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Macroeconomic Factors Affecting the Volume of Consumer-Based Problem Loans in Turkey: Analysis through Econometric Methods with Structural Breaks

Türkiye`de Tüketici Bazlı Sorunlu Kredi Hacmine Etki Eden Makro İktisadi Faktörler: Yapısal Kırılmalı Ekonometrik Yöntemler ile Analiz

Cavid SÜLEYMANLI
Lecturer, Azerbaijan State University of Economics
cavidsuleymanov060@gmail.com
ORCID: 0000-0003-2381-0000-4085

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ABSTRACT

In the study, an empirical application was conducted to examine the macroeconomic factors affecting the problematic loan volume, taking into account the structural breaks and using current time series methods. Explanatory variables such as loan interest, real effective exchange rate and public spending were used. Both conventional and structural break unit root tests were applied to examine the stationarities of the variables. The long-term relationship between the variables was examined with the Maki (2012) test with structural break and a cointegration matrix was found according to all 4 models. The structural break dates found to explain the economic shocks experienced in Turkey's economy for the relevant months. The long-term relationship between variables was estimated with the FMOLS methods. According to the estimator results, while CPI and public expenditures variables were found to be statistically insignificant, a positive relationship was found between all the other variables and the dependent variable. In addition, Hacker-Hatemi-J Bootstrap causality test was applied, and a one-way relationship from problematic credit volume to CPI, one-way relationship from loan interest and total loan volume to problem loan volume, and a two-way relationship between public expenditures and problem loan volume were found.

Anahtar Kelimeler:

Sorunlu krediler, yapısal kırılmalı birim kök testleri, maki eşbütünleşme

ÖZET

Çalışmada sorunlu kredi hacmini etkileyen makro iktisadi faktörleri incelemek amacı ile yapısal kırılmaları dikkate alan ve güncel zaman serisi yöntemleri ile ampirik uygulama yapılmıştır. Tasfiye edilecek tüketici kredilerini sorunlu kredi hacmi değişkeni olarak belirlendiği modelde, bu değişkeni açıklamak için TÜFE, isgücü, toplam tüketici kredilerin, tüketici kredi faizi, reel efektif döviz kuru ve kamu harcamaları gibi açıklayıcı değişkenler kullanılmıştır. Değişkenlerin durağanlıklarının incelenmesinde hem geleneksel hem de yapısal kırılmalı birim kök testleri uygulanmıştır. Değişkenler arasındaki uzun dönemli ilişki yapısal kırılmalı Maki (2012) testi ile incelenmiş ve her 4 modele göre eşbütünleşme matrisi bulunmuştur. Bulunan yapısal kırılma tarihleri o aylar için Türkiye ekonomisinde yaşanan iktisadi şokları açıklar nitelikte bulunmuştur. Değişkenler arasındaki uzun dönemli ilişki FMOLS modeli ile tahmin edilmiştir. Model sonuçlarına göre TÜFE ve kamu harcamaları değişkenleri istatistiksel olarak anlamsız bulunurken, diğer tüm değişkenler ile bağımlı değişken arasında pozitif ilişki saptanmıştır. Bunun yanı sıra Hacker-Hatemi-J Bootstrap nedensellik testi uygulanmış ve sorunlu kredi hacminden TÜFE`ye doğru tek yönlü, kredi faizlerinden ve toplam kredi hacminden sorunlu kredi hacmine doğru tek yönlü, kamu harcamaları ile sorunlu kredi hacmi arasında ise çift yönlü ilişki bulunmuştur.

1. INTRODUCTION

While problem bank loans are one of the main problems of the banking sector, they also create an imbalance in financial markets in general. Especially, the credit bubbles that have occurred with the growing financial sector in recent years have brought about the problem of not paying loans on time or not paying at all. This problem, following a growing trend in the banking sector in Turkey in recent years, influences macro-economic indicators and is also influenced by macro-economic indicators.

The growth of the problematic loan base affects the financial sector in the country, especially bank profitability. The formation and growth of problem loans, their becoming chronic for the financial sector, and the fact that this situation is experienced not only in a few banks but also in both public and private banks affect the finance sector deeply. We can explain the concept of the problem loan as the failure of the individual, commercial or mortgage loan to be paid on time, or in general, the borrower's being unable to pay the loan due to any reason. A loan can turn into a problem loan due to many different reasons such as the debtor's having inadequate assets, loss of health, the inability of the commercial enterprise to make a profit that will create the ability to pay, death of the debtor, not being able to reach the debtor, in general, due to the debtor's losing the ability to pay the debt. In this case, banks or non-bank financial institutions initiate a legal process for the recovery of the bad debt or accept that the debt cannot be paid in cases where recovery is impossible.

The main reasons for the growth of the problem loan base are the uncontrolled growth of the loan volume, the inadequacy of credit rating, the wrong credit policies of banks, an economic crisis or a natural disaster in the country, a decrease in the economic indicators and a decrease in the income in general. Seen from this perspective, it is observed that problem loans have the potential to create a crisis and an economic crisis has the potential to increase the volume of problem loans. That is, there is also mutual causality between problem loans and economic crises (real or financial crisis).

In general, it is accepted that the growth in the volume of loans leads to a proportional increase in problem loans. The stretching of the credit conditions by an expanding financial sector as a result of an expansionary monetary policy implemented in a country sometimes leads to incorrectly chosen credit rating policies. As a result of the emerging loan bubble, the bank profitability decreases because of debtors' inability to pay their loans resulting from the above-mentioned and other conditions, and banking crises are experienced as a result of the functional deterioration in banks. Financial crises also occur as the banking crises experienced create twin crises by causing the money crisis. In other words, an increase in the volume of problem loans may lead to significant financial crises.

The current study aims to conduct an empirical analysis of problem bank loans from a macro-economic perspective. In general terms, the current study is devoid of banking terms and a banking perspective of problem loans in both the theoretical and empirical parts because the aim of the study is to establish a relationship between problem loan base and macroeconomic indicators. In the time series analysis conducted to this end, the cointegration and causality relationship between macro-economic variables and the volume of problem loans in the period between January 2014 and January 2021 will be examined. In the current study, first, a short review of the literature of different empirical studies conducted in Turkey and abroad for the problem of bank loans was made. In addition, a brief background assessment of problem bank loans from an economic perspective was performed. An original model and a new method were tried by evaluating the methods and results of the studies mentioned in the literature review. By using new generation time series methods in the estimation of the relevant model, it was aimed to produce more consistent results and to make a significant contribution to the literature in terms of the period covered and new variables.

2. A MACROECONOMIC PERSPECTIVE OF CONSUMER-BASED PROBLEM LOANS

The concept of problem loans is also classified as "frozen receivables", "non-performing loans", "loans to be collected", "receivables to be liquidated" in the provisions legislation. The word problem loan can also be defined as "the delay of collection and the emergence of the possibility of loss due to the significant deterioration of the repayment agreement between the bank and the debtor." (Selimler, 2015). If the loan allocated fails to return to the bank, if the bank cannot restructure the loan and cannot establish any dialogue with the customer to solve the problem, or the borrower is unable to pay the loan, these loans become problem loans and often cause the bank to initiate legal proceedings. We can evaluate the problem loan process in four separate stages: early warning, pre-

administrative, administrative and legal stages. In the period between the early warning stage and the legal stage, the structuring options between the bank and the customer are reviewed, if this process cannot be accomplished, the loan is tried to be recovered by legal means (Yücememiş and Sözer, 2011).

Incorrectly rated credit risks, unsuitable credit policies, flexibility in credit terms, credit bubbles due to low credit interest generally result in an increase in consumer loans. This increase also leads to increasing risks in the collection of loans. Ignorance of the age criterion during the lending process, not determining the ability to pay correctly according to income and employment status, and loans given without taking similar risks into account can cause difficulties in the collection of loans in the future. The difficulties that banks face in getting back their loan payments create negative externalities for banks, particularly for their profitability. While the non-repayment of bank loans is a sign of financial risk, it also indicates that the economic power of the consumer is decreasing. The inability of the debtor's income source to pay the loan due to events such as natural disasters, political or economic shock, and epidemiological situation in the country is another reason that creates problem loans (Yüksel, 2016:5).

While problem loans affect macroeconomic factors, they are also affected by macroeconomic factors. Positive movements are expected in the economic factors that will affect the income level of the borrower in order to reach the level of income required for the individual borrower to be able to pay the loan or to reach the level of income intended while receiving the loan. For example, it is an accepted view in theory that increases in public expenditures and money supply, which generally increase the income level of the population, including loan payers, have a positive effect on the income level. In addition, an increase in employment and positive movements in inflation are variables that have a positive effect on social income. In other words, economic occurrences that generate or increase income can have an alleviating effect on the problem of loans that arise when the debtor cannot pay his/her debt due to economic difficulties. On the contrary, the income contraction and the inflation effect may occur due to the increase in the exchange rate and may decrease the borrower's ability to pay loans by creating a decrease in his/her income. Such macroeconomic phenomena have direct and indirect effects on the individual borrower's ability to pay loans.

3. LITERATURE REVIEW

The problem loan volume is also defined as the non-performing loan volume or the impaired loan volume. In the literature, there are time series, panel data and survey studies investigating the economic factors affecting this volume and affected by this volume. In this section, the results of some seminal empirical studies investigating the relationship between the volume of problem loans and macroeconomic variables only within the context of Turkey adopting a macroeconomic perspective are briefly summarized.

Koyuncu and Berrin (2011) examined the relationship between the non-performing loan volume and the volume of loans invested in the private sector for the period between 1986 and 2008, and a reducing effect was determined according to the results of the Method of Least Squares (MLS). Şahbaz and İnkaya (2014) examined the relationship between non-performing loans and domestic loan volume, real growth, private consumption expenditures and private fixed capital expenditures for the period over 1998Q2-2012Q3. In the study created with the Vector Autoregression (VAR) method, the cointegration relationship between the series and Granger causality was encountered. In the study by Altınöz (2018), the relationship between loan loss rates and macroeconomic variables was examined. According to the results of the time series analysis, it was seen that the increase in the M3 money supply and interest rate decreased the loan loss provision.

Radivojević et al. (2019) estimated the critical macro and microeconomic factors affecting troubled credit volume for Latin American countries with the Generalized Momentar Estimator. According to the results of the study, there was no significant relationship between the variables.

Tandon et al. (2017) estimated bank-specific, macroeconomic determinants of non-performing loans and their effects on banking profitability. In the period of 2007-2016, multivariate panel data analysis for 35 Indian public and private banks was performed using panel data through fixed effect regression and modified ordinary least squares and system GMM approach was discussed. According to the results, inflation and unemployment are the main determinants of bad loans in India.

In the Mazreku et al. (2018) study, macroeconomic factors affecting problematic banking loans for transition economy countries were also examined. According to the findings, GDP growth and inflation were found to be both negatively and significantly related to non-performing loans.

Yüksel (2016) examined the relationship between non-performing loan volume and macroeconomic variables for the period between 1998 and 2014. The Multivariate adaptive regression spline (MARS) method was used in the study conducted with a total of 13 variables. According to the results of the model, it was seen that the increase in the exchange rate increased the non-performing loan volume, while the economic growth and interest income of the banks decreased the relevant volume.

Çiftçi (2016) examined the relationship between monthly data for the period over 2006-2015 and variables such as rate of change in the Consumer Price Index (CPI), output gap, monetary aggregates, overnight interests between banks and non-performing loans using VAR analysis. According to the analysis results, the relationship between the macroeconomic variables and bad loan volume varies according to bank groups.

Baş and Kara (2020) investigated the relationship between the variables of exchange rate and inflation and non-performing loans with ARDL analysis. The study, covering the period 2005Q4-2017Q4 in Turkey, concluded that the increase in the real effective exchange rate also increased the nonperforming loans in both the short and long term.

Kuzu and Çelik (2019) examined the relationships between the problem loans of 25 commercial banks operating in the banking sector of Turkey between the years 2005 and 2018 and real effective interest rate, gross domestic product (GDP), return on assets, real exchange rate (RER), asset size, commercial credit interest rate, share of Turkish currency loans, the Stock Exchange İstanbul-100 (BIST) index, deposit to loan ratio, interbank overnight average interest rate, capital adequacy ratio, rate of inflation = speed of change in CPI, return on equity, monetary size = monetary base / CPI, loan growth rate, unemployment rate, and the share of consumer loans. While a positive correlation was found between the variables of the rate of inflation, the share of consumer loans, capital adequacy ratio and the dependent variable, a negative correlation was found between deposit to loan ratio and BIST 100 index and the dependent variable.

Torun and Altay (2019) analyzed the micro and macroeconomic variables that led to the problematic loans of 25 commercial banks for the period 2008-2015. As a result of the balanced panel analysis, inflation, unemployment rate, real exchange rate, GDP growth rate, GDP growth rate of the Euro zone and the BIST Index as macroeconomic variables and the real effective interest rate, capital adequacy ratio, the share of consumer loans as microeconomic variables were found to be related to problem loans.

In their study, Kabataş and Karamustafa (2019) examined the relationship between the rate of consumer-based problem loans and macroeconomic and bank-specific microeconomic variables in the period over 2005Q1–2016Q4 in Turkey. As a result, a negative and statistically significant relationship was found between the variables of growth, unemployment and equity / total assets ratio and the problem loan ratios in consumer loans of the Turkish banking sector.

4. EMPIRICAL ANALYSIS

In the empirical part of the study, macroeconomic factors affecting the consumer-based problem loan volume are analyzed using current time series methods. In this context, consumer loans to be liquidated both in Turkish Lira and in foreign currency have been determined as dependent variables. The period to be evaluated within the scope of the current study was evaluated by considering the period in which all variables in the model were observed continuously and without loss. The data set of the study is comprised of monthly data consisting of 89 observations covering the period between January 2014 and February 2021. All of the data were compiled from the Central Bank Electronic Data Distribution Centre (CBEDDC). “Eviews 9.0”, “Rats” and “Gauss 21.0” package programs were used in the estimation of the model.

As it was intended to conduct a study that takes into account structural breaks and shocks in macroeconomic variables, current methods with structural breaks were preferred. In this context, the stationarity tests of the variables were carried out with the Extended Dickey-Fuller (ADF) and Phillips-Perron tests, which are the most common tests in the literature and are important tests in time-series studies, and Zivot and Andrews (1992), Lumsdaine and Papell (1997), Lee and Strazicich (2003, 2004) and Carrion-i-Silvestre (2009) tests, which allow structural breaks, were applied. After the stationarity tests, the cointegration analysis under multiple structural breaks developed by Maki (2012) was performed and the long-term relationship was estimated with the FMOLS estimator. The causality analysis between variables was conducted with a causality analysis developed by Hacker and Hatemi (2006) using bootstrap simulations.

As the variables were by different percentages, they were included in the model by taking the natural logarithm of all the variables in the model and seasonally adjusting them. In addition, the trend-including Public Expenditures (Central Government Budget Expenditures) – Thousand TL (LNGOVR) series was freed from the trend. Descriptive information about the variables is given in the table 1:

Table 1. Measurement of Variables

Definition of the Model	Its Name in the Model
Consumer Loans to be Liquidated (TLYp)(Thousand Tl)	LNBDLOAN
Labour – Level	LNLABOUR
Consumer Price Index (General) – Level	LNCPI
CPI Based Real Effective Exchange Rate (2003=100) – Level	LNRE
Personal Loan Interest (Opened in TL and Foreign Currency)- %	LNINT
Total Loan Volume (Thousand TL) – Level	LNTOTLOAN
Public Expenditures (Central Government Budget Expenditures) – Thousand TL	LNGOVR

It is a theoretically accepted view that the increase in macroeconomic variables in the model macroeconomically provides stability or decreases the stability. Since the increase in the volume of problem loans poses a macroeconomic threat, that is, it is considered as a crisis indicator, factors that make it difficult to pay the loan or that contribute to the formation of a situation in which loans cannot be paid are evaluated. Within the framework of theoretical expectations, based on the perspective that the increase in the labour force has a positive macroeconomic effect, it is expected that a change in this variable will cause a decrease in the problem loan volume, while an increase in the real effective exchange rate and CPI is expected to have an increasing effect on the problem loans. In addition, a negative relationship is expected between an increase in public expenditures and the problem loan volume when seen from the perspective that the increase in public expenditures will have a positive effect on the individual's income.

4.1. Stationarity Tests

Economic and financial variables are often not stationary. Estimates that do not consider stationarity lead to spurious regression (Göktaş, 2015: 66). The effect of any shock that occurs in stationary series is not permanent. The concept of stationarity is generally explained as the invariance of the variance, covariance and mean of the series over time. For this reason, before progressing onto econometric estimation, it should be tested whether the stochastic process that makes up the series remains stationary over time. The ADF developed by Dickey-Fuller (1981) and the test developed by Phillips-Perron (1988) are the most preferred consistent and basic tests used in stationarity testing.

The ADF test is a test statistic that has an autoregressive process that includes the lagged values of the dependent variable as an independent variable and is decided according to the results of the T statistic. While determining the appropriate lag level of the lagged variable in the ADF test, Akaike Information Criterion (AIC), Schwartz Bayesian Criterion (SBC) and Hannan-Quinn Criterion (HQC) are used (Göktaş, 2005:67). Below are given the models of the test without constant and trend, without constant and with trend, and with constant and trend:

$$\Delta Yt = \delta Y_{t-1} + \sum \delta_i \, \Delta Y_{t-1} + \quad (1) \qquad \text{[without constant and trend]}$$

$$\Delta Yt = \mu + \delta Y_{t-1} + \sum \delta_i \, \Delta Y_{t-1} + \varepsilon_t \quad (2) \qquad \text{[without constant and with trend]}$$

$$\Delta Yt = \mu + \beta T + \delta Y_{t-1} + \sum \delta_i \, \Delta Y_{t-1} + \varepsilon_t \quad (3) \qquad \text{[with constant and trend]}$$

Phillips-Perron (1988) test is a unit root test that is mostly applied to financial data and developed on the Dickey-Fuller process. The PP test contains more flexible assumptions than the ADF test. The ADF test assumes terms homogeneous, while the PP test allows weak dependent and heterogeneous distribution of error terms. All three structures of the PP test are given in the following equations:

$$Y_t = \delta Y_{(t-1)} + u_t \quad (4) \qquad \text{[Without constant and trend]}$$

$$Y_t = \beta 1 + \delta Y_{(t-1)} + u_t \quad (5) \qquad \text{[With constant]}$$

$$Y_t = \beta 1 + \delta Y_{(t-1)} + \beta 2(t - T/2) + u_t \quad (6) \qquad \text{[With constant and trend]}$$

In the following table 2, the results of the ADF test conducted by considering 11 delays and decided according to the SBC criterion and the results of models with constant and with constant and trend of the Newey-West corrected PP test are presented:

Table 2. ADF and PP Test Results

VARIABLE	ADF		PP	
	With constant	With constant and trend	With constant	With constant and trend
LNBDLOAN	-1.6431 0.7674	1.0083 0.9164	-1.6480 0.7654	2.2521 0.9940
ΔLLNBDLOAN	-4.2717 0.0056**	-2.9533 0.0036**	-10.1687 0.0000*	-8.2146 0.0000*
LNLABOUR	-2.1996 0.4833	0.7912 0.8818	-2.4979 0.3285	0.9141 0.9025
ΔLNLABOUR	-6.6315 0.0000*	-7.0392 0.0000*	-3.5218 0.0097*	-3.5676 0.0005*
LNCPI	-1.7773 0.7067	4.4675 1.0000	-1.6288 0.7733	8.2100 1.0000
ΔLNCPI	-5.5317 0.0001*	-1.3155 0.0001*	-6.8287 0.0000*	-4.0137 0.0001*
LNGOVR	-6.4426 0.6010	6.0177 1.0000	-6.4261 0.2050	1.7359 0.9795
ΔLNGOVR	-5.7326 0.0000*	-13.8955 0.0000*	-25.6773 0.0001*	-23.5257 0.0000*
LNRE	-4.1064 0.1090	-1.0908 0.2476	-3.3177 0.1703	-0.9205 0.3149
ΔLNRE	-7.0656 0.0000*	-7.0038 0.0000*	-5.6724 0.0000*	-5.8042 0.0000*
LNINT	-2.5125 0.3216	-0.1545 0.6274	-2.1088 0.5333	0.1591 0.7298
ΔLNINT	-5.4727 0.0001*	-5.5366 0.0000*	-5.5445 0.0001*	-5.6096 0.0000*
LNTOTLOAN	-2.1318 0.5207	-1.7773 0.7067	-2.5164 0.3197	5.4672 1.0000
ΔLNTOTLOAN	-7.7638 0.0000*	-5.8254 0.0000*	-7.7598 0.0000*	-6.0574 0.0000*

*Indicates the significance level of 1%. ** indicates the significance level of 5%.
*, **, *** indicates the significance level of %10, %5, %1

According to the results of both the ADF and PP tests for all the variables in the model, the H_0 hypothesis arguing the presence of the unit root in the series could not be rejected because the T statistic values calculated at the level values were greater than the critical values at the 5% significance level. However, when the first differences of the series were taken, it was seen that the T statistic values calculated at these values were smaller than the critical value, that is, the H_0 hypothesis was rejected. As a result, it was determined that all series were not stationary at level values according to the ADF and PP tests, but became stationary at I (1) values.

Unit root tests, which take structural breaks into account, were applied after conventional unit root tests. Zivot and Andrews (1992) developed a unit root test, which determines the date of structural break internally. The ZA test is a unit root test that allows a single break under three different models named as model A, model B and model C occurring in three different types of break; break in constant, break in constant and trend and break in trend. Within the retro-perspective of the unit root models, the ZA model is criticized as it is a single break model and Lumsdaine and Papell (1997) tests, which are built on this model and allow two structural breaks, have been developed.

Zivot and Andrews (1992) Lumsdaine and Papell (1997) models are with a series of unit root, assume that there is no structural break in the null hypothesis and the critical values are found according to this assumption. To solve this problem, following the ZA and LP tests, Lee and Strazicich (2003, 2004) developed unit root tests with structural breaks whose minimum Langrange Multiplier (LM) allows one and two breaks (Gövdeli, 2016).

As a result of the crises experienced in different periods in the economy and the occurrence of many structural breaks due to shocks caused by political events and other reasons, the unit root tests with structural break were found to be insufficient in terms of long-term analyses. The structural break tests which were developed by Carrion-i-Silvestre et al. (2009) and which determine the structural break dates internally and allow up to five

breaks have eliminated this deficiency. The CS test obtains the structural break dates by using the algorithm in Bai and Perron (2003) method and by minimizing the sum of error squares with dynamic programming methods with the help of the Q-GLS method. The CS test consists of five different test statistics and these test statistics are produced by the bootstrap method.

The table 3 below gives the results of the ZA test that determines the structural break dates internally and allows a single structural break:

Table 3: ZA Test Results

VARIABLE	Model A (Break in	Model B (Break in Trend)	Model C (Break in Constant and
LNBADLOAN	-2.27763	-2.28348	2.28844
	2019:11	2019:08	2019:05
LNLABOUR	-4.49070	-4.79954	-4.50740
	2019:11	2019:03	2019:01
LNCPI	-3.51720	-3.08562	-3.68904
	2018:07	2016:08	2018:07
LNRE	-5.4305	-1.80012	-3.32947
	2019:06	2018:08	2018:05
LNINT	-3.74041	-1.11500	-3.32947
	2019:06	2016:04	2018:05
LNTOTLOAN	-3.61717	-3.23072	-4.49740
	2018:08	2020:01	2019:05
LNGOVR	2.91738	3.51382	2.80653
	2018:11	2016:08	2018:03
Critical values are the significance level of 1% and 5%	-5.34 -	-4.80	5.57
	-4.93 -	4.42	-5.08

Hypotheses related to the ZA test are given below:

H0: The series contains unit root without structural break

H1: The series is stationary with a structural break

As a result of the ZA test, when the t-statistics at 5% and 1% significance level in all the three models are compared with the ZA critical values, the H_0 hypothesis cannot be rejected because the test statistic is smaller than the critical value in terms of absolute value. In this context, since the T statistic value calculated at the structural break dates determined for all the variables is smaller than the critical values at both 5% and 1% significance level, it has been concluded that the series contains unit root without a structural break. Lumsdaine and Papell (1997) developed a unit root test that takes into account two structural breaks.

Table 4. Lumsdaine and Papell Unit Root Test

VARIABLE	Model A (Break in	Model B (Break in Trend)	Model C (Break in Constant and
LNLABOUR	-5.0577	-6.1197	-5.5416
	2018:10 2020:01	2018:03 2019:08	2018:04 2019:05
LNCPI	-5.2640	-5.2640	-2.3808
	2016:01 2018:07	2016:01 2018:07	2016:07 2018:07
LNRE	-2.4659	-2.8612	3.5779
	2015:09 2018:03	2017:08 2018:08	2018:08 2018:03
LNINT	-5.4305	-4.0777	-5.7279
	2018:05 2019:06	2017:08 2018:08	2018:07 2019:12
LNTOTLOAN	-5.0874	-4.7255	-4.9806
	2018:09 2020:02	2018:08 2019:09	2018:04 2019:05
LNGOVR	-5.3982	-5.1425	-6.3629
	2017:11 2018:11	2017:09 2018:12	2016:11 2017:11
LNBADLOAN	-3.4303	-3.4493	-4.3991
	2015:04 2020:02	2015:07 2020:01	2015:04 2019:05
Critical values are the significance level of 1% and 5%	-6.74	-7.19	-7.19
	-6.16	-6.62	-6.75

The LP test uses the same hypotheses as the ZA test and a decision is made by comparing the T statistic values with the critical values by using the same method. According to the findings, when two structural break periods are taken into consideration in all variables, the H_0 hypothesis established as "The series contains unit root without structural break" cannot be rejected because the calculated absolute T statistic values are smaller than the critical values at 1% and 5% significance level.

Although it was assumed that there was no structural break in the unit root null hypothesis in the LP and ZA tests and this assumption was investigated with critical values, the minimum Langrange Multipliers unit root test was developed by Lee and Strazicich (2003, 2004). This test was developed as two separate tests allowing both one structural break and two structural breaks. In other words, although unit root methods that take a structural break into account were used until the LS test, with the LS test, the unit root test that allows structural break was introduced to the applied literature. The hypotheses of the LS test are as follows:

H_0: The series contains unit root with structural breaks

H_1: The series is stationary with structural breaks

Table 5. Lee and Strazicich Unit Root Test with One Break and Two Breaks

VARIABLE	Results of the Test with One Break		Results of the Test with Two Breaks	
	Model A (Break in Constant)	Model C (Break in Constant and Trend)	Model A (Break in Trend)	Model C (Break in Constant and Trend)
LNLABOUR	-1.9754	-4.4012	-1.5007	-6.8761
	2020:06	2019:12	2018:10 2020:07	2019:01 2020:01
LNCPI	-1.4245	-3.0261	-4.3674	-1.6139
	2018:06	2018:06	2017:09 2018:10	2017:10 2018:06
LNRE	-3.2624	-1.8242	-4.7596	-4.1673
	2018:05	2018:07	2018:06 2019:01	2017:09 2019:03
LNINT	-2.8140	-3.5934	-3.2657	-5.9076
	2019:07	2019:04	2018:10 2019:07	2018:04 2019:09
LNTOTLOAN	-3.4978	2.8149	-3.6516	-4.9053
	2018:09	2018:09	2018:09 2020:05	2018:07 2020:02
LNGOVR	3.8768	4.3793	-4.4290	-3.4545
	2016:03	2017:05	2016:09 2019:04	2015:04 2018:02
LNBADLOAN	-3.3694	-0.9763	-3.9866	-1.1370
	2015:10	2017:07	2015:03 2017:12	2017:07 2018:11
Critical values are the significance level of 1% and 5%	-4.029033	-4.8532	-4.0730	-6.7500
	-3.430333	-4.2889	-3.5630	-6.1080

The fact that the LM test statistic values calculated for all the variables according to the results of the LS test with one break and two breaks were higher than the critical values at 1% and 5% significance level in the model that allows breaking in both constant, constant and trend, led to the conclusion that the H_0 hypothesis cannot be refuted. This confirms the hypothesis that there is a unit root under structural break for all series. As a result, the results of the LS test with one break have once again confirmed the ADF, PP and ZA and LP test results with a structural break. While the ZA, LS and LM tests, which are the unit root tests with the structural break, allow one and two structural breaks, Carrion-i-Silvestre et al. (2009) (CS) test allows five structural breaks and the structural break dates can be determined internally by the test method. The CS test was applied in the next step.

Table 6. Carrion-i-Silvestre (CD) Test with Structural Break

VARIABLE	Level Value					Structural Break Dates
	PT	MPT	MZA	MSB	MZT	
LNBDLOAN	7.11 [9.41]	6.48 [9.41]	-12,12 [-17.45]	0,29 [0.09]	-3,31 [-4.7]	2015:03 2017:12
LNLABOUR	6.56 [9.41]	6.83 [9.41]	-14,64 [-17.45]	0,40 [0.09]	-2,16 [-4.7]	2017:03 2019:01
LNCPI	7.61 [9.41]	7.34 [9.41]	-11,39 [-17.45]	0,35 [0.09]	-3,52 [-4.7]	2015:06 2016:09
LNRE	8.43 [9.41]	9.30 [9.41]	-10,26 [-17.45]	0,45 [0.09]	-2,66 [-4.7]	2016:08 2017:09
LNINT	8.67 [9.41]	8.95 [9.41]	-12,48 [-17.45]	0,43 [0.09]	-1,97 [-4.7]	2018:04 2017:03
LNTOTLOAN	7.27 [9.41]	7.45 [9.41]	-12,28 [-17.45]	0,35 [0.09]	-2,03 [-4.7]	2016:07 2018:09
LNGOVR	7.78 [9.41]	5.34 [9.41]	-15,35 [-17.45]	0,23 [0.09]	-3,39 [-4.7]	2016:09 2019:04
ΔLNBDLOAN	11.5 [9.41]	11.3 [9.41]	-28.90 [-17.45]	0.03 [0.09]	-5.6 [-4.7]	
ΔLNLABOUR	19.6 [9.41]	20.3 [9.41]	-31.44 [-17.45]	0.07 [0.09]	-7.8 [-4.7]	
ΔLNCPI	15.7 [9.41]	15.3 [9.41]	-25.93 [-17.45]	0.03 [0.09]	-5.1 [-4.7]	
ΔLNRE	33.6 [9.41]	37.8 [9.41]	-39.48 [-17.45]	0.02 [0.09]	-6.7 [-4.7]	
ΔLNINT	26.9 [9.41]	28.3 [9.41]	-21.84 [-17.45]	0.08 [0.09]	-8.5 [-4.7]	
ΔLNTOTLOAN	18.4 [9.41]	17.6 [9.41]	-28.41 [-17.45]	0.06 [0.09]	-5.3 [-4.7]	
ΔLNGOVR	26.3 [9.41]	25.7 [9.41]	-31.36 [-17.45]	0.01 [0.09]	-9.4 [-4.7]	

* The values in parentheses are the critical values found as a result of 1000 replications using the bootstrap technique. The variable with the symbol "Δ" in front of it is the first differentiated variable of the series. Break dates of variables are given only in level values.

According to the results of the CS test and according to the PT, MPT, MZA, MSB and MZT test statistics, it was concluded that the series was not stationary in the level values, and I (1) was stationary in the first differences.

According to both the ADF and PP unit root test results and the ZA, LP, LM and CS (according to all test statistics) tests performed under the structural break, all the variables were found to be non-stationary in level values, and stationary in case of I (1). This situation makes it possible to investigate the cointegration relationship between variables.

4.2. Cointegration Analysis

Macroeconomic variables are structurally affected by significant conjunctural changes in economies and non-economic events. In this case, the relevant series diverges from the line it has maintained up to now. Ignoring this situation, which is explained as a structural break in empirical studies, reduces the consistency of the related estimates. Especially in recent years, in econometrics studies, the opinion that studies conducted with current structural break methods, which replace the traditional unit root, cointegration and causality tests, yield more consistent results compared to traditional methods is dominant. Structural break tests have improved with the increase in the number of structural breaks, allowing the calculation of consistent test statistics with the use of bootstrap techniques.

The use of cointegration analysis with structural break started with Gregory and Hansen (1996) method, and further developed by Cerrion-i-Silvestre and Sanso (2006) and Westerlund and Edgerton (2006) methods. While these tests have developed cointegration vectors that allow a structural break, the Maki (2012) test allows for up to five structural breaks. That is, it predicts the long-term relationship in the presence of five structural breaks. This method, in which the structural break dates are determined internally, determines the possible breaking point for each period and determines the points where T is minimum among the T statistic values calculated for those

periods and chooses those points as the structural break dates. The Maki (2020) test is currently known in the literature as the cointegration test that allows the most structural breaks, and as a superior method to the Gregory and Hansen (1996) and Hatemi-J (2008) tests. Maki (2012) developed four models to determine the co-integration relationship under the structural break.

Studies to examine the existence of a cointegration relationship between series under the presence of structural breaks started with Gregory and Hansen (1996), followed by Carrion-i-Silvestre and Sanso (2006) and Westerlund and Edgerton (2006). While one structural break in the cointegration vector can be taken into account in these tests, Maki (2012) developed a method that can test the presence of cointegration between series in the presence of up to five structural breaks. This method can also calculate the structural break dates internally. In particular, when there are three or more structural breaks in the cointegration equation, this method is superior to the Gregory and Hansen (1996) and Hatemi-j (2008) methods (Maki, 2012). In the working algorithm of the test, each period is taken as a possible breaking point, t statistics are calculated and the points where t is minimum are accepted as the breaking point. Maki (2012) developed four different models in order to test whether there is a cointegration relationship between series in the presence of structural breaks.

Model 0: The model where a break is allowed in the constant term:

$$Y_t = a + \sum_{i=1}^{k} a_i + D_{i,t} + \beta X_t + e_t \quad (7)$$

Model 1: The model where a break is allowed in the constant term and slope:

$$Y_t = a + \sum_{i=1}^{k} a_i + D_{i,t} + \beta X_t + \sum_{i=1}^{k} \beta_i X_i D_{i,t} + e_t \quad (8)$$

Model 2: The model with a trend where a break is allowed in the constant term and slope:

$$Y_t = a + \sum_{i=1}^{k} a_i + D_{i,t} + \gamma t + \beta X_t + \sum_{i=1}^{k} \beta_i X_i D_{i,t} + e_t \quad (9)$$

Model 3: The model where a break is allowed in the constant term, slope and trend:

$$Y_t = a + \sum_{i=1}^{k} a_i + D_{i,t} + \gamma t + \sum_{i=1}^{k} \gamma_i t D_{i,t} + \beta X_t + \sum_{i=1}^{k} \beta_i X_i D_{i,t} + e_t \quad (10)$$

The Di, variable here shows the dummy variables that explain the structural break dates. The critical values required for the Maki (2012) test are derived through Monte Carlo simulation. The hypotheses of the test are as follows:

H_0: There is no cointegration relationship under structural breaks between series.

H_1: There is a cointegration relationship under structural breaks between series.

To test the hypotheses, the calculated test statistic values are compared with the absolute critical value. Maki (2012) cointegration test results are given in the table 7:

Table 7. Maki (2012) Cointegration Analysis

Model	Test Statistics	Critical Values			Break Dates
		%1	%5	%10	
Model 0	-7.143*	−6.640	−6.132	−5.892	2016:1,2018:7,2020:8
Model 1	-7.067*	−7.053	−6.494	−6.220	2016:7,2018:7,2020:7
Model 2	-9.490*	−9.441	−8.869	−8.541	2018:7,2019:8,2020:7
Model 3	-11.043*	−10.08	−9.482	−9.151	2018:8,2019:5,2020:08

*Indicates the significance level of 1%.

The fact that the test statistics calculated according to the results of all four models are greater than the critical values at 1%, 5% and 10% significance levels in terms of the absolute value means that the H_0 hypothesis is rejected. Given that Model 2 is preferred more in the literature, a cointegrated relationship is also found in model

2. Determination of a cointegration relationship for all the models shows that the estimation to be made with the level values of the series will be consistent. Although Maki (2012) test can detect up to 5 structural breaks, 3 structural breaks were determined for all the models. The emergence of this situation can also be evaluated as the statistical and econometric success of the model established. The fact that the same results emerged for all the unit root tests at all three levels of significance is one of the indicators that make the model prediction successful. At the same time, we see that the structural break dates determined according to all models are close to each other. For example, the periods 2020:7 and 2020:11 are the structural break dates found for all the models.

There is the variable of GDP per capita in the study that measures the relationship between multi-question loans and macroeconomic variables in the literature. The reason why this variable is not included in the model within the scope of the current study is that the study is conducted with the same frequencies (monthly). However, the Ramsey Reset test was applied in response to the identification error caused by keeping an important variable outside the model, and the H_0 hypothesis that "There is a specification error in the model" was rejected as a result of the comparison of the calculated F statistic values (2.293143, P = 1.3339) with the critical values at the relevant degree of freedom. In other words, there was no specification error found in the model that could be caused by excluding any variable from the model.

The Fully Modified Ordinary Least Squares (FMOLS) method, developed by Phillips and Hansen (1990), is an estimator based on a semi-parametric correction method that takes into account the intrinsic relationship between independent variables and the error term and the autocorrelation problem between error terms. The FMOLS estimator is a consistent method that is successful in a small number of observations and is an asymptotically non-deviating method (Küçükaksoy et al., 2006: 751). Long-term coefficients were estimated with the FMOLS estimator. In this context, the model where the structural break dates in Model 2 were taken as dummy variables, which is the most preferred model in the literature and where a cointegration relationship was encountered at the three levels of significance, was estimated.

Table 8. Results of the FMOLS Cointegration Estimator

VARIABLE	Coefficient	Test statistic	Probability
LNTOTLOAN	1.097527	6.634482	0.0000*
LNCPI	-0.149463	-0.557617	0.5787
LNINT	0.119612	2.376389	0.0200*
LNGOVR	0.044954	0.913489	0.3638
LNLABOUR	1.116837	3.482328	0.0000*
LNER	0.372849	3.436425	0.0010*
D2018:7	0.044929	2.371426	0.0202*
D2019:9	0.056578	3.074151	0.0029*
D2020:7	-0.051000	-2.587297	0.0116*
Constant	-7.740704	-4.505250	0.0000*

* Indicates the significance level of 5%.

According to the results of the model whose F statistic was significant (864.71. P = 0.000) and the explanatory level was high (R2 = 0.95), the LNCPI and LNGOVR variables were found to be statistically insignificant (1%, 5% and 10% significance level). When the dummy variables showing the structural break dates were included, the other variables and constant were found to be significant. Economically, we can interpret the results of the FMOLS estimator as follows:

- 1% increase in total loan volume increases the volume of problem up to by 1.09.
- 1% increase in loan interest increases the volume of problem loans up to by 0.11.
- 1% increase in workforce increases the volume of problem loans up to by 1.11.
- 1% increase in the effective exchange rate increases the volume of problem loans up to by 0.37.
- Within the framework of the relationship between the variables, shocks that caused structural breaks were experienced in July 2018, September 2019 and July 2020. The shocks experienced in 2018 and 2019 were

found to have a positive effect on the problem loan volume, while the shock experienced in 2020 was found to have a negative effect.

The structural break dates found within the scope of the current study explain the shocks affecting the variables in the Turkish economy in the related periods and affected by these variables. There occurred significant exchange rate fluctuations in Turkey in July of 2018 and September of 2019 and these exchange rate fluctuations have affected many aspects of the economy. The multi-dimensional effects of Covid-19, which started to spread across Turkey since March of 2020, have affected the Turkish economy in many respects and have led to the emergence of structural changes on the relevant series. However, while the economic problems experienced due to the COVID-19 pandemic were expected to positively affect the problem loan volume, which is a problem indicator, the determination of a reducing effect is an unexpected economic result. In addition, a positive relationship was found between the increase in the workforce and the problem loan volume, contrary to the expectation of a negative relationship. Except for the LNLABOUR and 2020:7 dummy variable, the relationship between the other variables and problem loan volume is considered to be an economically expected and significant relationship.

4.3. Causality Analysis

Hacker-Hatemi-J (2006) applied Todo-Yomamato (1995) test against possible normal disintegration with critical values calculated by the bootstrap technique. The test developed by Hachker and Hatemi-J (2006), as in the Todo-Yomamato (1995) test, tests that there is no Granger causality among the variables in the null hypothesis and that there is the Granger causality among the variables in the alternative hypothesis (Ulucak, 2014.14). The Hacker-Khatami-J (2006) test tests the causality between variables using the Vector Autoregressive Model (VAR) between variables:

$$Y_t = a + A_1 Y_{y-1} + \cdots . + A_p Y_{y-p} + \cdots + A_{p+d} Y_{y-p-d} + u_t \quad (11)$$

The sequence p in the process is known and d equals to the maximum number of integrations of variables. Hypothesis tests are performed by comparing the Wald test statistic value calculated in Hacker-Hatemi-J (2006) test with the values of Khatami distribution obtained by the bootstrap method. In the test, the appropriate delay length is decided according to the information criterion (HJC), which consists of the combination of the Schwarz information criterion (SBC) and the Hannan-Quin (HQC) information criterion developed by Khatami-J (2003).

The results of the test performed with the critical values found with 10000 replications through the Bootstrap technique and with 3rd delay length obtained by adding 1 to the 2nd delay length selected according to the VAR model and HJC information criterion are given in the table below:

Table 9. Results of the Hacker-Hatemi-J (2006) Bootstrap Causality Test

DIRECTION OF CAUSALITY	MWALD statistics	Bootstrap Critical Value		
		%1	%5	%10
LNBADLOAN→LNLABOUR	0.587969	10.042	6.745	4.962
LNLABOUR→LNBADLOAN	22.85983*	9.870	6.540	4.827
LNBADLOAN→LNCPI	11.28568*	10.739	6.539	4.561
LNCPI→ LNBADLOAN	3.927539	12.831	7.095	5.130
LNBADLOAN→LNRE	0.473535	12.673	7.018	5.042
LNRE→ LNBADLOAN	0.905394	10.830	6.481	4.741
LNBADLOAN→LNINT	0.879002	9.895	5.038	4.217
LNINT→ LNBADLOAN	8.875933*	9.673	5.013	4.183
LNBADLOAN→LNTOTLOAN	0.972073	10.531	6.692	4.721
LNTOTLOAN→LNBADLOAN	27.65959*	10.439	6.971	4.818
LNBADLOAN→LNGOVR	5.459710***	9.514	6.104	4.582
LNGOVR→ LNBADLOAN	11.04296*	9.386	6.051	4.345

* Indicates the significance level of 1%.
** Indicates the significance level of 5%.
***Indicates the significance level of 10%.

According to the test results, there is a one-way causality relationship from labour to problem loan volume, one-way causality relationship from problem loan volume to CPI, one-way causality relationship from loan interest

and total loan volume to problem loan volume, and two-way causality relationship from public expenditures to problem loan volume (10% significance level).

RESULTS

The increasing problem loan volume as a result of macro reasons such as failure to measure credit risks correctly, looseness in banks' credit policies, natural disasters in the country, traumatic shocks in the economy, policies resulting in a reduction in national income, macroeconomic instability, unemployment, inflation, and the rise in the exchange rate pose a threat to the banking sector and therefore to the financial and real economy. The formation of problem loans creating financial instability is one of the main reasons for financial crises.

In the current study, the analysis of the macroeconomic variables affecting problem loan volume was conducted by using monthly data covering the period between January 2014 and March 2021 in Turkey. Since the study approached problem credit volume only from a macroeconomic perspective, micro variables unique to the banking sector were not included in the model. The study was conducted with the empirical expectation that positive macroeconomic changes would have a decreasing effect on problem loans by identifying problem loans as a negative phenomenon. In this context, it is expected that the increase in the variables of labour and public expenditures in the model has a positive economic effect in terms of improving the ability to pay a debt, and the economic expectation has been that these variables will have a decreasing effect on the dependent variable. Based on the view that the problem loan is generally caused by a disproportionate and inappropriate credit risk rating in the loan volume, a negative relationship was expected between an increase in the total loan volume and the problem loan volume as a result of the conviction that the reason for the increase in loan volume is because of the inappropriate credit rating to a certain extent and that problem loan generally arises from the presence of loan. In addition, due to the fact that high loan interest rates, which are one of the main reasons that make loan payments difficult, lead to problem loans, it is expected that an increase in loan interest rates will lead to an increase in problem loan volume. A positive relationship was predicted between problem loans and real exchange rate and inflation, which are the variables most emphasized in empirical studies on problem loans and affect the income level of the public.

In the time series analysis study, first, the stationarity of the series was examined. In this context, the variables were subjected to both the traditional unit root tests ADF and PP, and the unit root tests ZA, LM, LP and CS, which are the unit root tests with a structural break. In all the tests, it was concluded that the series was not stationary at level values according to all the models, yet stationary at the I (1) level. In this case, with the conviction that a cointegration relationship between series is possible, the Maki (2012) cointegration test with structural break was conducted. According to the results of the test, a cointegration vector was found under the structural break in all four models. Model 2 was preferred and the coefficients were estimated by using the FMOLS estimator, where the structural break dates of 2018: 7, 2019: 8, 2020: 7 in this model were added as dummy variables. Properly chosen structural break dates in the model were found to be statistically significant and to coincide with the exchange rate shocks and the negative effects of COVID-19 experienced in Turkey in these periods.

In the model, the CPI and public expenditure variables were not found to be statistically significant. Apart from the conclusion that the increase in the workforce leads to an increase in the volume of problem loans, the results showing that the other variables, which are increases in the exchange rate, the total loan volume, and loan interest rates, lead to an increase in problem loans are found to be economically significant. Since the FMOLS method is a predictor resistant to standard errors, diagnostic test results were not given. The findings obtained support the results of the Çiftçi (2016) and Yüksel (2016). While the CPI variable was found to be statistically significant in the study by Kuzu and Çelik (2019), it was found to be insignificant in the current study. The results related to the real effective exchange rate variable support the studies by Torun and Altay (2019) and Altınöz (2018).

According to the results of the Hacker-Hatemi-J (2006) Bootstrap Causality test, there is one-way causality relationship from labour to problem loan volume, one-way causality relationship from problem loan volume to CPI, one-way causality relationship from loan interest and total loan volume to problem loan volume, and two-way causality relationship from public expenditures to problem loan volume. The result of "Problematic Loan Volume is the Granger Cause of Public Expenditure" is considered to be economically unexpected and considered as a statistical coincidence. The results other than this result were interpreted as economically expected results.

The study was conducted on macroeconomic factors affecting the problem credit volume with new econometric methods that cover the monthly and most recent period and have advanced qualities. The study is an up-to-date

study approaching the problem loan volume that poses both macroeconomic and financial threat from an empirical and economic perspective and it also includes unit root analysis with structural break and cointegration analysis and current causality test and bootstrap technique with Kacker-Hatemi-J; thus, it is believed to make some contributions to the relevant literature and shed light for further macroeconomic studies.

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