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Araştırma Makalesi/Research Article

DO MACROECONOMIC VARIABLES HAVE A SYMMETRIC OR ASYMMETRIC EFFECT ON NON-PERFORMING LOANS? EVIDENCE FROM TURKEY

MAKROEKONOMİK DEĞİŞKENLER TAKİPTEKİ KREDİLER ÜZERİNDE SİMETRİK VEYA ASİMETRİK BİR ETKİ YARATIR MI? TÜRKİYE ÖRNEĞİ

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Abstract

In this study, the existence of the relationships between non-performing loans and macroeconomic variables for the monthly data of the Turkish banking sector between January 2005 and August 2018 were analysed through the Johansen cointegration test (1991), VECM Granger causality test (1988) and Hatemi-J asymmetric causality test (2012). The results of the Johansen cointegration test indicated that there are significant cointegration relationships between the variables in long-run. According to Granger causality test based on VECM, unidirectional causalities exists between non-performing loans, market capitalisation, exchange rate, industrial production index and foreign trade deficit. Except for market capitalization, those causality relationships were determined to be directed from the macroeconomic variables to NPLs. Under Hatemi-J (2012) asymmetric causality test, the results revealed that there exists asymmetric causality relation between NPLs and other macroeconomic variables excluding the consumer price index. It is possible to verify as a result of the analysis that the causality relationships between the variables differ and NPLs are affected as long as the macroeconomic conditions change. The results also revealed that the NPLs in the Turkish banking sector are different before and after the recent global financial crisis.

Keywords: Credit Risk, Non-Performing Loans, Macroeconomic Factors, Johansen Cointegration Analysis, Symmetric and Asymmetric Causality Test, Turkish Banking Sector

Öz

Bu çalışmada, Türk bankacılık sektörünün Ocak 2005 ile Ağustos 2018 dönemine ait aylık verileri için takipteki krediler ile makroekonomik değişkenler arasındaki ilişkinin varlığı Johansen eşbütünleşme (1991), VECM Granger nedensellik (1988) ve Hatemi-J (2012) asimetrik nedensellik testleri kullanılarak analiz edilmiştir. Johansen eşbütünleşme sonuçları, anlamlı eşbütünleşme ilişkilerinin değişkenler arasındaki uzun dönemde var olduğunu göstermiştir. VECM'e dayalı Granger nedensellik testine göre, takipteki krediler, piyasa kapitalizasyonu, döviz kuru, sanayi üretim endeksi ve dış ticaret açığı arasında tek yönlü nedensellik ilişkisi olduğu tespit edilmiştir. Bu nedenselllik ilişkisinin piyasa kapitalizasyonu hariç makroekonomik değişkenlerden takipteki kredilere doğru olduğu belirlenmiştir. Hatemi-J asimetrik nedensellik testine göre, bulgular tüketici fiyat endeksi hariç takipteki krediler ile diğer makroekonomik değişkenler arasında asimetrik nedensellik ilişkisi olduğunu ortaya koymuştur. Analiz sonuçları değişkenler arasında nedensellik ilişkilerinin farklılaştığını ve makroekonomik koşullar değiştikçe takipteki kredilerin etkilendiğini kanıtlar niteliktedir. Bulgular ayrıca Türk bankacılık sistemindeki takipteki kredilerin son küresel finansal kriz öncesi ve sonrası dönemde farklılaştığını ortaya koymuştur.

Anahtar Kelimeler: Kredi Riski, Takipteki Krediler, Makroekonomik Faktörler, Johansen Eşbütünleşme Analizi, Simetrik ve Asimetrik Nedensellik Testi, Türk Bankacılık Sektörü

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GENİŞLETİLMİŞ ÖZET

Araştırmanın Amacı: Takipteki kredilerin makroekonomik değişkenlerle etkileşimi analiz edilerek, Türk bankacılık sektörü için hangi makroekonomik değişkenin takipteki kredilerle ilişki içinde olduğunu belirleyerek literatüre katkıda bulunmak bu çalışmanın amacını oluşturmaktadır. Bu çalışmanın önemi ise ülke ekonomilerinin birer can damarı olan bankaların en önemli gelir kalemlerinden biri olan kredilerin takibe düşmesine neden olabilecek değişkenlerin tespit edilerek, hem bankaların kredi risklerini sağlıklı ve etkin bir biçimde yürütülmesinde hem de piyasa katılımcılarının davranışlarını ve kredi tercihlerinin belirlenmesinde yönelik politikalara yardımcı olacağıdır.

Literatür Taraması: Ekonominin geneli üzerinde dolaylı ve dolaysız etkisi sebebiyle son zamanlarda çalışmalarda takipteki krediler üzerinde etkili olan değişkenler incelenmekte ve yapılan birçok çalışma literatürde yer almıştır. Literatürde takipteki krediler bankacılık sektörü kredi riskinin önemli bir göstergesi olarak seçilmekte ve takipteki kredilerin belirleyicileri üzerine yoğunlaşmaktadır. Takipteki kredilerin belirleyicilerinin tespiti üzerine yoğunlaşan uygulamalı çalışmalar, sadece bankaya özgü değişkenleri kullanan çalışmalar, sadece makroekonomik değişkenleri kullanan çalışmalar veya hem bankaya özgü faktörlerin hem de makroekonomik değişkenlerin birlikte ele alındığı çalışmalardan oluşmaktadır. Analizlerde kullanılan yöntemler ağırlıklı olarak, VAR analizi, eşbütünleşme testleri, simetrik nedensellik testleri, ARDL sınır testi, VECM modeli, GMM modeli, rassal ve sabit etkiler yöntemi, dinamik panel veri analizi, en küçük kareler yöntemi ve regresyon analizi olarak literatürde karşımıza çıkmaktadır.

Veri ve Yöntem: Çalışmada takipteki krediler ve makroekonomik değişkenler arasında bir etkileşim olup olmadığını Ocak 2005 ile Ağustos 2018 dönemine ait aylık veriler kullanılarak analiz edilmiştir. Analize tabi tutulan değişkenlerin hepsinin ortak olarak bulunduğu dönem 2005 yılının ilk ayından başladığı için ve güncel veriler 2018 yılının Ağustos ayına ait olduğu için 2005-2018 dönemi seçilmiştir. Çalışmada kullanılan zaman serisi verileri; OECD istatistik, Türkiye Cumhuriyet Merkez Bankası, Elektronik Veri Dağıtım Sistemi ve Türkiye Bankalar Birliği'nden alınmıştır. Analize tabi tutulan değişkenler literatüre bağlı kalınarak ve takipteki kredileri etkilediği düşünülen değişkenlerden yola çıkılarak seçilmiştir. Bu çalışmada Türk bankacılık sektörüne ait Ocak 2005 ile Ağustos 2018 aylık verileri kullanılarak takipteki krediler ile temel makroekonomik değişkenler arasındaki ilişki ekonometrik yöntemler uygulanarak incelenmiştir. Bu ilişkiyi analiz etmek için değişkenler arasındaki ilişkinin varlığı Johansen eşbütünleşme (1991), VECM Granger nedensellik (1988) ve Hatemi-J (2012) asimetrik nedensellik testleri kullanılarak analiz edilmiştir.

Sonuç ve Öneriler: Analiz sonuçları takipteki krediler ile seçilmiş makroekonomik değişkenler arasında hem simetrik hem de asimetrik nedensellik ilişkilerinin varlığını ve bu ilişkilerin değişkenler arasında farklılık arz ettiğini göstermiştir. Bunlardan ilki olan VECM Granger (1988) analiz sonuçlarına göre, takipteki krediler, piyasa kapitalizasyonu, döviz kuru, sanayi üretim endeksi ve dış ticaret açığı arasında tek yönlü ve istatistiksel olarak anlamlı bir nedensellik ilişkisi olduğu tespit edilmiştir. Bu nedensellik ilişkinin döviz kuru, sanayi üretim endeksi ve dış ticaret açığı değişkenlerinden takipteki kredilere; takipteki kredilerden piyasa kapitalizasyonu değişkenine doğru olduğu belirlenmiştir. Bununla birlikte takipteki krediler tüketici fiyat endeksi ve üretici fiyat endeksi arasında herhangi bir nedensellik ilişkisine rastlanılamamıştır. Sonuç olarak VECM Granger nedensellik analizi ile takipteki krediler ile makroekonomik değişkenler arasındaki ilişkinin varlığı ve yönü belirlenmiştir. Hatemi-J (2012) asimetrik nedensellik testi sonuçlarına göre, tüketici fiyat endeksi hariç diğer tüm makroekonomik değişkenler arasında anlamlı bir ilişkinin varlığına rastlanılmıştır. Sözkonusu ilişkinin değişkenler arasında tek yönlü ve çift yönlü olarak gerçekleştiği tespit edilmiştir. Takipteki kredilerin pozitif şoklarından, piyasa kapitalizasyonunun negatif şoklarına, piyasa kapitalizasyonun negatif şoklarından takipteki kredilerin pozitif şoklarına doğru tek yönlü bir nedensellik ilişkisi sözkonusudur. Pozitif takipteki krediler şoklarından pozitif döviz kuru şoklarına doğru çift taraflı; pozitif takipteki krediler negatif şoklarından negatif döviz kuru şoklarına doğru çift taraflı bir nedensellik ilişkisi bulunmuştur. Sanayi üretim endeksi negatif şoklarından takipteki kredilerin pozitif şoklarına doğru tek yönlü, üretici fiyat endeksinin pozitif şoklarından takipteki kredilerin pozitif şoklarına doğru tek yönlü, pozitif dış ticaret açığı şokundan pozitif takipteki kredi şokuna doğru ve negatif dış ticaret açığı şokundan negatif takipteki krediler şokuna doğru tek yönlü nedensellik ilişkileri tespit edilmiştir. Bununla birlikte, takipteki kredileri ile tüketici fiyat endeksi arasında asimetrik bir ilişki rastlanılmamıştır. Elde edilen bulgular dahilinde hem simetrik hem de asimetrik nedensellik testinde takipteki krediler ile makroekonomik değişkenler arasında bir etkileşimin olduğu tespit edilmiştir. Ayrıca, söz konusu çalışmada Türk bankacılık sistemindeki takipteki kredilerin 2008-2009 küresel finansal kriz öncesi ve sonrası dönemde farklılaştığını ve 2008-2009 küresel finansal krizin Türk bankacılık sistemi üzerinde yapısal kırılmalar yarattığını ortaya koymuştur.

INTRODUCTION

Capital markets are one of the indicators showing the development level of a company. There is a linear relationship between capital markets of a country and their development level. Since banks, which are one of the most significant units of capital markets, have a crucial role to enable the economies of countries to follow an unfaltering and consistent course by bringing the ones with fund surplus and the ones with funding needs together and also by stabilizing supply and demand equilibrium for funds; their importance for the economies of countries has been increasing day by day. Correspondingly, it is certainly beyond doubt that, banking sector is one of the fundamental sectors especially in developing countries in terms of assuring financial stability, future of the economy and new investments. One of the most important functions of banks is to provide loans for people or companies etc. A sudden shock on the loan performances of banks can be the main reason for disruption of a financial system and also for real economy. On the other hand, banks have several functions as a part of the economic system. Some of their functions are as follows; being a financial intermediary, providing liquidity, increasing efficiency of the monetary policy, providing economic consistency, enabling projects to be put into practice, providing opportunities for employment generation, increasing the activities of the payment systems, funding to foreign trade and encouraging importation (Yagcılar, 2011: 5).

Banks, constituents of the financial system, consist of central banks, stock markets and other institutions in general. The majority of the share which the mentioned units take from gross domestic product is taken by banks. The financial systems of developing countries such as Turkey depend substantially on the banking sector. Therefore; in order to enable the Turkish banking system to be able to function as expected, they should be sound, strong and durable, and the regulations should not impose a burden on them (Kartal, 2018: 7).

The majority of the economic activities in Turkey have been funded by banks. Banks earn the most of their income from the loans they provide with a specific interest rate. Although; the main functions of banks are to collect deposits and to bring investors and the ones with funding needs together by providing commercial, consumer, housing and vehicle loan facilities for the ones with the funding need with a specific profit margin through collected deposits; they are managed through the international standards and they also have good controlling standards; sometimes they are not able to manage their own credit risks and encounter with NPLs. Since the NPLs are one of the most important indicators representing the soundness of banking sector; investigating the determinants of NPLs is crucial to decrease credit risk (Touny and Shehab, 2015: 11).

The loans granted by banks are the assets which have the lowest liquidity within the active structure and also have the highest risk not to be paid back among all assets. While banks are carrying out the abovementioned activities; on one hand they gain an income (interest and principal), and they encounter with a considerable risk on the other. The risk in question is defined as the risk of the loans granted by the banks not to be paid back or paid late. Generally, NPLs can be defined as unfavourable loans in the banking sector. NPLs are used as the indicators for the stability of financial banking system in particular. Besides, NPLs are defined as circumstances which the fund-requester party refuse to pay the complete principal and interest payment or a part of it although it arrives at maturity. It is a default in payment where the bank has not received any payment from the borrower for over 90 days or during the maturity date agreed as stated in the loan agreement (Zainol et al. 2018: 694). The rates of NPLs become prominent as a measure of credit risk and asset quality for banking sector (Isık and Bolat, 2016: 341). For banks, NPLs mean unfavourable loans which directly affect two main components of them responsible for overall efficiency.

Increasing loan demand and banks' desire to satisfy those demands by taking high risks to give the demandants the loans, and the insufficient management of the credit policies in the banking sector cause the loans transform into non-performing loans; in other words, they increase the number of NPLs and directly disrupt the consistent activities of the banks. Accordingly; it has adverse and direct effects on active qualities of banks, their policies for profit margin distribution, their capital adequacies and their equity structure, i.e. the financial sector; and it also has adverse but indirect effects on real economy. On the other hand; the facts

that the loan receiving parties lose their trade registry and commercial reputation due to their non-performing loans, that they have to sell their assets for the prices under their market values due to their debts and that they get to the stage of liquidation and bankruptcy cause both important losses for Turkish national economy and psychological and social devastations for the society (Hatipoglu et al. 2012: 74).

In case the credit risk management is not taken into consideration by banks can both place a financial burden on economy and the banks, and also cause serious devastations on national economies of the countries. Correspondingly, for an economy with a large saving gap and in which the banking sector functions as a main financial channel such as Turkish national economy NPLs are important not only for financial system but also for policy-makers trying to provide stability in macroeconomy.

Determining the direction and power of the relationship between macroeconomic variables and NPLs (credit risk) which shows solvencies of companies and also is one of the most important factors affecting size of assets of banks which are vital for economies of the countries has a significant role for banks in terms of credit risk management, estimation of possible losses from credits and making necessary regulations on time. The aim of this study is to make a contribution to the literature by considering the changes on macroeconomic developments causing some changes on the quality of loan portfolio, by determining the variables having relationships with NPLs for the Turkish banking sector and by analysing the interaction between NPLs and the selected macroeconomic variables. In other words, the macroeconomic indicators of potential instability in the banking system were tried to be determined. The importance of the study is to help the banks carry out credit risks properly and effectively by detecting the variables causing the loans, which are one of the most important income items of banks and the life-blood of national economies, to transform into NPLs.

For the national economies where the financial systems mainly depend on banking sector especially in developing countries, the activities of banking sector affect whole economic system. Subsequently, it is important to determine the variables causing the loans in banking system to transform into NPLs. Economic conditions play a critical role for banks to maintain their credit performance. Since a sudden change occurring on the macroeconomic variables increases the number of NPLs in the national economy, it also affects performance of the banking sector and financial system adversely. Accordingly, NPLs are one of the most important indicators which represent the soundness of the banking sector. From this point, in this study the relationships between the NPLs and basic macroeconomic variables were analysed by using the data of the Turkish banking sector between January 2005 and August 2018 and by applying the econometric methods. In order to analyse the aforementioned relationships; the VECM Granger (1988) causality test was used to test the existence of the symmetric relationships between the variables, and Hatemi-J (2012) causality test was used to test the existence of asymmetric causality. The reason for using those two models is that they are applicable to analyse the macroeconomic and financial variables. Additionally, the Hatemi-J (2012) asymmetric causality test is highly applicable to use for the financial time-series data

To the best of my knowledge, it is the first study in which the relationships between NPLs and the selected macroeconomic variables are analysed through the Hatemi-J (2012) asymmetric causality test. Subjecting the variables to the asymmetric causality analysis by separating the relationships between NPLs and the macroeconomic variables through positive and negative shocks shows the difference of this study. Therefore, it is possible to say that this study will make a contribution to the literature, since the test method of the analysis and the examined data set are current.

The rest of the study was organized as follows: in the section 1, the existing literature related to the macroeconomic determinants of NPLs was described briefly; in the section 2, the data specifications and variables for the cointegration and causality analysis were defined extensively; in the section 3, the research methodology and the experimental results were presented; and in the last section, the conclusions and the policy related to the implication and future studies were summarized.

1. LITERATURE REVIEW

The sharp rise in NPLs in the last decade has caught the attention of many scholars trying to explain the phenomenon around the world. The variables affecting NPLs have been examined in recent studies due to their direct and indirect effects on general economy, and most of them have taken their parts in the literature. NPLs are preferred as the essential indicators of the credit risk of the banking sector and the determinants of NPLs have been focused on in the literature. The empirical studies focusing on determination of the determinants of NPLs consist of the studies using the variables specific to the bank, the studies using macroeconomic variables and the studies using both the variables specific to the bank and macroeconomic variables together.

Different empirical results have been presented by the author(s) and there are some researchers supporting the effects of macroeconomic variables on NPLs, and they can be presented as follows: Jayaratne and Strahan (1996), Gambera (2000), Domac and Peria (2000), Arpa et al. (2001), Kalirai and Scheicher (2002), Shu (2002), Quagliariello (2003), Ranjan and Dhal (2003), Jimenez and Saurina (2006), Ghosh (2007), Bebczuk and Sangiácomo (2008), Cifter et al. (2009), Espinoza and Prasad (2010), Dash and Kabra (2010), Bofondi and Ropele (2011), Vogiazas and Nikolaidou (2011), Yuksel (2011), Adebola et al. (2011), Nkusu (2011), Alper and Anbar (2011), Louzis et al. (2012), Swami (2012), Saba et al. (2012), Farhan et al. (2012), Zeng (2012), Mileris (2012), Macit (2012), Messai and Jouini (2013), Beck et al. (2013), Badar et al. (2013), Otasevic (2013), Vatansever and Hepsen (2013), Klein (2013), Messai and Jouini (2013), Ahmad and Bashir (2013), Castro (2013), Ebeke et al. (2014), Sahbaz and Inkaya (2014), Makri et al. (2014), Clichici and Colesnicova (2014), Prasanna (2014), Turan and Koskija (2014), Ghosh (2015), Chaibi and Ftiti (2015), Baselga-Pascual et al. (2015), San et al. (2015), Yagcılar and Demir (2015), Islamoglu (2015), Demirel (2015), Sheefeni (2015), Mensah and Adjei (2015), Touny and Shehab (2015), Ouhibi and Hammami (2015), Pradhan and Pandey (2016), Isik and Bolat (2016), Genc and Sasmaz (2016), Us (2016), Dimitrios et al. (2016), Jovic (2017), Chouikh and Blagui (2017), Isaev and Masih (2017), Gabeshi (2017), Upadhyaya and Roy (2017), Belke et al. (2018), Agic and Jeremic (2018), Mazreku et al. (2018), Zainol et al. (2018), Saif-Alyousfi et al. (2018), Altunoz (2018), Causi and Baldini (2018), Sahib et al. (2018), Petkovski et al. (2018).

It has been determined from the previous empirical researches that NPLs are mainly explained by some macroeconomic variables. Based on all of the aforementioned issues, it can be observed that many researches have focused on the determinants of credit risk as a measurement of NPLs in many countries. The existing literature on macroeconomic variables suggests that many macroeconomic variables have strong effects on NPLs and there are strong feedback effects from macroeconomic conditions to NPLs. From this point of view, we focussed on the studies in which the symmetric and asymmetric relevance of the effects of macroeconomic factors on NPLs in Turkish banking system were examined.

2. DATA AND VARIABLES

In this study, the existence of the interaction between NPLs and macroeconomic variables was analysed by using the monthly data of the period between January 2005 and August 2018. Since all of the variables appear together from the first month of 2005 and August 2018, it is the date of the current data; and thus the period was determined between the mentioned dates. Furthermore, the selected time span, from January 2005 to August 2018, considers the impact of the on-going recent financial crisis on the Euro Zone banking system.

The time-series data used in the study were acquired from OECD statistics, Central Bank of Turkey, Electronic Data Distribution System and The Banks Association of Turkey. One of the most common indicators used to identify the credit risk was the ratio of NPLs. Accordingly; NPLs (NPLs; □ millions) were used as the indicators of the credit risks of the banks; and market capitalisation (CAP; Borsa Istanbul, US $ millions), exchange rate (EXC; 1 US $), consumer price index (CPI; 2010=100), industrial production index (IPI; 2010=100), producer price index (PPI; 2010=100) and foreign trade deficit (FTD; thousand US $) were used as macroeconomic variables. The variables were selected based on the studies of Mileris (2012), Vatansever and Hepsen (2013), Ahmad and Bashir (2013) and Demirel (2015).

The variables subjected to the analyses were also selected by following the literature and among the variables thought to affect NPLs. The complete set of macroeconomic variables was accepted as exogenous variables. All of the series were used in the analyses, except for the foreign trade deficit, by taking their natural logarithm. The standard unit root tests and VECM Granger causality test were applied by using Eviews 10.0 software package; the unit root tests with the breaks and Hatemi-J (2012) asymmetric causality test were applied by using Gauss 10.0 software package.

The progress of the data of NPLs and the related macroeconomic variables for the mentioned period is indicated in the Figure 1.

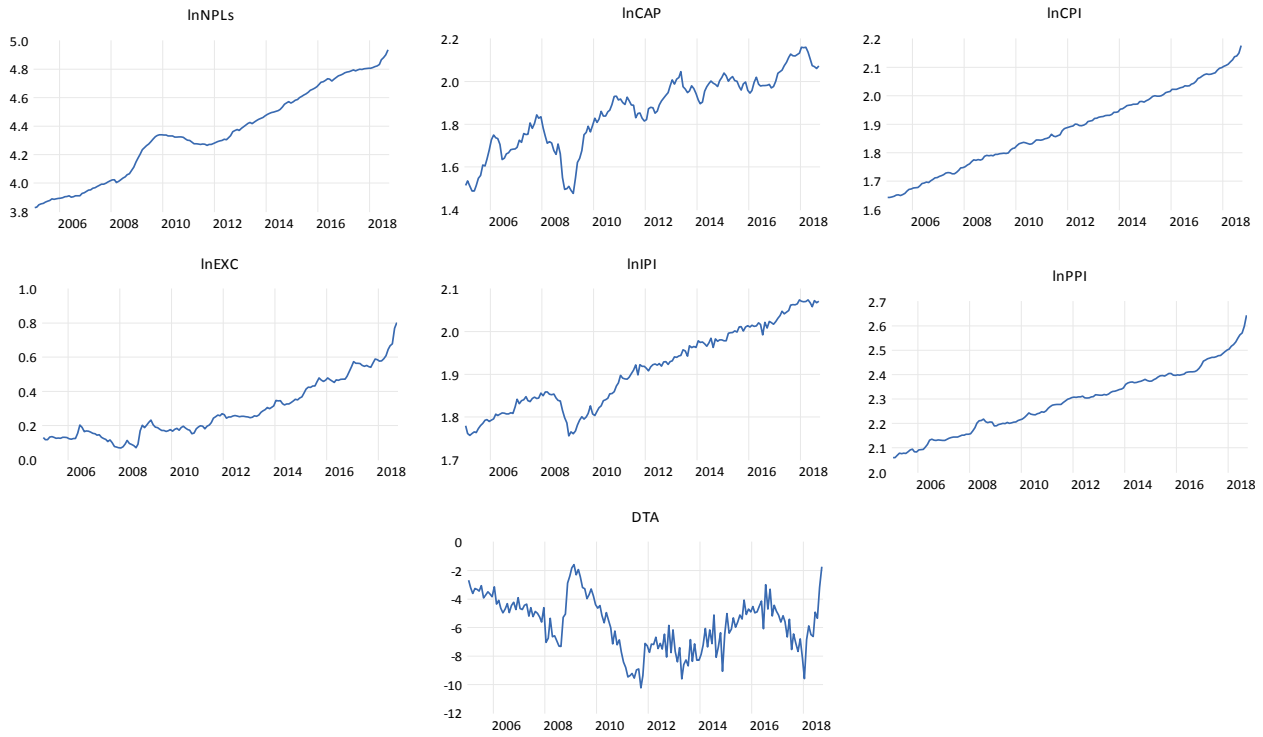

Figure 1: Time-Series Plots of Variables
Source: Own computation (E-views)

The analysis of the related diagrams of the series gives the impression of the existence of the unit root problems, many of which exist in the macroeconomic time-series and which contain a stochastic trend as Nelson and Plosser (1982) indicated. When the Figure 1 is examined, it can be observed that; although some structural formations occur in the interim periods; NPLs, market capitalisation, exchange rate, consumer price index, industrial production index and foreign trade deficit data from 2005 have exhibited an increasing trend continuously. It can be also observed that there were some structural changes (breaks) in all of the series between 2008 and 2009; however, they were in a continuous trend. The observations reflect the effects of the global financial crisis in 2008 broken out in the U.S.A. and extended globally. From this point of view, it can be interpreted that the factors affecting NPLs have differed before and after the crisis. Some main descriptive statistics of the data to be subjected to the causality analysis are indicated in the Table 1.

Table 1: Descriptive Statistics of the Variables

Variables	Mean	Median	Maximum	Minimum	Std. Dev.
NPLs	**28,277.01**	**21,202.00**	**86,167.00**	**6726.00**	**19,609.73**
CAP	**77.98589**	**78.01392**	**144.6856**	**29.88934**	**28.53626**
EXC	**2.096740**	**1.771960**	**6.344575**	**1.170474**	**0.953360**
CPI	**79.88388**	**76.64000**	**149.9900**	**43.94000**	**25.71891**
IPI	**83.23915**	**82.69000**	**118.6900**	**57.00000**	**18.41264**
PPI	**203.5419**	**200.3100**	**439.7800**	**114.8000**	**64.22245**
FTD	**-5.753460**	**-5.426428**	**-1.578577**	**-10.23117**	**1.911490**

Source: Own computation (E-views).

It can be observed from the Table 1 that the average of NPLs between January 2005 and August 2018 was 28,277.01. The mean on market capitalisation, exchange rate, consumer price index, industrial production index, producer price index and foreign trade deficit were respectively 77.98589, 2.096740,

79.88388, 83.23915, 203.5419, -5.753460 within the same period. Furthermore, the standard deviation and other statistical values of the variables are presented in the Table 1 in detail.

3. METHODOLOGY AND RESULTS

This section details the econometrics models applied to study and the linkages between the NPLs and the selected macroeconomic variables. This study adopted unit root tests, cointegration test, stability test, VECM Granger causality test, and Hatemi-J (2012) asymmetric test. In the context of causality analysis, Granger and Hatemi-J tests were performed to investigate whether the change in macroeconomic variables is a substantial determinant of the variation in NPLs of Turkish banking sector.

The economic and financial time-series are usually non-stationary. For this reason, it is necessary to analyse the orders of stationarity and integration included by the analysis before testing the causality relationships between the series. The unit root analysis of the series used in this study was carried out with the standard unit root tests and unit root tests considering the breaks. In the study; DF-GLS (1996) and Phillips-Perron (1988) were used as standard unit root tests; Zivot-Andrews (1992) and Lee-Strazicich (2013) single break unit root tests were used as the unit root tests considering the breaks, to ensure the non-existence of unit roots.

The DF-GLS proposed by Elliot, Rothenberg and Stock (1996) is a modification of the ADF in which a unit root test based on detrending a linear model of the variables before performing the regression test (Cooray and Wickremasinghe, 2005: 5). They have shown that the DF-GLS test has significantly greater power than the augmented Dickey-Fuller test. The time-series were detrended by employing a GLS estimator which improves power and reduces size distortions. The following equation is then estimated to test a unit root in the variable:

$$\Delta y_t^d = \alpha y_{t-1}^d + \beta_t \Delta y_{t-1}^d + ... + \beta_p \Delta y_{t-p}^d + \varepsilon_t \quad (1)$$

Where Δ is the difference operator; y_t^d is the generalised least squares de-trended value of the series; α, β_t and β_p are the coefficients to be estimated; and ε_t is the error term distributed independently and identically (Cooray and Wickremasinghe, 2005: 5).

Phillips and Peron (1988) evaluated the standard Dickey-Fuller test with non-parametrically modified test statistics, which are more popular in financial time-series. This test differs from the ADF tests mainly in a way they deal with the serial correlation and heteroskedasticity in the error terms. Instead of adding delayed values to prevent autocorrelation in the ADF equation, the authors re-arranged the *t* statistics by estimating the DF equation which is given as follows (Chen et al., 2014: 375):

$$\Delta y_t = \alpha y_{t-1} + x'\delta + \varepsilon_t \quad (2)$$

The following equation is then estimated to test a unit root in the variable:

$$\hat{t}_\alpha = t_\alpha \left(\frac{\gamma_0}{f_0} \right)^{-1/2} - \frac{T \quad f_0 - \gamma_0 \quad s_e \quad \hat{\alpha}}{\alpha f_0^{1/2} s} \quad (3)$$

Where $\hat{\alpha}$ is the estimator of α, t_α the ratio of α, $s_e(\hat{\alpha})$ is the coefficient standard error, s is the standard error of the test regression. Also, γ_0 is an estimator of random error term in the equation (2). The remaining term f_0 is an estimator of the residual spectrum at frequency zero (Chen et al., 2014: 377). The hypotheses and the decision criteria are the same as the DF test and since it overcomes the limitations of the Dickey-Fuller test, it is a more powerful test than the Dickey-Fuller test. The null hypothesis (H_0) says that the variables are not stationary, i.e. they have a unit root; the alternative hypothesis (H_a) is that the variables are stationary, i.e. they do not have a unit root test. The results of the DF-GLS and PP tests are presented in Table 2. Those results are separated into levels and first difference under the intercept model.

Table 2: The Results of DF-GLS and PP Test Statistic

	DF-GLS (1996) unit root test (Intercept Model)	
	Level	1st difference
NPLs	2.536581	-4.425809*
CAP	-0.037799	-8.180721*
EXC	2.757968	-3.142078*
CPI	2.194501	-0.997979**
IPI	1.923584	-1.053344**
PPI	3.612635	-4.421049*
FTD	-1.310215	-3.175851*
	Phillips-Perron (1988) unit root test (Intercept Model)	
	Level	1st difference
NPLs	0.197400	-7.379234*
CAP	-1.781014	-9.583120*
EXC	2.540667	-8.886579*
CPI	1.952994	-7.993795*
IPI	-0.175827	-15.39179*
PPI	2.131360	-4.640067*
FTD	-3.340234	-20.40196*

Source: Own computation (E-views).

Note: The results of the unit root test for the DF-GLS test were obtained by applying the Schwarz information criteria. For the spectral estimation method, Bartlett Kernel was determined and for the Newey-West method, Bandwidth options were used. *, ** and *** denote the rejection of the null hypothesis at 0.01, 0.05 and 0.10 level of significance respectively. The critical values of the Elliott-Rothenberg-Stock (1996) for the significance levels of 0.01, 0.05 and 0.10 were evaluated as -2.579226, -1.942793 and -1.615408 respectively. It was determined that the series contain unit root in the level, and they are stationary for the first differences. The critical values of the MacKinnon (1996) for the significance levels of 0.01, 0.05 and 0.10 are evaluated as -3.470679, -2.879155 and -2.576241 respectively. It was also determined that the series contain unit root in the level, and they are stationary for the first differences.

It was determined as the Table 2 indicates that none of the series are stationary at the level and it was observed that the series became stationary by calculating the first degree differences. Accordingly, the probability of the existence of the long-run equilibrium model between the series has risen.

Several unit root test strategies considering the breaks by adding dummy variables on the ADF unit root regression model have been developed by many of the studies in the literature. The models estimated with the test strategy types of Zivot-Andrews (1992) and Lee and Strazicich (2013) are indicated in the following equation (Caglar, 2015: 16-17).

Zivot and Andrews (1992) performed a unit root test based on the following three models against any kind of structural break alternative (Zivot and Andrews, 1992: 254):

Model A (break in intercept)

$$Y_t = \mu + \beta_t + \theta DU_t(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + e_t \quad (4)$$

Model B (break in trend)

$$Y_t = \mu + \beta_t + \gamma DT_t(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + e_t \quad (5)$$

Model C (break in both)

$$Y_t = \mu + \beta_t + \theta DU_t(T_b) + \gamma DT_t(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + e_t \quad (6)$$

The following regression is addressed for the Lee and Strazicich (2013) unit root test;

$$\Delta y_t = \hat{\delta} Z_t + \phi y_{t-1} + \sum_{j=1}^{k} \beta_j \Delta y_{t-j} + \varepsilon_t \quad (7)$$

$$\Delta y_t = \hat{\delta} \Delta Z_t + \phi \tilde{S}_{t-1} + \varepsilon_t \quad (8)$$

In the equations (7) and (8); $\tilde{S}_t = y_t - \tilde{\psi}_x - Z_t\tilde{\delta}, \quad t = 2,...,T$. $\tilde{\psi}_x$ is obtained with $y_1 - Z_1\hat{\delta}$ there. $\tilde{\delta}$ represents the coefficients obtained via the regression of Δy_t upon ΔZ_t. *Zt* is defined as the vector of exogenous variables. Besides; for the ADF-type test approach, the expression $\sum_{j=1}^{k}\beta_j \Delta y_{t-j}$; and for the LM-type test approach, the expression $\sum_{j=1}^{k}\beta_j \Delta\tilde{S}_{t-j}$ were included in the regression model to resolve the autocorrelation problem. Zivot-Andrews (1992) and Lee-Strazicich (2013) tests produced the results shown in Table 3. These results are separated into the Model A (break in intercept) and Model C (break in trend and intercept).

Table 3: The Results of One Break Unit Root Test

	Zivot and Andrews (1992) ADF Test			
	Model A	**Breakpoint**	**Model C**	**Breakpoint**
NPLs	-3.604	09/2010	-3.641	09/2010
CAP	-3.775	05/2009	-4.184	05/2009
EXC	-1.666	08/2016	-2.963	11/2011
CPI	-0.853	09/2016	-3.385	06/2016
IPI	-4.248	05/2008	-4.200	05/2008
PPI	0.905	08/2016	-2.097	05/2016
FTD	-3.040	01/2010	-3.273	05/2010
	Lee and Strazicich (2013) LM Test			
	Model A	**Breakpoint**	**Model C**	**Breakpoint**
NPLs	-2.877	11/2012	-2.995	11/2012
CAP	-3.197	05/2009	-3.209	05/2008
EXC	-1.704	04/2008	-3.629	11/2011
CPI	-1.533	05/2011	-4.153	06/2016
IPI	-2.111	12/2008	-2.585	11/2008
PPI	-1.285	08/2008	-4.104	05/2016
FTD	-2.412	07/2010	-3.327	05/2010

Source: Own computation (Gauss).

Note: Zivot-Andrews (1992) indicates the single break unit root test; Lee-Strazicich (2013) indicates the LM-type single break unit root test. The values in the Model A and C indicate the t-statistic. The model A indicated the break on the intercept model and the model C indicates the break on the intercept and trend models. The critical values related to the statistics of the test were taken from the study of Zivot-Andrews (1992). The critical values of the Zivot-Andrews (1992) on the models A for the significance levels of 0.01, 0.05 and 0.10 are evaluated as -5.34, -4.80, -4.58 respectively; and the critical values of the Zivot-Andrews (1992) on the model C for the significance levels of 0.01, 0.05 and 0.10 are evaluated as -5.57,-5.08, -4.82 respectively. Lee-Strazicich (2013) on the model A for the significance levels of 0.01, 0.05 and 0.10 are evaluated as -4.239, -3.566, and 3.211 respectively; and the critical values of the Lee-Strazicich on the model C for the significance levels of 0.01, 0.05 and 0.10 are evaluated as (-5.05 to -5.11), (-4.45 to -4.50) and (-4.17 to -4.21) respectively.

The results of the ADF-type Zivot-Andrews (1992) and LM-type Lee-Strazicich (2013) tests which consider a single break to determine whether the structural changes affect those two series are presented in the Table 3. As can be observed from the model A (break in intercept) and C (break in trend and intercept), the results of the both tests indicated that neither of the series is stationary, i.e. they contain unit roots. Consequently, as it can be observed from the Table 2 and 3, it was determined that consistent results can be obtained from the standard unit root test and the ones considering the breaks and all of the variables contain unit roots. Besides, it can be seen that the consistent results for the model A and model C were obtained after comparing the results of Zivot-Andrews and Lee-Strazicich. Accordingly, the probability for the existence of the long-run equilibrium model between the series has risen. According to the unit root test estimation results, the dates of the breaks determined to be the dates of the structural transformations for the series of the period between 2005 and 2018 are approximately same dates and the dates of the breaks estimated for all the series supports the period of the global financial crisis in 2008 started in 2007 in U.S.A. and reached its maximum level in September 2008 and continued to the last months of 2011. Therefore, it was concluded that there was a significant structural break occurred in the period determined by the tests. Consequently, it was confirmed that the global financial crisis in 2008 based on mortgage system in U.S.A. caused breaks on

NPLs in the Turkish banking sector and basic macroeconomic variables in Turkey. The breakpoints have indicated a substantial increase in the credit risk during the recent financial crisis period.

Cointegration relationship between variables in the VECM Granger model is generally tested with the Johansen (1988). A cointegration analysis was applied to all series in order to determine whether NPLs and the macroeconomic variables within this study act as cointegrated. The cointegrated number of vector changes no matter which variable is considered as the dependent variable in the model of the cointegration test. This is because the relevant model takes the relationships between all series into account when finding the cointegrated vector and presents results which contain all of the variables. Since all series are I(1), the Johansen method is applicable for the cointegration relationships between NPLs and the macroeconomic variables. Consequently; since the first-degree differences of all series included by the analysis are stationary, it was determined that there is no problem to investigate the cointegration relationships between them and the false causality relationships are avoided with the help of the Johansen cointegration test. Through this test approach, it was investigated whether there are long-run relationships between the variables in the equations created to test the causalities. It is necessary to study the variables as information which is a source for estimation and is hidden in the time series and with the help of the estimations from the VAR model in the Johansen and VECM Granger causality approach. The first step of the Johansen and Granger methods was to determine the lag length. The lag number can be established by analysing the information criteria for it.

There are 5 models for the estimation of the VECM model. Since the equation does not contain intercept and trend for both long- (CE) and short-run VAR, the Model 1; and since it does not contain quadratic trend term and has difficulties to interprete the coefficients, the Model 5 is not generally preferred by the researchers. Accordingly; Model 2, Model 3 and Model 4 was considered to choose the most optimal VECM model for the study, and the lag length was determined by testing them to 6 lags. Table 4 indicates the choice of the optimal lag length in the VECM model.

Table 4: Results from Johansen Cointegration Test

Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob****
None*	0.275059	157.9826	125.6154	0.0001
At most 1*	0.229867	106.1945	95.75366	0.0079
At most 2	0.142787	64.14268	69.18889	0.1305
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob**
None*	0.275059	51.78812	46.23142	0.0116
At most 1*	0.229867	42.05184	40.07757	0.0296
At most 2	**0.142787**	**24.80502**	**33.87687**	**0.3983**

Source: Own computation (E-views).

Note: Trace and Max-eigenvalue tests indicate 2 cointegrating eqn(s) at the 0.05 level. The critical values for the two statistics were obtained from MacKinnon-Haug-Michelis (1999) p values. * denotes rejection of the hypothesis at the level 0.05. ** MacKinnon-Haug-Michelis (1999) p-values.

As it can be observed in the Table 4, the number of the optimal lag length was determined as the 4 with the VECM model 2, based on the criteria AIC and SC. Besides, the consistency conditions (AR characteristic root, autocorrelation, heteroscedasticity) necessary for the VECM model were provided in the analysis. That is to say lag length of 4 is appropriate, and the established VECM(4) model is stable after going through stability test.

The test results of the trace (λ_{trace}) and the maximum eigen (λ_{max}) values necessary to determine the number of vectors and the existence of the cointegration for the 4 lag length are reported in the Table 5. The minimum values were calculated for the model where the data followed a linear trend during the test and the information criteria Akaike (AIC) and Schwarz (SC) are the invariants and trends for the cointegration equation.

Table 5: Selection of the Optimal VECM model

Model 1 - Intercept (no trend) in CE no intercept in VAR						
Lag	Cointegration	CointEq1	LM	White	AIC	SIC
1	✓	✓	×	×	-38.28034	-37.06562
2	✓	✓	✓	×	-38.35513	-36.20144
3	✓	×	✓	×	-38.07500	-34.97446
4	✓	×	✓	×	-37.86055	-33.80517
5	✓	×	✓	✓	-37.49759	-32.47925
6	**✓**	**✓**	**✓**	**✓**	**-37.41786**	**-31.42836**
Model 2 - Intercept (no trend) in CE test VAR						
Lag	Cointegration	CointEq1	LM	White	AIC	SIC
1	✓	✓	×	×	-38.35378	-37.02518
2	✓	✓	✓	×	-38.43835	-36.17030
3	✓	✓	✓	×	-38.13918	-34.92380
4	**✓**	**✓**	**✓**	**✓**	**-37.91985**	**-33.74915**
5	✓	×	✓	✓	-37.56089	-32.42675
6	**✓**	**✓**	**✓**	**✓**	**-37.52140**	**-31.40659**
Model 3 - Intercept and Trend in CE no trend in VAR						
Lag	Cointegration	CointEq1	LM	White	AIC	SIC
1	✓	✓	×	×	-38.36489	-37.01731
2	✓	✓	✓	×	-38.45147	-36.16436
3	✓	×	✓	×	-38.15397	-34.91946
4	✓	×	✓	✓	-37.93735	-33.74743
5	✓	×	✓	✓	-37.57881	-32.42536
6	✓	✓	✓	✓	-37.53020	-31.40501

Source: Own computation (E-views).

Note: LM test indicates autocorrelation; White test indicates heterokedaksticity (No Cross Terms). The indicators are as follows: the existence of the cointegration relationship is demonstrated by (✓) the non-existence of it is demonstrated by (×); the negative and statistically significant error correction coefficient in the model is demonstrated by (✓); the opposite is demonstrated by (×); the non-existence of the autocorrelation and heterokedaksticity problems in the model is demonstrated by (✓) the existence of them is demonstrated by (×). The optimal VECM model is determined Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC).

As it can be observed in the Table 5, the same results were obtained for the tests for trace (λ_{trace}) and max-eigen (λ_{max}) values. Table 5 indicates that, in both of the trace and maximum eigenvalue tests, the test results are to accept the null hypothesis under the 0.05 level. It means there are stable and long-run equilibrium relationships between the variables. According to the trace and max-eigen value statistics, the test statistics of the H_0 hypotheses (none and at most 1) were higher than the critical values at the significance level of 0.05. Under this circumstance, the H_0 hypotheses indicating that there is no cointegration between the variables were rejected. Consequently, the existence of at least one cointegration relationship between the variables since the trace (λ_{trace}) and the max-eigen (λ_{max}) values were higher than the critical value of 0.05; in other words, the existence of the long-run relationships between the variables was accepted. Here, the existence of the cointegrations between NPLs and the macroeconomic variables can be considered as an evidence for the variables affecting each other.

The Johansen cointegration test indicates the existence of the long-run relationships between NPLs and the macroeconomic variables. This means there are stable and long-run equilibrium relationships among the variables. However, this test does not provide any kind of information about the direction of the interactions of the variables. Within this scope, it is possible to determine whether any of the variables has an effect on the series or the variables affect each other; and if they affect each other, it is also possible to determine the direction of the causality with the causality tests. For this purpose, the direction of the interaction was tried to be determined by applying the causality tests in the analysis. In this study, the relationships between the variables were analysed through the symmetric and asymmetric causality tests. The VECM Granger causality test was applied to test the existence of the symmetric relationships between the variables. However, it is possible to study whether there is a causality between the positive and negative changes on the variables even if there is no causality relation between the variables. In order to analyse the asymmetric relationships between the variables, the Hatemi-J (2012) causality test was applied. With the help of the VECM model, it was determined whether both models meet the conditions for consistency and optimal lag length. After determining that the series are not stationary and there is at least one cointegration relationships between them, then the causality relationships between the series were started to be analysed.

Firstly, the causality test developed by Granger was applied in order to test the symmetric relationships between the variables. The VECM test was used to determine whether there are relationships between economic and financial variables, to reveal the relationships between the variables and to determine the direction of the existed relationships; and the variables are not separated as dependent and independent ones in this test. The interaction between the variables can be analysed simultaneously in the VECM Granger causality test (Dogan et al. 2016: 9). Subsequently, Engle and Granger (1987) indicated that the standard Granger test based on the VAR model is not valid when the series are cointegrated, and in this case the causality relationships between the series are needed to be analysed through the vector error correction model (VECM). According to Engle and Granger (1988), if there is a cointegration indicating the existence of at least one long-run balance relationship between the variables, there is also at least one long-run causality relationship. In this case VECM is formed in accordance with the dependent variables X and Y in order to reveal the deviation from long-run balance, to remove the short- and long-run imbalance, and to explain the short- and long-run causality relationships (Demirci, 2017: 54).

On the premise of the existence of cointegration relationships, VECM Granger modelling can be further conducted. It is assumed that there are two series as x_{1t} and x_{2t} in order to reveal the VECM Granger causality relationships between two integrated series (Loizides and Vamvoukas, 2005: 135):

$$x_{1t} = \sum_{j=1}^{m} \gamma_i x_{1t-j} + \sum_{j=1}^{m} \varphi_i x_{2t-j} + \alpha ECM_{1,t-1} + \varepsilon_{1t} \quad (9)$$

$$x_{2t} = \sum_{j=1}^{m} \theta_i x_{2t-j} + \sum_{i=1}^{m} \delta_i x_{1t-j} + \beta ECM_{2,t-1} + \varepsilon_{2t} \quad (10)$$

Where x_{1t} and x_{2t} are time series of the variables, x_{1t-j} and x_{2t-j} are the lagged term of x_{1t} and x_{2t} respectively. $ECT_{1,t-1}$ and $ECT_{2,t-1}$ are error correction terms, and α and β are the coefficients of the error correction terms. $ECT_{1,t-1}$ (x_{1t-1} - $\alpha_1 x_{2t-1}$) ve $ECT_{2,t-1}$ (x_{2t-1} - $\beta_1 x_{1t-1}$) are 1-term lag values of the error term obtained by the estimation of the cointegration equation where x_{1t} and x_{1t} are considered as dependent variables respectively. γ_i, φ_i, θ_i and δ_i represent the lag coefficients, t denotes time trend in both equations, m is the number of lags used for the variable and the error terms ε_{1t} and ε_{2t} are determined as white noise residuals in both equations. The causality relationship between x_{1t} and x_{2t} was determined with the t-statistics resultant by the estimation of the equations (9) and (10). As it can be seen in the equation (9); if H_0: $\varphi_i = 0$ hypothesis is applicable, the null hypothesis where there is no causality from the x_{1t} to the x_{2t} is accepted. Similarly, as it can be seen in the equation (10); if H_0: $\delta_i = 0$ hypothesis is applicable, it is indicated that there is no causality relation from the x_{2t} to the x_{1t}.

After the long-run relationships between the series are established, it is necessary to demonstrate the short-run movements of the variables with the long-run relationships. The short-run analysis of the VAR model is performed via the vector error correction mechanism. Therefore, to analyse the stability of long-run equilibrium relationship, the VECM was applied. Results of the equation are presented in Table 6.

Table 6: Results of Cointegration Equation

Cointegrating Eq:	CointEq1
NPLs(-1)	1
CAP(-1)	0.366324[2.67140]
EXC(-1)	0.410328[2.13111]
CPI(-1)	-4.064795[-5.60852]
IPI(-1)	0.516171[1.64621]
PPI(-1)	0.572378[1.66802]
FTD(-1)	-0.029725[-3.74033]
C	**0.068417**

Source: Own computation (E-views).

Note: The number in parenthesis is the [t] statistic value. Since the *t* statistic values of the variables are 1.64, 1.96 and above 2.5 for the significance levels 0.10, 0.05 and 0.01 respectively as the absolute values; the long-run coefficient estimations are determined as significant.

With the help of the relevant equation it can be observed that, each percentage-point increase in CAP causes a decrease of 0.366324 percentage points in NPLs, each percentage-point increase in EXC causes a decrease of 0.410328 percentage points in NPLs, each percentage-point increase in CPI causes an increase of 4.064795 percentage points in NPLs, each percentage-point increase in IPI causes a decrease of 0.516171 percentage points in NPLs, each percentage-point increase in PPI causes a decrease of 0.572378 percentage points in NPLs, each percentage-point increase in FTD causes an increase of 0.029725 percentage points in NPLs. The findings confirm the stability of long-run equilibrium relationship between NPLs and selected macroecomic variables.

In order to test the short-run causality relationships between NPLs, CAP, EXC, CPI, IPI, PPI and FTD for each equation in the VECM; χ^2 (Wald) statistics in the equation was considered for the significance of the lagged endogenous series. Table 7 reports the VECM estimation results.

Table 7: VECM Estimation Results

Dependent Variable: NPLs

Error Correction	**Coefficient**	**Error Correction**	**Coefficient**
CointEq1	-0.071146[-3.98394]	D(IPI(-1))	-0.095523[-1.38
D(NPLs(-1))	0.242833[2.93963]	D(IPI(-2))	-0.036600[-0.48408]
D(NPLs(-2))	0.005309[0.06118]	D(IPI(-3))	-0.031239[-0.39835]
D(NPLs(-3))	-0.003157[-0.03581]	D(IPI(-4))	0.027002[0.39991]
D(NPLs(-4))	0.007203[0.08573]	D(PPI(-1))	0.082733[0.55783]
D(CAP(-1))	0.025462[0.92366]	D(PPI(-2))	-0.023943[-0.14920]
D(CAP(-2))	0.054378[1.80827]	D(PPI(-3))	0.004936[0.03193]
D(CAP(-3))	0.006593[0.22467]	D(PPI(-4))	0.235804[1.61075]
D(CAP(-4))	0.044340[1.49790]	D(FTD(-1))	0.000294[0.36687]
D(EXC(-1))	0.097396[1.69884]	D(FTD(-2))	0.000863[0.95569]
D(EXC(-2))	0.139891[2.17175]	D(FTD(-3))	0.000350[0.39837]
D(EXC(-3))	-0.040560[-0.63648]	D(FTD(-4))	0.000929[1.33217]
D(EXC(-4))	0.084598[1.40871]	C	0.006393[4.56122]
D(CPI(-1))	-0.376662[-2.08532]	R-squared	0.596033
D(CPI(-2))	-0.395133[-2.14119]	F-statistic	6.614077
D(CPI(-3))	**0.044792[0.23769]**		
D(CPI(-4))	**-0.378471[-2.05769]**		

Source: Own computation (E-views).

Note: The number in parenthesis is the [t] statistic value.

As it can be observed in Table 7, CointEq1 indicates the error correction term. The error terms are negative and statistically significant as expected in the model where the dependent variable is NPLs. It also shows that the error correction model is working. The data in Table 7 demonstrate that the fitting degree of the VECM model is $R^2 > 0.5$, which indicates the reasonability of model estimation.

Table 8: VECM Granger Causality Test

Null Hypothesis	Wald χ^2 test	Prob.	Decision
NPLs ≠> CAP	7.788589	0.0996***	Refuse
CAP ≠> NPLs	6.489225	0.1655	Accept
NPLs ≠> EXC	4.073433	0.3962	Accept
EXC ≠> NPLs	17.22538	0.0017*	Refuse
NPLs ≠> CPI	3.504041	0.4773	Accept
CPI ≠> NPLs	5.792751	0.2152	Accept
NPLs ≠> IPI	5.554521	0.2350	Accept
IPI ≠> NPLs	21.33712	0.0003*	Refuse
NPLs ≠> PPI	5.018402	0.2854	Accept
PPI ≠> NPLs	5.837293	0.2116	Accept
NPLs ≠> FTD	**10.75303**	**0.2295**	**Accept**
FTD ≠> NPLs	**35.53067**	**0.0000***	**Refuse**

Source: Own computation (E-views).

Note: It provides the conditions of consistency and optimal lag in the VECM model. ≠> indicates the null hypothesis where there is no causality. For instance, CAP is not the VECM Granger cause of NPL. *, ** and *** indicate significance at 0.01, 0.05 and 0.10 levels respectively. The lag length of the variable is chosen following AIC and SIC. The optimal the lag length of the VECM is 4.

Table 8 reports the results of VECM Granger causality test. According to the results of the VECM Granger causality analysis; the causes of NPLs were EXC, IPI and FTD in the significance levels of 0.01 and 0.10. NPLs are being caused by EXC, IPI and FTD while CPI, PPI do not Granger cause NPLs. So, there are unidirectional Granger causalities from NPLs to CAP, EXC to NPLs, IPI to NPLs and FTD to NPLs. Furthermore, there are no VECM Granger causality relationships between NPLs, CPI and PPI. In other

words, any kind of causality relation was determined neither from NPLs to the CPI nor from the CPI to NPLs, neither from NPLs to the PPI nor from the PPI to NPLs. The VECM Granger results of the study as a whole, the macroeconomic variables are the main determinants of NPLs in the Turkish banking sector. This means the developments on the macroeconomic variables affect the NPLs. It was concluded that the results of the study show consistency with the former studies. When the Granger causality results based on the VECM revealing the short-run causality relationships are evaluated in general; exchange rate, industrial production index and foreign trade deficit can be observed to be reasons for the changes on NPLs in the Turkish banking sector.

For the next step of the study, the causality relationships between NPLs and the macroeconomic variables were studied with the Hatemi-J (2012) test. Based on the idea that, each of the investor in the market can have different positions and makes different decisions for the shocks; the different reactions of the investors for positive and negative shocks will not be considered and the shocks on the series will not be separated if the VECM Granger causality analysis is applied. This reflects the weak sides of those kinds of tests. The Hatemi-J (2012) asymmetric causality test which entered in the literature in 2012 is one of the tests which can be used to fill the gap for the causality relationships. The Hatemi-J (2012) asymmetric causality test, which separates the relationships between the series against positive and negative shocks, is applied in the analysis where the financial data is used. The VAR models can be created where the level values are used even if the series show unit root properties in this test method. The Hatemi-J (2012) asymmetric causality test is applied with the help of the following equations. The causality analysis between variables in the VAR models can be carried out in accordance with the cumulative sums approach. In other words, the causality analysis is performed within the VAR model (Hatemi-J, 2012: 449). It is assumed that there are two series as y_{1t} and y_{2t} in order to reveal the asymmetric causality relationship between two integrated series (Hatemi-J, 2012: 449).

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{1,0} + \sum_{i=1}^{t} \varepsilon_{1t} \qquad t = 1,....,T \tag{11}$$

$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{2,0} + \sum_{i=1}^{t} \varepsilon_{2t} \qquad t = 1,....,T \tag{12}$$

Where, $t=1,2,...T$; $y_{1,0}$ and $y_{2,0}$ represent initial values of both random walk processes and the error terms ε_{1i} and ε_{2i} are determined as white noise residuals in both equations. In this regard, positive and negative shocks are presented as follows, respectively (Hatemi-J, 2012: 449).

$$\varepsilon_{1i}^{+} = max\ \varepsilon_{1i},0\ ,\varepsilon_{2i}^{+} = max\ \varepsilon_{2i},0\ ,\varepsilon_{1i}^{-} = min\ \varepsilon_{1i},0\ ,\varepsilon_{2i}^{-} = min\ \varepsilon_{2i},0 \tag{13}$$

In this respect, residuals can be expressed as a sum of positive and negative shocks as $\varepsilon_{1i} = \varepsilon_{1i}^{+} + \varepsilon_{1i}^{-}$, and $\varepsilon_{2i} = \varepsilon_{2i}^{+} + \varepsilon_{2i}^{-}$. With the information assumption, it is possible to express the equations for a $y_{1,0}$ and $y_{2,0}$ as follows:

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{1,0} + \sum_{i=1}^{t} \varepsilon_{1i}^{t} + \sum_{i=1}^{t} \varepsilon_{1i}^{t} \tag{14}$$

And similarly;

$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{2,0} + \sum_{i=1}^{t} \varepsilon_{2i}^{t} + \sum_{i=1}^{t} \varepsilon_{2i}^{t} \tag{15}$$

With the equations (14) and (15), positive and negative shocks which take part in each variable can be stated as an equation in cumulative form as follows:

$$y_{1t}^{+} = \sum_{i=1}^{t} \varepsilon_{1i}^{+}, y_{1t}^{-} = \sum_{i=1}^{t} \varepsilon_{1i}^{-}, y_{2t}^{+} = \sum_{i=1}^{t} \varepsilon_{2i}^{+}, y_{2t}^{-} = \sum_{i=1}^{t} \varepsilon_{2i}^{-} \tag{16}$$

With the equation (16), it is accepted that positive and negative shocks may have a permanent impact on other variables.

Banking sector has a significant role to determine the macroeconomic variables which are thought to affect NPLs are important place in the literature as indicators of credit risk and to reveal their causes and in terms of financial consistency especially for the economies of the countries. Accordingly, with the help of Hatemi-J (2012) asymmetric causality approach, where several effects can be examined together, the effects of shocks on the variables were studied. Table 9 reports the results of the Hatemi-J (2012) asymmetric causality test.

Table 9: The Results of Hatemi-J (2012) Asymmetric Causality Test

Null Hypothesis	Test Value	Critical Bootstrap Value			Null Hypothesis	Test Value	Critical Bootstrap Value		
		%1	%5	%10			%1	%5	%10
Panel A									
$NPL^{+} \neq\!\!> CAP^{+}$	11.951	22.775	16.933	14.480	$CAP^{+} \neq\!\!> NPL^{+}$	12.322	21.604	16.195	13.985
$NPL^{+} \neq\!\!> CAP^{-}$	22.092**	23.391	16.681	14.088	$CAP^{+} \neq\!\!> NPL^{-}$	3.964	22.437	16.898	14.404
$NPL^{-} \neq\!\!> CAP^{-}$	12.015	24.485	17.041	14.211	$CAP^{-} \neq\!\!> NPL^{-}$	13.902	25.459	17.758	14.685
$NPL^{-} \neq\!\!> CAP^{+}$	8.852	22.410	16.375	13.860	$CAP^{-} \neq\!\!> NPL^{+}$	23.566*	22.676	16.665	14.183
Panel B									
$NPL^{+} \neq\!\!> EXC^{+}$	15.859**	21.987	16.646	14.139	$EXC^{+} \neq\!\!> NPL^{+}$	36.916*	22.577	16.370	13.864
$NPL^{+} \neq\!\!> EXC^{-}$	4.071	25.847	17.842	14.693	$EXC^{+} \neq\!\!> NPL^{-}$	4.486	21.883	16.408	13.903
$NPL^{-} \neq\!\!> EXC^{-}$	15.515**	21.645	16.406	13.760	$EXC^{-} \neq\!\!> NPL^{-}$	14.833***	23.992	17.304	14.490
$NPL^{-} \neq\!\!> EXC^{+}$	10.043	27.500	18.460	14.972	$EXC^{-} \neq\!\!> NPL^{+}$	8.790	21.118	16.085	13.819
Panel C									
$NPL^{+} \neq\!\!> CPI^{+}$	10.244	22.552	16.479	14.019	$CPI^{+} \neq\!\!> NPL^{+}$	8.855	22.069	16.290	14.012
$NPL^{+} \neq\!\!> CPI^{-}$	14.009	23.141	17.017	14.323	$CPI^{+} \neq\!\!> NPL^{+}$	3.140	23.558	17.202	14.449
$NPL^{-} \neq\!\!> CPI^{-}$	9.244	28.656	18.583	14.983	$CPI^{-} \neq\!\!> NPL^{-}$	12.864	27.319	18.834	15.269
$NPL^{-} \neq\!\!> CPI^{+}$	7.639	23.185	16.793	14.350	$CPI^{-} \neq\!\!> NPL^{+}$	2.438	23.398	16.924	14.201
Panel D									
$NPL^{+} \neq\!\!> IPI^{+}$	6.050	22.339	17.073	14.332	$IPI^{+} \neq\!\!> NPL^{+}$	12.317	21.577	16.318	13.775
$NPL^{+} \neq\!\!> IPI^{-}$	10.919	22.288	16.679	14.065	$IPI^{+} \neq\!\!> NPL^{-}$	9.457	22.519	16.855	14.232
$NPL^{-} \neq\!\!> IPI^{-}$	8.311	24.893	17.275	14.314	$IPI^{-} \neq\!\!> NPL^{-}$	4.237	25.366	18.048	14.686
$NPL^{-} \neq\!\!> IPI^{+}$	9.346	22.070	16.578	14.065	$IPI^{-} \neq\!\!> NPL^{+}$	17.430**	21.982	16.508	14.021
Panel E									
$NPL^{+} \neq\!\!> PIP^{+}$	9.812	21.248	16.126	13.642	$PIP^{+} \neq\!\!> NPL^{+}$	40.074*	23.008	17.030	14.588
$NPL^{+} \neq\!\!> PIP^{-}$	6.628	22.347	16.437	14.067	$PIP^{+} \neq\!\!> NPL^{-}$	11.299	23.023	16.894	14.076
$NPL^{-} \neq\!\!> PIP^{-}$	7.796	28.529	18.906	15.241	$PIP^{-} \neq\!\!> NPL^{-}$	5.831	28.413	18.649	14.928
$NPL^{-} \neq\!\!> PIP^{+}$	6.105	22.762	16.765	14.040	$PIP^{-} \neq\!\!> NPL^{+}$	9.277	21.980	16.636	13.961
Panel F									
$NPL^{+} \neq\!\!> FTD^{+}$	10.544	21.844	16.777	14.331	$FTD^{+} \neq\!\!> NPL^{+}$	25.069*	22.461	17.105	14.349
$NPL^{+} \neq\!\!> FTD^{-}$	7.026	22.391	16.316	13.979	$FTD^{+} \neq\!\!> NPL^{-}$	4.691	22.412	16.806	14.196
$NPL^{-} \neq\!\!> FTD^{-}$	7.938	22.780	16.350	13.747	$FTD^{-} \neq\!\!> NPL^{-}$	15.065***	22.979	16.431	13.964
$NPL^{-} \neq\!\!> FTD^{+}$	12.893	24.180	17.643	14.723	$FTD^{-} \neq\!\!> NPL^{+}$	9.644	21.767	16.261	13.829

Source: Own computation (Gauss).

Note: The denotation X $\neq\!\!>$ Y indicates the null hypothesis that variable X does not cause variable Y. For example, $NPL^{-} \neq\!\!> CAP^{-}$ means that a negative shock in NPLs does not cause negative shocks in the market capitalization. *, ** and *** represents significance at 0.01, 0.05 and 0.10 levels respectively. The lag length of the variable is chosen following AIC and SIC. The optimal the lag length of the VAR is 4. The bootstrap p-values are, in each case, based on 10,000 replications.

The causality relationships which show mutual interactions between NPLs and the variables of market capitalization, exchange rate, consumer price index, industrial production index, producer price index and foreign trade deficit variables are summarized in the Table 9. Faced with positive and negative shocks, the reaction at NPLs were analysed as Panel A, Panel B, Panel C, Panel D, Panel E and Panel F. The panel results are explained as follows, respectively.

Firstly, when the panel A is examined, it can be seen that there is a bidirectional relationship between NPLs and CAP indicating the power of financial consistency and stock exchange. A positive shock occurs on NPLs with the level of 0.05 creates a negative shock on CAP. When the other side of the causality examined, it can be seen that there is causality from CAP to NPLs with the significance level of 0.01 and this causality creates a positive effect on NPLs with a negative shock occurs on CAP. When all results indicated in the panel A are examined, it can also be seen that there is a reverse relationship between NPLs and CAP. These causality relationships support the idea that the losses on the values of share certificates increases the number of NPLs and this kind of increase will create a decrease on the values of share certificates. As it is known, stock markets reflect outlook on firms' profitability and improve financial health of national economies. Therefore; since a decrease on stock exchange affects the prices of share certificates and returns adversely, it also decreases the income and profit shares. It causes cash outflow for companies. Under the mentioned

adverse events, companies can get into some difficulties to pay their loans, and thus the number of NPLs of companies increases. Additionally, banking sector composes a significant part of the shares in the Istanbul Stock Exchange. Since the increase on the number of NPLs decreases the annual income of banks and imposes a financial burden, an adverse event on banking sector may affect Istanbul Stock Exchange. This causality relationship can be explained as the developments on stock exchange which affects the expectations of the investors adversely and causes NPLs to increase as reasons for foreign capital outflows in Turkey. Given the causality relationships between NPLs and CAP, the findings comply with the studies of Bofondi and Ropele (2011), Beck et al. (2013), Vatansever and Hepsen (2013), Skarica (2014), Demirel (2015), Karahanoglu and Ercan (2015) Baselga-Pascual et al. (2015), Genc and Sasmaz (2016).

Secondly, in the panel B, it can be seen that there are bidirectional relationships from shocks on NPLs to EXC. It can be observed with the asymmetric causality analysis, while an increase on the number of NPLs causes another increase on EXC, a decrease on the number of NPLs also causes another decrease on EXC. Similarly, while an increase on EXC causes another increase on the number of NPLs, a decrease on EXC causes another decrease on the number of NPLs. These causality relationships causes the loans not to be paid or delay in payment by affecting the increase on exchange rate; incomes of the banks, companies or even households adversely. For the bank customers who are in debt in exchange and do not have an income in foreign exchange which enables them to pay their debts arises as an important credit risk. In the conditions where the national monetary unit decrease in value against the exchange rate in the real economy, it causes decreases on the sector and purchasing powers of the individuals. Using the foreign exchange indexed products commonly causes rises on dollar and the costs of relevant products. This affects consumer price index in short-run and also affects the employment and incomes by causing interest rates to increase; the demand on consumer's products and investments to decrease and the growth to decelerate. Banks can make profit with asset management since the high foreign exchange rate increases the costs; however, different sourcing and funding terms puts the banks into a trouble. All of the mentioned adverse events in the economy weaken the debt-servicing of the domestic debtors, hinder the payments in the real or financial sector and lead to some troubles by causing increase on credit. Given the causality relationships between NPLs and EXC, this results is consistent with the studies Farhan et al. (2012), Beck et al. (2013), Klein (2013), Chaibi and Ftiti (2015), Demirel (2015), Genc and Sasmaz (2016) and Altunoz (2018).

Thirdly, it can be observed in the panel C that there is no causality interrelationship between NPLs and CPI. Accordingly, any kind of causality relationship was determined neither from NPLs to CPI nor from CPI to NPLs. These results indicate that as the most considered indicators of credit risks for banks, NPLs are not affected by the increases and decreases on CPI. It is possible to say that it is not an expected result. In other words; banks, companies and households can have difficulties to pay their loans in the economy with increased consumer price index, it is normal to expect a linear relationship between NPLs and consumer price index. However, there was no kind of relationship can be determined within this study. Given the causality relationship between NPLs and CPI, the findings comply with the studies of Quagliariello (2003) and Altunoz (2018).

Fourthly, a unidirectional causality relationship between NPLs and IPI can be observed in the panel D. The mentioned relationship was directed from the negative shocks on IPI to the positive shocks on NPLs. It can be summarised as follows: industrial production presents a measure of the overall economic activity in a country and it is expected that a decrease in an industrial production index is related to stock price negatively. The decrease on the value of share certificates of companies creates risks for banks. Similarly, banking sector supports industrial sector in terms of total credit support the most. Economic slowdown and decrease on production can cause an increase on the number of NPLs; since the fluctuations on foreign exchange rates as a result of providing the majority of the inputs used in production decrease production and employment and also emerges the risks of banking sector. The results obtained provide information for estimating the effects of negative shocks on industrial production index on NPLs. The precautions on reducing foreign dependency in terms of production structure are considered to be significant, since the fluctuations on foreign interest rates decrease the negative effects on this sector and the supporting policies related to industrial sector popularise using additional tools and incentives. Given the causality relationships

between NPLs and IPI, this results is consistent with the studies Kalirai and Scheicher (2002), Cifter et al. (2009), Kalirai and Scheicher (2002), Vatansever and Hepsen, (2013), Ahmad and Bashir (2013), Demirel (2015).

Fifthly, a unidirectional causality relationship can be determined only between NPLs and PPI in the panel E. Here, the positive shocks on PPI cause the positive shocks on NPLs, and this creates the causality relationship between them. It can be explained as follows: the shocks on exchange rates cause a decrease on the national monetary unit in value for a country. The costs of the products produced with the imported inputs will be increased as a result of the shocks on exchange rate. The increase on producer price index affects the prices of the goods and services provided national economy of the country. In a real economy where the production costs are increasing, the companies will have difficulties on selling their goods and there are decreases on the production amounts because of the increases on input costs. This affects industrial production adversely. And since the sales revenues of companies within the market will decreases; it causes liquidity shortage, failures on the payments in the real and financial sectors, finally the number of NPLs will also increases.

Sixthly, in panel F, a unidirectional relationship can be observed from FTD to NPLs. It is possible to say that there is a causality relationship from the positive shocks on FTD to the positive shocks on NPLs; and similarly, there is a causality relationship from the negative shocks on FTD to the negative shocks on NPLs. It can be explained as follows: a foreign trade deficit is expected to cause a shortage on the foreign exchange and a decrease in value on the national monetary unit. It affects the economic growth adversely by decreasing the purchasing power of individuals and/or the companies depending on the domestic demand. The slowdown on the economic growth decreases the income per capita. Additionally, if foreign trade takes place as a result of the increase on domestic consumption, the credit expansion underlying the increase on consumption can create an indirect effect on the increase on the number of risky loans. In the cases where foreign trade deficit cannot be met by national savings, external resources are applied. The costs of additional borrowing resulting from the high foreign exchange rates affect the economy adversely. All of the mentioned events cause an increase on the number of NPLs by increasing the credit risks of banks. On the other hand, resolving the instability on the foreign and local purchase activities can expedite economic growth for the country and also increase the income per capita. It meets the individuals'/companies' financial needs in minimum and can create an indirect effect on the decrease of risky loans by balancing the real credit expansion in banking system. Given the causality relationships between NPLs and FTD, the findings comply with the studies of Mileris (2012), Ahmad and Bashir (2013) and Demirel (2015).

While the results in the Table 9 are evaluated together, it can be observed that there are interactions between NPLs and other macroeconomic factors except for consumer price index; and the macroeconomic variables can provide useful information to estimate the factors affecting NPLs. Those results are economically and financially logical. The results of this study are parallel to the reality which states the relationships between the macroeconomic variables and NPLs in the Turkish banking sector.

CONCLUSION AND POLICY IMPLICATIONS

The banking sector is known as one of the most important sectors for not only developing countries such as Turkey, but also for whole world. The banks play an active role for estimating the financial activities and planning the investments. The banks, which are the heart of the economic activities, have an inquestionable place; since they collect the deposits and provide loans for the government, individuals and the companies. Therefore, banks are the most active and the most important ones among the financial institutions. Beyond any doubt, banks are extremely important for national economies of the countries by providing funding needs of the market. Although banks make profits by carrying out the mentioned activities, they can also face with credit risks. Banks are also obliged to fulfil the credit demands of their customers by considering credit risks, since the credit risk is an important financial risk by containing default risk.

Since credit risk cannot be resented, some of the loans are expected to transform into NPLs. However, if the shares of NPLs increase among the total loans, it indicates warning signs for banks. An increase on the number of NPLs makes the banks have some difficulties in short-run and can create an adverse effect which can indicate an economic disruption. The real economic performance fails after the disruption on the banking sector as a result of an increase on the number of NPLs.

For the countries which have financial systems mainly depend on banking such as Turkey, the activity of the banking sector affects the whole economic system. Therefore, it is important to determine the variables causing the loans to transform into NPLs in the banking system. The credit risk of a bank can be affected by internal variables such as bank management; and also be affected by the external dynamics such as legal and structural changes or the macroeconomic variables. For this exact reason, the existence of the causality relationships between the macroeconomic variables and NPLs which are one of the indicators of credit risks of banks accepted in the literature were studied for the Turkish banking sector. The causality relationships between the positive and negative shocks on the mentioned variables were also studied mutually, with the assumption that there can be hidden relationships between the variables. The analysis period was determined between January 2005 and August 2018, and the monthly data within this period were used. The Johansen cointegration test (1991) was applied in order to investigate long-run cointegration relationships between the variables. Two different causality analysis methods were used for the econometric analysis. The VECM Granger (1988) causality test was applied in order to test the symmetric relationships between the variables; and the Hatemi-J (2012) asymmetric causality test was applied in order to test the asymmetric relationships by separating them into positive and negative shocks.

The Johansen cointegration tests, through the statistics of the trace (λ_{trace}) and of the maximum eigenvalue (λ_{max}), revealed the existence of at least one cointegrating relationship between the variables in the long-run. For causality relationships, the results of the analysis indicated that there are both symmetric and asymmetric causality relationships between NPLs and the macroeconomic variables, and those relationships differ for each variable. According to the VECM Granger analysis results; NPLs were caused by EXC, IPI and FTD while CPI and PPI did not Granger-cause NPLs. Moreover, there was a bidirectional Granger causality between NPLs and IPI, and there were unidirectional Granger causalities from NPLs to CAP, EXC to NPLs, IPI to NPLs and FTD to NPLs. Hovewer, there were no VECM Granger causality relationships between NPLs, CPI and PPI. Accordingly, any kind of causality relation was determined neither from NPLs to CPI nor from CPI to NPLs, neither from NPLs to PPI nor from PPI to NPLs. The VECM Granger results of the study as a whole, the macroeconomic variables were the main determinants of the NPLs in the Turkish banking sector. Consequently, the existence and the direction of the relationship between the variables were determined through VECM Granger causality analysis. According to the Hatemi-J (2012) asymmetric causality analysis, relationships between all of the macroeconomic variables except for CPI were determined. There is a unidirectional causality relationship from the positive shocks on NPLs to the negative shocks on CAP; from the negative shocks on CAP to the positive shocks on NPLs. Bidirectional causality relationships were determined from the positive shocks on NPLs, to the positive shocks on the EXC; and from the negative shocks on the positive NPLs to the negative shocks on the negative EXC. A unidirectional causality relationship from the negative shocks on IPI to the positive shocks on NPLs; the same relationship from the positive shocks on PPI to the positive shocks on NPLs; and also from the positive shocks on FTD to the positive shocks on NPLs and from the negative shocks on FTD to the negative shocks on NPLs were determined. However, any kind of asymmetric relationship between NPLs and CPI was established. With the help of the results obtained from both the symmetric and the asymmetric causality tests, an interaction between NPLs and the macroeconomic variables was determined. Besides, it was revealed that NPLs within the Turkish banking system differed before and after global financial crisis between 2008 and 2009; and also that this crisis created structural breaks on the Turkish financial system.

The results of the study as a whole, the macroeconomic variables are the main determinants of NPLs in the Turkish banking sector. It is evident that the macroeconomic conditions affect the performance of NPLs via this study. The results obtained through those researches revealed that, it is necessary for banks to focus on the macroeconomic variables to decrease credit risk and to provide the consistency on the banking

sector. From this viewpoint, we would recommend to the government and policy-makers to prevent any political instability in order to avoid a great number of NPLs in the national economy. In order to lower the hyperinflation in Turkey, it is necessary to find a solution related to the high costs which the producers faced with in a structural way. In order not to face with the high inflation rates, the conditions causing them should be removed, the primary aim should be provide consistent prices, reasonable inflation rates should be determined by removing the uncertainties to provide the price consistency and applicable policies should be followed. The financial and fiscal policies should be applied correspondingly with the loan volumes. Besides, it is necessary to make some arrangements to increase the crediting capabilities of banks. It is also necessary to make attempts and incentives supporting the sustainable production period with a high added value for increasing the competitive power of Turkey. On the other hand, it was concluded that the banks which desire to have a low rate for NPLs should be careful about their credit improvement policy.

The main limitation of this study is that the causality relationships between NPLs and the macroeconomic conditions were analysed. In other words, in our estimation model, the data only consisted of the macroeconomic variables. For the future researches, the following ideas can also be taken into account: a) investigating the effects of other macroeconomic variables (e.g., interest rate, unemployment, economic growth, house price index); b) investigating the effects of bank-specific indicators on NPLs (e.g., financial ratios, company size, net interest margin, board size, institutional ownership, management skills, risk preferences, auditor opinion); c) investigating the relationships between variables with different econometric analysis methods; d) and a panel application can be carried out by investigating the factors of developed and developing countries on NPLs.

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