık Sektörü, Sahiplik Yapısı, Panel Veri, Heterojenlik.

1. Introduction

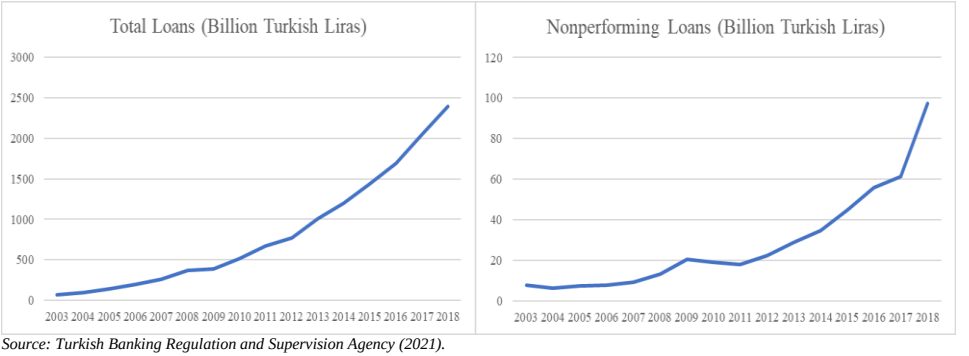
Banks, like other commercial institutions operating in a particular market, are subject to several risks. However, three distinctive features distinguish banks from others. First, banks are leveraged institutions, so a market problem has more devastating effects on banks. In other words, equity capital is a tool that prevents adverse shocks from ending in bankruptcy. Given the lowest capital ratio, even small shocks can cause banks to fail (Gavin & Hausmann, 1996: 31). Although banks are not at the centre of the Coronavirus Pandemic, for instance, the banking sector has been the most affected sector by the pandemic, and share prices fell sharply with the expectation of a significant increase in credit risk compared to the broad market. Second, a problem in the banking sector might rapidly spread throughout the economy due to the spillover effects. The global financial crisis, for example, has provided clear evidence of the spillover effect at the national or international level. Last but not least, bank managers tend to hold more risky portfolios in the interest of shareholders because shareholders benefit more from positive outcomes. At the same time, the cost of negative consequences is shared with the depositors and borrowers. Therefore, regulatory authorities are expected to emphasise banks' risk excessively.

Banks are exposed to several risks in the course of their operations. Banks' main risks are categorised under three groups: credit risk, market risk, and operational risk (Yuksel, 2017: 406). Credit risk addresses the losses from the borrowers' failure to fulfil their obligation to the bank. Market risk explains the risk arising from macroeconomic fluctuations. Finally, operational risk indicates the losses resulting from the banks' operational failures. These risks are not independent of each other. For instance, market risk may affect credit risk since a change in market conditions also impacts borrowers' solvency. Similarly, an operational problem may lead to a mis-selection allowing ineligible borrowers to qualify for loans, increasing credit risk. Therefore, among these risk categories, credit risk seems to be the primary driver of bank risk (Jiménez et al., 2013: 188). Reinhart and Rogoff (2011: 1680) address significant increases in nonperforming loans as a reliable indicator of the banking crisis. González-Hermosillo (1999: 12) also finds that higher nonperforming loans and lower capital equity are associated with a higher probability of bank failure.

Despite well-documented literature on developed countries, the number of studies looking into the determinants of credit risk in developing economies is relatively limited. Theoretically, developed economies differ from developing ones in several aspects. For instance, developed economies have high legal regulations and institutions that reduce moral hazard and adverse selection problems. Besides, developed economies have more stable economic conditions, so households and businesses have consistent incomes and are less likely to default. Given these differences, understanding the dynamics of credit risk in a developing economy context would be informative for management and policy-making decisions. Departing from this motivation, the current study explores the internal (bank-specific) and external (macroeconomic) determinants of credit risk in the Turkish banking sector. Investigating what drives credit risk in Turkish banking is significant for three reasons. First, the Turkish financial system is a bank-based financial system. As of 2018, the

share of bank assets in the Turkish financial system is 83% (The Banks Association of Turkey, 2019). Given this high share, banking distress may result in a crisis through the spillover effect. Second, developing economies are more prone to crises compared to developed economies. For instance, Turkey has suffered several crises (the currency crisis in 1994 and the banking crisis in 2000 and 2001) over the past decades. Third, and more importantly, the credit volume increased rapidly in the Turkish banking sector from 2003-2018, when nonperforming loans also followed an upward trend (see, Figure 1).

Figure: 1
Total Loans and Nonperforming Loans in Turkey



Source: Turkish Banking Regulation and Supervision Agency (2021).

This study contributes to the existing literature on two fronts. First, even though several studies analysed the determinants of credit risk in the context of the Turkish banking sector (Ersoy, 2021; Yuksel, 2017, Us, 2017; Demirel, 2016; Isik & Bolat, 2016; Kasman & Kasman, 2015; Vatansever & Hepsen, 2013; among others), these studies did not consider ownership structure, except Us (2017). However, bank-owners impact various bank-related decisions (objectives, lending behaviours, business models, and productivity, among others). State-owned banks, for example, have broader objectives than private banks. Therefore, state-owned banks tend to finance projects that support economic growth, even if they do not generate a high return, while private banks are unwilling to finance such projects. The lending behaviour of state banks is countercyclical, while private banks adopt procyclical lending policies (Colak & Senol, 2021; Hamid, 2020; Bertay et al., 2015; Brei & Schlarek, 2013;). It is also widely accepted that state banks tend to allocate credit in line with political interest (Boateng et al., 2019; Dinc, 2005; La Porta et al., 2002). Similarly, domestic banks tend to finance opaque but profitable customers, while foreign banks are willing to cherry-pick the more transparent and the less risky opportunities (Beck & Martinez Pierra, 2008; Detragiache et al., 2008). In addition to different financing policies, banks also differ from each other in terms of efficiency. Bonin et al. (2005a, 2005b) show that foreign-owned banks in transition economies are better cost-efficient than other banks[1]. Given the divergent

[1] *In the case of Turkey, a bulk of studies supports the finding that foreign banks surpass their domestic peer in term of efficiency (Isik & Hasan, 2003; Isik & Hasan, 2002). In addition, several studies in the literature have*

characteristics of banks, we analyse whether the dynamics of credit risk differ across banks with various ownership structures. Our study differs from Us (2017) in two ways. First, this study provides fresh evidence on the dynamics of credit risk between 2003 and 2018, whereas Us (2017) focuses on the period 2002-2013. Second, instead of a standard panel regression analysis, we use a time series estimator, i.e., an Augmented Mean Group (AMG) estimator, which is robust to heterogeneity and cross-sectional dependence. Notice that previous literature on this issue imposes slope coefficients to be constant across panel groups and does not consider possible cross-sectional dependence, both of which are likely to produce inconsistent and biased results[2].

The remainder of the study is organised as follows. The next section provides a literature review, Section 3 introduces data and the econometric model, Section 4 presents the econometric methodology and empirical findings, and Section 5 discusses policy implications and concluding remarks.

2. Literature Review

Since credit risk seems to be associated with bank failure, the number of researches that explores the determinants of credit risk has increased rapidly, especially soon after the global financial crisis. One set of studies focuses on external determinants of credit risk, with the view that macroeconomic factors affect the financial solvency of borrowers. Using the Logit model, Ali and Daly (2010) investigate whether factors affecting credit risk are similar for Australia and the USA and report that the same macroeconomic variables have a different impact on default rates for these economies. Nkusu (2011) explores the macroeconomic determinants of NPLs for the 26 advanced economies using panel VAR analysis and finds that adverse macroeconomic conditions increase credit risk. Beck et al. (2013) examine the external determinants of NPLs across 75 economies using dynamic GMM analysis. The results reveal that real growth, lending interest rate and exchange rate stock prices impact credit risk. Castro (2013) investigates the macroeconomic determinants of credit risk for Greece, Ireland, Portugal, Spain and Italy by using dynamic GMM analysis and reports that an increase in GDP growth and real exchange rate leads to lower credit risk, whereas a decrease in the unemployment rate, interest rate, credit growth, stock price index and housing price index reduces credit risk. He also reveals that the global financial crisis causes a notable increase in credit risk.

The second set of studies addresses external and bank-specific variables in explaining credit risk since macroeconomic variables do not fully explain the variation of NPLs among banks in the same market. However, a significant number of these studies have focused on high-income economies. Keeton and Morris (1987), for instance, investigate the causes of loan loss variation for approximately 2500 banks in the US. Regression results show that

found that state banks are less efficient than private and foreign banks (Burki & Niazi, 2010; Di Patti & Hardy, 2005; Bonin et al., 2005a; Mercan et al., 2003).

[2] *See the literature section for further review.*

local economic conditions account for a significant variance. The results also reveal that the risk-taking behaviour of banks affects loan loss. Using a fixed effects estimator and dynamic GMM, Ghosh (2015) examines the determinants of credit risk for the US and incorporates the regional macroeconomic and bank-specific variables. The empirical findings show that higher capitalisations, liquidity risk, lower credit quality and cost inefficiency increase credit risk in US banks, whereas credit risk decreases with profitability. In the case of the regional variables, inflation, unemployment and public debt trigger credit risk, while real GDP, personal income growth and changing housing prices decrease NPLs. Louzis et al. (2012) examine the determinants of loan loss in the Greek banking sector for various loan categories. The dynamic GMM results demonstrate that all loan categories' macroeconomic conditions and management quality influence NPLs. Salas and Saurina (2002) analyse the determinants of credit risk in the Spanish context using dynamic GMM analysis and find that macroeconomic and bank-specific variables impact credit risk. Using panel OLS regressions, Ahmad and Ariff (2008) investigate the bank-specific determinants of credit risk for developed and developing economies. The results reveal that regulatory capital is essential for banks providing several services, while management quality is critical for loan-dominant banks in developing economies. Klein (2013) investigates the impact of macroeconomic and bank-specific factors on credit risk in sixteen European countries using fixed effects and GMM estimators. The results show that macroeconomic and bank-specific variables affect credit risk, with a dominant role of the former variables. Chaibi and Ftiti (2015) examine whether the drivers of credit risk vary between bank-based (Germany) and market-based (France) financial systems. The dynamic GMM results show that macroeconomic variables affect NPLs in both financial systems, except for the inflation rate. The results also indicate that bank-specific variables have a more dominant impact on French commercial banks than on German banks.

Several studies analyse the dynamics of non-performing loans in Turkey; some only address macroeconomic factors, while others consider bank-specific and macroeconomic variables. Yurdakul (2014), for instance, investigates the impact of macroeconomic factors on the credit risk of Turkish banks adopting the General-to-Specific Modelling, Engle-Granger (1987) and Gregory-Hansen (1996) methods and finds that economic growth rate and market index decrease nonperforming loans ratio while money supply, foreign exchange rate, unemployment rate, inflation rate, and interest rate increase credit risk. Demirel (2016) also investigates drivers of loan loss, focusing on macroeconomic factors such as growth rate, volatility, 2-year bond yields in the U.S, industrial production, credit growth, current account deficit, and exchange rate and finds that shocks originating from the stock market have the most power to explain the changes in NPLs, followed by volatility and 2-year bond yields in the US. Ersoy (2021) considers bank-specific and macroeconomic factors in analysing determinants of credit risk. Using pooled OLS, the fixed effects and the system GMM, he reports that capital adequacy ratio and economic growth decrease the nonperforming ratio, whereas operating efficiency, income diversification, lagged nonperforming loans, and inflation increase loan loss. Yuksel (2017) analyses the determinants of credit risk for the Turkish banking sector using the Probit model and reports

that a decrease in the industrial production index is the most significant determinant of NPLs. Isik and Bolat (2016) provide that among bank-specific variables, capital and loan loss provisions increase credit risk, whereas profitability and revenue diversification decreases loan loss, and economic growth is the only macroeconomic variable that has a negative impact on credit risk. Vatansever and Hepsen (2013) also find that industrial production, market index, and inefficiency ratio adversely affect nonperforming loans, while the unemployment rate, return on equity and capital adequacy ratio positively affect the NPL ratio.

Only a few studies consider the ownership structure in analysing the dynamics of credit risk. Gulati et al. (2019) investigate whether credit risk determinants vary by ownership structure in the Indian banking context using the system-GMM approach. The findings show that lower profitability, higher business diversification, larger size and higher bank concentration increase NPLs. Regarding the ownership type, bank-specific factors have a more dominant impact on NPLs for state-owned banks, while macroeconomic and industry-specific factors have a significant effect on credit risk for private and foreign banks. In the case of Turkey, Us (2017) analyses the impact of the global financial crisis on the determinants of credit risk from 2002Q4 to 2013Q3, considering ownership breakdown and revealing that crisis affects loan loss dynamics asymmetrically across banks. In particular, the bank-specific determinants (such as loan size, inefficiency, bank size, and bank dispersion) have a more significant impact on nonperforming loans in the pre-crisis period compared to the post-crisis period, and the effect of these determinants differ across ownership strata while macroeconomic and policy-related factors have an almost similar impact on banks.

Overall, there is well-documented literature on the determinants of credit risk. However, we still need to learn more about whether ownership structure matters in explaining the dynamics of credit risk. In addition, previous literature employs homogeneous panel estimation techniques in which cross-sectional dependence is not considered.

3. Model and Data

The paper aims to determine credit risk drivers in the Turkish banking sector. Risk, in classical terms, reflects the variation in the distribution of expected results and is measured by the variance of the probability distribution of possible outcomes associated with a given alternative. Accordingly, the risky option is where the deviation in the possible results is significant. The managerial perspective, however, emphasises negative outcomes more than the distribution of possible outcomes (March & Shapira, 1987: 1407). From the classical perspective, the risky alternative has a wide variety of potential consequences, while according to the latter view, a risky option is the one with a higher probability of bad results.

The empirical model is formulated as a dynamic panel model of credit risk. To determine what drives credit risk for Turkish commercial banks, we address two groups of

variables: bank-specific and macroeconomic variables. The first group of variables represents internal determinants of credit risk.

Adopting a managerial perspective, the study utilises loan loss, namely the nonperforming loans, to the total gross loans ratio, as a measure of credit risk. In line with the current literature, we address four bank-specific variables to explore the internal determinants of credit risk. Profitability is the first bank-specific variable. The franchise value paradigm asserts that banks with high profitability avoid excessive risk-taking because banks have too much to lose if a risky project they undertake ends up in bankruptcy (Demsetz et al., 1996: 4). Based on the franchise value view, a negative relationship is expected between profitability and NPLs. On the other hand, the model proposed by Rajan (1994: 401) implies a positive relationship between profitability and loan loss. According to the model, bank management aims to enrich the market reputation of the bank by adopting a liberal credit policy. However, liberal credit policy causes credit quality problems in the long run, even though it increases current profits. Therefore, there is no clear expectation regarding the nexus between profitability and NPLs. *Profitability (roa)* is represented by net profit on assets.

Cost (in)efficiency is the second variable considered an internal determinant of credit risk. As with profitability, the nexus between cost-efficiency and NPLs is multifaceted. On the one side, Bad luck and bad management hypotheses formulated by Berger and DeYoung (1997) argue that cost-efficiency is negatively related to loan loss. According to the bad luck view, growing credit problems force banks to devote more resources to monitoring borrowers, and additional resources allocated to monitoring activities reduce cost efficiency. Under the bad management view, cost-efficiency is an indicator that reflects management skills, so low cost-efficiency seems to be a signal for poor management, thereby, higher credit risk. In sum, the bad management hypothesis argues that low cost-efficiency causes higher credit problems, whereas the bad luck hypothesis supposes that higher NPLs cause low cost-efficiency. On the other hand, the skimping hypothesis formulated by Berger and DeYoung (1997) supposes that cost-efficiency is positively associated with credit risk. This view argues that the number of resources devoted to monitoring activities affects both cost efficiency and credit risk, implying that banks should balance short-term operating costs and future credit problems. Banks can increase cost-efficiency in the short run by reducing resources allocated to monitoring activities; however, cutting resources may result in problems in the long run. *Cost efficiency (ic)* is measured by total income as a share of total costs.

Credit size is another potential determinant of NPLs. One of the goals of banks is to increase their market share. Banks generally reduce interest rates and ease credit terms to achieve this goal. However, easing credit terms lead to higher credit problems (Gulati et al., 2019: 51). Besides, it will be difficult for a bank with a large-scale loan portfolio to monitor borrowers. Therefore, a more extensive loan portfolio is expected to result in a higher probability of loan default (Ahmad & Ariff, 2008: 139). On the other hand, a larger credit

size enables banks to diversify their loan portfolio and, thus, makes them less exposed to credit risk. *Credit size (ld)* is measured by total loans to total deposits.

Bank size is the last bank-specific determinant of credit risk. The empirical literature provides conflicting views regarding bank size and credit risk nexus. According to Louzis et al. (2012: 1015)'s diversification hypothesis, bigger banks have more diversification opportunities and are less exposed to credit risk. Besides, they can better control NPLs by adopting a better risk management system (Gulati et al., 2019: 51; Zribi & Boujelbène, 2011: 72). Too big to fail paradigm, on the other hand, asserts a positive association regarding the relationship above. This paradigm propounds that governments protect bank creditors, especially the large bank creditors; therefore, creditors who expect government protection impose less discipline on banks (Stern and Feldman, 2004: 12-13). Consequently, bigger banks that face less market discipline will tend to take more risks and increase lending to lower-quality borrowers, thereby having more trouble loans (Chaibi & Ftiti, 2015: 5). *Bank size (lnta)* is the natural logarithms of total assets.

Equation (1) describes c*redit risk (npl)* as a function of profitability (roa), cost-efficiency (ic), credit size (ld), and bank size (lnta):

$$npl_{it} = \beta_{1i} npl_{it-1} + \beta_{2i} roa_{it} + \beta_{3i} ic_{it} + \beta_{4i} ld_{it} + \beta_{5i} lnta_{it} + d\_crisis_t + \nu_i + \varepsilon_{it} \qquad (1)$$

where i indicates the banks (i = 1,….,N); t shows the period (t =1,…..,T); ν_i represents the bank-specific effects, and ε_{it} is the residuals. Note that a crisis dummy (d_crisis) is also included to explore the impact of the 2008 global financial crisis on credit risk. Note that empirical results reported under Model-A correspond to the slope coefficients described in equation (1).

The second group of variables represents external determinants of credit risk because macroeconomic conditions affect borrowers' debt repayment capacity. Even though previous studies employ a different set of variables, key macroeconomic performance indicators such as economic growth, unemployment, and inflation are the standard variables used in these studies (Gulati et al., 2019; Yuksel, 2017; Chaibi & Ftiti, 2015; Castro, 2013; Nkusu, 2011; among others). In line with the literature, we employ three commonly used macroeconomic variables. Economic growth is the first macroeconomic variable that may impact credit risk. The negative association between economic growth and loan loss is common among existing studies (Ghosh, 2015; Klein, 2013; Nkusu, 2011; Espinoza & Prasad, 2010). Similarly, we expect a negative relationship between economic growth and NPLs. *Economic growth (eg)* is proxied by the annual change of real GDP per capita.

Unemployment is the second external determinant of credit risk. Higher unemployment causes a deterioration in the borrowers' future income and negatively affects their repayment capacity (Rinaldi & Sanchis-Arellano, 2006: 24). Therefore, we expect a positive relationship between unemployment and loan loss. *Unemployment (unemp)* is measured by the unemployed population as a share of the total labour force.

The last macroeconomic variable used in the study is inflation. Unlike the previous macroeconomic variables, the relationship between inflation and NPLs is ambiguous. Inflation deteriorates the real value of outstanding loans and, therefore, enhances the debt repayment capacity of borrowers. Based on this view, we expect an increase in the inflation rate results in lower NPLs. On the other hand, when the wages are sticky, higher inflation increases credit risk since it reduces the real income of borrowers. Besides, higher inflation may increase nominal interest rates, causing an increase in the cost of borrowing. *Inflation (inf)* is represented by the annual percentage change in consumer prices. Data were retrieved from the Banks Association of Turkey except for the macroeconomic indicators obtained from the World Development Indicators database (World Bank, 2021). Note that empirical results reported under Model-B, -C and -D corresponds to the slope coefficients described in equation (2), (3) and (4), respectively.

$$npl_{it} = \varphi_{1i} npl_{it-1} + \varphi_{2i} roa_{it} + \varphi_{3i} ic_{it} + \varphi_{4i} ld_{it} + \varphi_{5i} lnta_{it} + \varphi_{6i} eg_t + \varphi_{7i} d\_crisis_t + \nu_i + \varepsilon_{it} \quad (2)$$

$$npl_{it} = \theta_{1i} npl_{it-1} + \theta_{2i} roa_{it} + \theta_{3i} ic_{it} + \theta_{4i} ld_{it} + \theta_{5i} lnta_{it} + \theta_{6i} unemp_t + \theta_{7i} d\_crisis_t + \nu_i + \varepsilon_{it} \quad (3)$$

$$npl_{it} = \gamma_{1i} npl_{it-1} + \gamma_{2i} roa_{it} + \gamma_{3i} ic_{it} + \gamma_{4i} ld_{it} + \gamma_{5i} lnta_{it} + \gamma_{6i} inf_t + \gamma_{7i} d\_crisis_t + \nu_i + \varepsilon_{it} \quad (4)$$

where ν_i represents the bank-specific effects and ε_{it} is the residuals. Notice that macroeconomic factors incorporated to the baseline model are individual-invariant.

Annual data on credit risk, profitability, cost-efficiency, bank size, and macroeconomic indicators were obtained for the period 2003-2018 for 22 deposit banks operating in Turkey[3]. The list of banks in our analysis includes the following: Akbank, Alternatif Bank, Anadolubank, Arab Turkish (A&T) Bank, Burgan Bank, Citibank, Denizbank, Fibabanka, Garanti BBVA, Halkbank, HSBC Bank, ICBC Turkey, ING Bank, İş Bank, QNB Finansbank, Şekerbank, Turkishbank, Turkish Economy Bank (TEB), Turklandbank (T-Bank), Vakıfbank, Yapı Kredi Bank and Ziraat Bank[4,5].

Panel A of Table 1 presents the descriptive statistics. Notice that the profitability variable has the lowest mean values, indicating the challenges for bank profitability operating in Turkey. Notice also that the variable with the highest standard deviation is credit size, followed by cost efficiency. Conversely, Panel B of Table 1 shows the correlation matrix among the variables. Notice that correlation between bank-related variables and credit risk is invariably negative. The credit risk variable shows the highest correlation with the credit size variable and the lowest correlation with the cost-efficiency variable. Notice

[3] *Because of the reshaping structure of the Turkish banking system after the banking crisis experienced in 2001, the analysis period started in 2003.*

[4] *Due to changing ownership structure over the sample period, the list of banks is not provided by ownership.*

[5] *Cross-section dimension of the panel data is applied to comprise as many observations as possible.*

also that the highest correlation among the variables is between profitability and cost-efficiency, which is fairly high compared to other correlation coefficients.

Table: 1
Panel A. Descriptive Statistics

	npl	roa	ic	ld	lnta
Mean	4.62	1.29	135.56	91.97	9.64
Max.	48.59	5.27	304.55	332.16	13.19
Min.	0.01	-17.61	34.64	4.85	4.63
Std. Dev.	5.18	1.66	23.20	33.26	1.86
Obs.	352	352	352	352	352

Panel B. Correlation Matrix

	npl	roa	ic	ld	lnta
npl	1.000				
roa	-0.073	1.000			
ic	-0.012	0.596	1.000		
ld	-0.245	0.001	-0.030	1.000	
lnta	-0.044	0.291	0.387	0.148	1.000

Given the unit-invariant structure, macroeconomic variables are not reported.

4. Methodology and Findings

Sarafidis and Wansbeek (2012) emphasise that one crucial issue in panel data analysis is the assumption that the cross-sections are interdependent. Parameter estimations with cross-sectional dependence might provide biased and inconsistent results. We initially employed the cross-sectional dependence (CD) test proposed by Pesaran (2004) to examine this possibility. The results reported in Table 2 strongly support cross-sectional dependence in each series.

Table: 2
Cross-Sectional Dependence Test

Variable	CD-test
npl	24.25[a]
roa	18.99[a]
ic	13.48[a]
ld	39.87[a]
lnta	62.07[a]

Significance at 1% level "a".

A wide range of studies assumes that slope coefficients are homogeneous. However, ignoring slope heterogeneity will likely lead to biased results (Pesaran & Smith, 1995). Various estimation techniques can be utilised to test whether slope coefficients are homogeneous or heterogeneous. Table 3 reports the results of the slope homogeneity test proposed by Pesaran and Yamagata (2008). The null hypothesis of homogeneity is rejected for each model, indicating that slope coefficients are not identical across cross-sections.

Table: 3
Homogeneity Test

Model	Adj. Delta
Model-A	2.802[a]
Model-B	3.347[a]
Model-C	1.695[c]
Model-D	2.438[b]

Significance levels at the 1% level "a", 5% level "b", and 10% level "c".

Having found the existence of cross-section dependence, unit root tests that do not consider possible cross-section dependence, i.e., first-generation tests, are likely to produce biased results. Therefore, we employ Pesaran's (2007) CIPS test, which considers cross-sectional dependence in the residuals[6]. Considering the possible breaks, we further use the KT test, allowing for a structural break developed by Karavias and Tzavalis (2014). Table 4 reports the findings of the unit root test. Empirical results from both tests reveal that variables do not contain unit root except for *ld* and *lnta*.

Table: 4
Unit Root Test

Variable	CIPS	ΔCIPS	KT	ΔKT	IPS
npl	-4.420[a]		-13.439[a]		
roa	-2.906[a]		-19.977[a]		
ic	-2.322[b]		-8.601[a]		
ld	0.667	-10.927[a]	-0.151	-7.305[a]	
lnta	-1.237	-8.888[a]	0.182	-5.113[a]	
eg					-4.510[a]
unemp					-3.617[b]
inf					-5.077[a]

Δ signifies the first difference.
CIPS test is estimated with one lag.
Cross-section results are reported in the IPS test.
Maximum lag length is determined considering the SIC in the IPS procedure.
Significance levels at the 1% level "a" and 5% level "b".

Given the presence of cross-sectional dependence and heterogeneity, slope coefficients should be estimated using a technique robust to cross-section dependence and heterogeneity. We, therefore, employ the Augmented Mean Group (AMG) estimator.

Table 5 presents the results of the AMG estimator. Model-A is the baseline model, which does not include a macroeconomic indicator, whereas Models B-D incorporates macroeconomic indicators. For each model, the lagged credit risk variable is positive and statistically significant at the 1% level, proving that credit risk in the current year is permanently affected by credit risk in the previous year. This result is similar to Ersoy's (2021) and Chaibi and Ftiti (2015) results. Parallel to Ghosh (2015) and Vatansever and Hepsen (2013), we find that profitability has a negative and statistically significant impact on credit risk across all models except Model-D. A 1% increase in profitability decreases credit risk by around 0,429-0,588%. Consistent with Ersoy (2021), the cost-efficiency variable is positive and statistically significant across all models in which the magnitude

[6] *Unlike bank-specific variables, we follow IPS procedure for individual-invariant variables, including inflation, unemployment, and economic growth.*

varies between 0,030 and 0,055%. Except for Model-D, we also find a negative and statistically significant impact of credit size on credit risk. A 1% increase in credit size decreases credit risk by around 0,015-0,021%. In the case of bank size, we estimate a negative and statistically significant impact of bank size on credit risk, confirming the findings of Salas and Saurina (2002) but contradicting Gulati et al. (2019). A 1% increase in bank size decreases credit risk by around 0,030-0,047. Despite the positive estimated coefficients across all models, we find that the impact of the global financial crisis on credit risk is statistically significant in Model-B and Model-C. Given the effects of macroeconomic indicators on credit risk, the only significant impact comes from Model-C. Unemployment is positive and statistically significant at the 1% level. A 1% increase in unemployment increases credit risk by 0,312%, whereas inflation and growth do not have a statistically significant impact. This result supports the findings of Yurdakul and Vatansever, and Hepsen (2013).

Table 5
Parameter Estimations

Variable	Model-A	Model-B	Model-C	Model-D
npl(-1)	0.419[a]	0.438[a]	0.439[a]	0.449[a]
roa	-0.583[b]	-0.429[b]	-0.588[a]	-0.232
ic	0.055[a]	0.042[b]	0.047[a]	0.030[b]
ld	-0.021[b]	-0.019[a]	-0.015[c]	-0.003
lnta	-4.738[a]	-4.113[a]	-4.198[a]	-3.043[a]
eg		0.028		
unemp			0.312[a]	
inf				-0.064
d_crisis	0.189	0.485[c]	0.306[b]	0.012
constant	0.617	-1.617	-6.084[a]	2.291

Parameter estimates are calculated as sample averages.
Significance levels at the 1% level "a", 5% level "b", and 10% level "c".
For simplicity purposes, standard deviations are not reported throughout the study. They are available upon request.

Table 6 provides the results of the AMG estimator concerning state-owned banks[7]. Unlike the results of the pooled panel, the lagged credit risk variable is not statistically significant for most of the specifications, which is also the case for the profitability variable. Although credit risk decreases with profitability in state-owned banks, only a significant relationship comes from Model-B. Evidence that the impact of cost-efficiency on credit risk is positive and statistically significant is confirmed given the results obtained from Model-A and Model-D. Likewise, the results obtained from Model-A and Model-C verify credit size's negative and statistically significant impact on credit risk in state-owned banks. The only macroeconomic indicator that affects credit risk is economic growth. A 1% increase in economic growth leads to a decrease in credit risk by 0,151%. Despite the positive estimated coefficients in all specifications, the impact of the global financial crisis on credit risk is statistically significant in Model-C and Model-D.

[7] *This group includes the following banks: Halkbank, Vakıfbank and Ziraat Bank.*

Table: 6
Parameter Estimations for State-Owned Banks

Variable	Model-A	Model-B	Model-C	Model-D
npl(-1)	0.378	0.594[a]	0.419	0.633
roa	-0.009	-0.190[b]	-0.193	-1.228
ic	0.047[b]	0.013	0.060	0.060[a]
ld	-0.060[b]	-0.039	-0.059[c]	0.043
lnta	-6.303	-9.653	-7.773[a]	-9.534
eg		-0.151[a]		
unemp			0.256	
inf				0.216
d_crisis	0.170	0.182	1.822[b]	1.076[c]
constant	-1.624	-4.487	-6.393	1.931[a]

Notes: Parameter estimates are calculated as sample averages.
Significance levels at the 1% level "a", 5% level "b", and 10% level "c".

Table 7 shows the estimation results for domestic banks. We find that cost-efficiency no longer significantly impacts credit risk compared to previous results. Apart from bank-specific variables, economic growth and unemployment statistically affect credit risk in domestic banks. A 1% increase in economic growth leads to a decrease in credit risk by 0,151%, whereas a 1% increase in unemployment increases credit risk by 0,447%. We also find that the impact of the global financial crises is not robust to empirical specification.

Table: 7
Parameter Estimations for Domestic Banks

Variable	Model-A	Model-B	Model-C	Model-D
npl(-1)	0.336[a]	0.397[a]	0.277[b]	0.299[b]
roa	-0.862[c]	-0.723[b]	-0.534	-0.754[b]
ic	0.040	0.031	0.011	0.045
ld	-0.044[a]	-0.038[a]	-0.048[a]	-0.026[a]
lnta	-4.848[a]	-5.388[a]	-4.819[a]	-4.689[a]
eg		-0.103[c]		
unemp			0.447[a]	
inf				0.026
d_crisis	-1.703[a]	0.120	0.403[b]	0.134
constant	4.745	0.613	-2.486	-1.559

Parameter estimates are calculated as sample averages.
Significance levels at the 1% level "a", 5% level "b", and 10% level "c".

The results for foreign banks are reported in Table 8. Unlike previous estimations, credit size does not significantly impact credit risk in foreign banks. Although statistically insignificant, the impact of the global financial crisis on credit risk is positive across all specifications. The only group that all external determinants that affect credit risk are foreign banks. A 1% increase in economic growth leads to a decrease in credit risk by 0,228%; a 1% increase in unemployment increases credit risk by 0,227%, and a 1% increase in inflation decreases credit risk by 0,192%. In addition, the impact of the global financial crisis is not statistically significant.

Table: 8
Parameter Estimations for Foreign Banks

Variable	Model-A	Model-B	Model-C	Model-D
npl(-1)	0.415[a]	0.524[a]	0.419[a]	0.491[a]
roa	-0.839[a]	-1.269[a]	-1.235[a]	-0.394
ic	0.064[c]	0.088[b]	0.073[b]	0.046[a]
ld	-0.017	-0.019	-0.008	-0.007
lnta	5.826[a]	-5.638[a]	-5.237[a]	-2.991
eg		-0.288[a]		
unemp			0.227[b]	
inf				-0.192[a]
d_crisis	0.255	0.667	0.076	0.213
constant	-3.486	-5.547	-7.032	-0.682

Parameter estimates are calculated as sample averages.
Significance levels at the 1% level "a", 5% level "b", and 10% level "c".

5. Policy Discussions and Implications

Empirical results reveal that internal and external factors affect credit risk, and these factors impact varies by ownership. Profitability is the most significant determinant of credit risk among internal determinants, followed by lagged NPLs. The negative association between profitability and credit risk suggests that banks with high profitability tend to be risk-averse in the credit market, considering Turkey's crisis-prone structure. If profitability is taken as an indicator of management quality, well-managed banks are less exposed to credit risk. However, the magnitudes of profitability and lagged NPLs vary by ownership. For instance, profitability is not such a decisive determinant of credit risk for state-owned banks than local and foreign ones, indicating a higher risk appetite of private banks. Given the public guarantee state-owned banks have, they can cover the loss from outstanding credits to offer loans at much easier terms. Besides, state-owned banks have broader missions, such as social welfare functions through which they are expected to take more risks, albeit at the cost of losing current profits. Therefore, supervisory authorities should take necessary actions, including implementing an audit committee and adopting independent board members to ensure deposit banks take adequate measures to minimise credit risk. Notice also that the number of significant covariates in the case of the state-owned banks is relatively smaller than the other two. On the other side, the previous year's credit risk affects the current year's NPLs in domestic and foreign banks more than in state-owned banks. This finding indicates that credit risk is an ongoing phenomenon for privately-owned banks, whereas state-owned banks can absorb the realised credit losses through government funding schemes. Thus, private banks should adjust their credit risk levels considering their previous credit losses. In addition, banks with high levels of NPLs should be closely monitored by supervisory authorities, depositors, and investors.

The evidence that credit size and bank size negatively affect credit risk confirms that larger size allows better diversification and results in less credit risk. Although bigger banks lead to a less competitive environment, larger size also allows for risk diversification. Therefore, regulatory authorities should consider this dilemma when evaluating bank mergers and acquisitions.

Because credit risk rises as cost-efficiency increases, the skimping hypothesis is valid for the Turkish banking sector, indicating that bank managers attempt to maximise short-term profits despite long-term credit problems. This evidence is probably due to emerging markets' fragile business and political environment.

As an external determinant, unemployment also exerts a significant positive impact on credit risk. This impact likely stems from the loss of revenue, which, in turn, affects borrowers' solvency. Notice that the effect of unemployment on credit risk in domestic banks is nearly two times higher than that in foreign banks, indicating the importance of borrowers' selection policy. Domestic banks tend to finance opaque firms, whereas foreign banks are willing to offer loans only to the largest and the most transparent firms whose employment decisions are less affected by cyclical fluctuations.

Unlike other banking groups, this study addresses foreign banks as the most responsive group to external factors since each macroeconomic element has a statistically significant impact on credit risk. Because foreign banks have operations in various markets, they are more likely to be affected by macroeconomic conditions. Consequently, foreign banks should adopt more prudent credit policies. Notice also that the statistically insignificant impact of the 2008 global financial crisis obtained from most specifications addresses the importance of financial system regulations adopted following the 2001 banking crisis.

Overall, the evidence that one regulation does not fit all suggests that regulatory authorities should consider the ownership structure of the banks while developing appropriate policies. Given the simultaneous impact of internal and external factors on credit risk, regulatory authorities should cooperate with bank managers to overhaul their approach to credit risk assessment.

6. Conclusion

Identifying the determinants of credit risk, the leading indicator of the banking crisis, is quite significant for emerging countries. Determining the factors triggering credit risk is essential for detecting early signs of the crises and for a successful loan management process, particularly for Turkey, where the costs associated with the banking sector have been very high. Given the increasing credit volume in the Turkish banking sector over the last two decades, this study attempts to determine the internal and external determinants of credit risk from 2003-2018. Empirical results reveal that both internal and external factors affect credit risk in the Turkish banking sector. Among internal factors, profitability has the highest impact on credit risk, whereas credit size has the lowest.

On the other hand, unemployment is the only external factor affecting credit risk in the pooled panel. Moreover, we find that empirical results vary considerably by ownership. For instance, cost-efficiency is not a significant risk determinant in domestic banks, while credit size does not affect credit risk in foreign banks. Regarding external factors, economic

growth is the only factor affecting state-owned banks' credit risk, whereas credit risk in privately-owned banks is more responsive to macroeconomic determinants. We also find that the 2008 financial crisis leads to an increase in credit risk, except for foreign banks.

This study focuses on a post-crisis era when the banking system was heavily regulated. Regulation is likely to lead to a change in the determinants of credit risk; future researchers can use high-dimensional time series to observe whether the results are robust to the analysis period. In addition, a change in the determinants does not necessarily have a linear impact on credit risk, especially for developing countries where financial stability still needs to be fully achieved. Therefore, a nonlinear framework can be adopted in the following studies.

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