SEYAD
Siyaset, Ekonomi ve Yönetim Araştırmaları Dergisi

The Operation of Credit Channel in Fragile Five Countries

Kırılgan Beşli Ülkelerinde Kredi Kanalının İşleyişi

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Makale Bilgisi

Makale Türü: Araştırma Makalesi
Geliş Tarihi: 24.05.2020
Kabul Tarihi: 17.06.2020
Yayın Tarihi: 29.06.2020

ISSN: 2147-6071 **CİLT:** 8
E-ISSN: 2147-7035 **SAYI:** 1
Cilt/Volume: 8 | Sayı/Issue: 1 |
Yıl/Year: 2020 (Haziran/June)

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Abstract

In this paper, it is aimed to empirically examine the credit channel which is one of the channels of monetary transmission mechanism. The operation of credit channel is investigated for the countries Brazil, Indonesia, India, South Africa and Turkey which are categorized as fragile five countries. For this purpose panel Granger causality analysis is conducted with 2001:Q1-2019:Q4 quarterly data. According to the results, the interest rates Granger-cause the credit volume and the credit volume Granger-causes inflation. But the credit volume fails to Granger-cause growth. The absence of a causal relationship between growth and credit implies that the credit channel is partially operating in these countries.

Keywords: Credit Channel, Monetary Policy, Fragile Five Countries, Panel Granger Causality

Kırılgan Beşli Ülkelerinde Kredi Kanalının İşleyişi

Öz

Bu çalışmada parasal aktarım mekanizması kanallarından kredi kanalının ampirik olarak incelenmesi amaçlanmaktadır. Bu amaç doğrultusunda Kırılgan Beşli olarak adlandırılan Brezilya, Endonezya, Hindistan, Güney Afrika ve Türkiye için 2001:Q1-2019Q4 çeyrek dönem verileriyle panel Granger nedensellik analizi yapılmıştır. Granger nedensellik analizi sonuçlarına göre faiz oranları kredi hacminin Granger nedeni iken, kredi hacmi de enflasyonun Granger nedenidir. Fakat kredi hacmi ile büyüme arasında bir nedensellik ilişkisi tespit edilmemiştir. Büyüme ve kredi hacmi arsında nedensellik ilişkisinin olmaması kredi kanalının söz konusu ülkelerde kısmen işlediğini göstermektedir.

Anahtar Kelimeler: Kredi Kanalı, Para Politikası, Kırılgan Beşli Ülkeleri, Panel Granger nedensellik analizi

Introduction

Policymakers implement economic policies to achieve macroeconomic objectives such as price stability, growth, and employment. Economic policies consist mainly of fiscal and monetary policies. With fiscal policy, policymakers use tax and spending methods to achieve macroeconomic objectives. Monetary policies are carried out by central banks.

Central banks use a variety of tools to achieve price stability and financial stability targets. These instruments are classified into two groups as direct and indirect monetary policy instruments. While direct instruments involve intervention to regulate prices or quantities, indirect instruments are market-based instruments by affecting money markets. Direct instruments determine prices or quantities with regulations. Direct monetary policy instruments in the form of credit ceilings aim to influence the balance sheets of commercial banks. The most common types of direct instruments are interest rate controls, bank-by-bank credit ceiling and direct lending by central banks. Indirect monetary policy instruments are carried out by influencing the supply - demand conditions in the market which aim to affect the central bank money. Indirect instruments of monetary policy are open market operations, reserve requirements, and discount operations (Alexander et al., 1995, 2-6).

The key roles of the central banks are to determine the interest rates to be applied to monetary policy, credit policy, and reserves (Goodfriend, 2011, 3). However, especially in recent years, central banking functions such as monitoring the banking system and implementing monetary policy have become more important. Today, there is a consensus on that the most important duty of central banks, according to modern central banking, is the task of conducting monetary policy.

Central banks are concerned with price stability, full employment, financial stability, stabilization of exchange rate, interest rate stability, and economic growth and use major monetary policy tools to achieve prominent monetary policy objectives. Central banks try to use their instruments in the most appropriate way to achieve an objective or objectives while conducting monetary policy. From this point of view, it is crucial to recognize through which channels the effects of the monetary policy practices implemented by the central bank on macro-economic variables such as prices and aggregate demand can be

achieved. Studies about the operation of the monetary transmission mechanism began to increase, especially with the 1980s to carry out economic activities more effectively and determine the positive and negative effects on the economy. The channels that belong to monetary transmission mechanisms can guide the policymakers by reflecting the effects of monetary exchanges on total demand and prices. In this regard, it is crucial for policymakers to know how monetary transmission mechanisms work to understand better the relationship between the real sector and the financial sector and to interpret better the fluctuations seen in the financial markets.

In this study, the operation of credit channel is investigated for the countries Brazil, Indonesia, India, South Africa and Turkey which are categorized as 'fragile five' by Morgan Stanley first. The main feature that distinguishes this study from previous studies on this subject is the country group included in the model. The most prominent features of the Fragile Fives countries are high inflation, current account deficit, economic growth problems as well as insufficient capital. The fragile feature of these countries is mostly due to their sensitivity to external financial shocks. From this point of view, it is also important whether the credit channel of these countries in a globalized financial network is operating properly. In this context, firstly, the conceptual and theoretical framework of the monetary transmission mechanism is explained in this study. Later, a literature review related to empirical studies on credit channel is included. Finally, the credit channel of fragile five countries is examined with the panel Granger causality method and the findings are discussed.

1. Conceptual and Theoretical Framework of Monetary Transmission Mechanism

The monetary policy transmission mechanism is the process of transfer to the economy through the effects of monetary policy decisions on the gross national product and inflation (Taylor, 1995, 11). Monetary transmission mechanism, which explains the effect of change in money supply on economic activities (Jain - Tomic, 1995, 137), examines the effect of demand or excess supply on total expenditures that arise due to the amount of money in the market while the economy is in equilibrium. Besides, the monetary transmission mechanism also affects real variables such as total production and workforce through policy-driven changes in nominal money stock or short-term interest rates (Ireland, 2005, 2).

There are also theories of Classical, Keynesian, and Monetarist school representatives in the literature about how monetary policy affects macroeconomic variables. In the classical school, the monetary transmission mechanism is better known for the Quantity Theory of Money, which was developed with the contributions of Fisher, Marshall, and A.C. Pigou. The classical quantity theory of money is based on the approach in which the money supply determines nominal income. The nominal income is equal to the multiplication of the price level and the total output. The equality of the Quantity Theory of Money, more commonly known as the Fisher equation, is expressed as in model 1 below:

$$M.V = P.Y \quad (1)$$

In equation 1, *M* is the money supply, *V* is the velocity of money, *P* is the average price level, and *Y* is the volume of transactions (real GDP). The velocity of money (*V*) shows how many times the money is spent on purchasing goods and services. As in model 2, the velocity of money can be calculated as the proportion of the total expenditure to the total amount of money in the market.

$$V = \frac{P.Y}{M} \quad (2)$$

If the model in the equation 2 is to be organized, the Quantity Theory of Money is acquired which belongs to the classics expressed as the model in equation 1. Classical economists assumed V as constant. According to them, since fees and prices are flexible, full employment balance will continue in normal times, while Y will remain constant in the short run. In this case, since V and Y are constant, if the money supply changes, only the price level changes (Dornbusch - Fischer, 1994, 390).

In Keynes's book "The General Theory of Employment, Interest, and Money," published in 1936, he suggested that, unlike the Classics, the velocity of money was not constant. Also, he developed a theory of demand for money in which interest rates are emphasized. He put forward "The Liquidity Preference Theory," as the answer to the question of why people prefer to be liquid. In general, the transmission mechanism of monetary policy in the Keynesian model operates by the way that the money supply (M) affects interest rates (r), r affects investment expenditures (I), and I affects total production (Y) (Mishkin, 2004, 604).

According to Friedman, the pioneer of the monetarist school, monetary changes are the main factor affecting the decisions of economic units. Reinterpreting classical quantity theory, Friedman suggested that demand for money depends on the amount of wealth and the amount of return of various forms of wealth (Erim, 2011, 220-222). Even though Friedman refers to the "Quantity Theory of Money" of the Classics in monetarist theory, the theory of money demand is more similar to Keynes's theory. In Friedman's analysis, although the theory of quantity is reformulated as the theory of money demand, the new quantity theory includes stocks, money, and assets, unlike Keynes's theory that includes only money flows such as savings, spending, investment, and output (Gowland, 1991, 33-37).

Various theories and approaches have emerged as a result of the studies carried out by the representatives of the economic schools regarding the operation of the monetary transmission mechanisms. Studies carried out to support these theories have revealed findings on the operation of monetary transmission mechanisms, channels that provide this operation, and the effects of these channels. In this context, these studies are important in terms of a better understanding of the relations between the real sector and the financial sector and for policymakers to interpret better the fluctuations experienced in financial markets and to know in detail the operation of monetary transmission mechanism and channels.

As a result of the studies conducted on the monetary transmission mechanism, any change in monetary policy has been found to affect consumption and investment decisions through different channels, and there are different opinions in the literature regarding these transmission channels. The two main arguments for monetary transmission mechanisms are money view and credit view (Friedman, 2000). The money view is based on directing the real process with money supply and interest rates on the basis of the IS-LM model. In Credit view the mechanisms are in the form of two main transmission channels, the bank credit channel and the balance sheet channel. The credit channel is an important channel in terms of banks trying to resolve asymmetric or missing information problems in the credit market and financing households and small and medium-sized companies that have difficulty in meeting their funding need rather than large firms. The balance sheet channel mostly focuses on the financial status of the borrower, its effects

on the net value associated with income accounts and balance sheets, and general credit terms and availability (Giuliodori, 2004, 3-4).

In general, the transmission channels of monetary policy are the interest channel, the asset prices channel, the exchange rate channel, the expectation channel, and the credit channel. In this study, the credit channel is examined in particular.

2. The Credit Channel

Dissatisfaction with traditional reports on how interest rate effects clarify the influence of monetary policy on spending on long-term assets has led to a new view of the monetary transmission mechanism that emphasizes asymmetric information on financial markets (Mishkin, 1996, 8). This argument was analyzed in the literature with the name of the credit channel.

Keynes (1973) expresses that the most important variable in terms of total economic activity is money, emphasizing that credit market conditions will significantly affect investment behavior. What is essential here is trust, which is one of the determinants of investments. The trust is based on two elements in the form of credit opportunities determined by the creditor's trust and the creditor's belief about the expected return from the investment. Thus, a negative case in the trust of both the borrower and the lender will lead to a negative impact on the economy (Claus - Grimes, 2003, 6).

The credit channel is basically aimed at influencing bank credit volumes through monetary policy practices. For this purpose, it will be possible to affect total demand and prices as targeted. For example, an expansionary monetary policy increases reserves and deposits of a bank. This increase in the reserves of a bank will also increase the amount of credit that banks can release. Thus, this increase in credit volumes will lead to the consumption expenditures of households and the investment expenditures of firms. This process will have an expansionary effect on aggregate demand, in the end, causing total income to rise. A contractionary monetary policy reduces loanable funds by reducing the amount of the reserves of a bank. Given that a large proportion of firms and households spend on investment and consumption by borrowing credits from banks, a decline in the supply of loanable funds will reduce investment and consumption spending significantly, consequently reducing total spending. Also, this will significantly affect the economy (Kuttner - Mosser, 2002, 17).

There are two basic monetary transmission mechanisms in the credit market. These are the bank credit channel and the balance sheet channel (Kashyap - Stein, 2000, 411). Both channels emphasize the asymmetry between the information that lenders and borrowers in financial markets. In the case of asymmetric information, using interest rates to distribute credits may not produce an optimum result (Mauskopf, 1990). Critical to the presence of a credit channel is the presence of imperfections in financial markets (Walsh, 2010, 479). These imperfections can be listed as information asymmetry, adverse selection, and moral hazard.

Information asymmetry refers to the situation in which one party in an economic relationship is better or more informed than the other. For example, a borrower knows the possible returns and risks of the projects he invested better than the lender. On the one hand, this disruption prevents the effective distribution of resources, while, on the other hand, it causes the reduction of investments. Lack of information in financial markets is encountered in two ways. These are the adverse selection that arises before the event and the moral hazard problem that arises after the event (Mishkin, 2004, 174).

Adverse selection means taking advantage of the lack of information about the opposing party before the economic relationship is established. For example, a firm with high credit risk accepts the credit even if the interest payment is high because it knows it will probably not pay it back. The problem of adverse selection increases the likelihood that a credit will be sunk even if there are good credit risks in the market. Moral hazard refers to avoiding the fulfillment of the conditions of the economic relationship established by the lack of knowledge of the other party or taking risks above normal. It is more of a condition that occurs after the transaction takes place. For example, a company may want to make riskier investments that will bring more risk to lose because the money they use after receiving credit is not their own. The problem of moral hazard increases the risk of repaying the credit, as well as the lending party, may decide not to lend again (Mishkin, 2004, 174).

In general, there are two approaches, bank lending channel and balance sheet channel, which are based on asymmetric information in financial markets related to the credit discussions. It is assumed that the effect of monetary policy is more reliable than the

projected effect in traditional transmission due to the asymmetric information in these two approaches.

2.1.Bank Credit Channel

Since the bank credit channel only examines the borrowing behavior of the banks, if the monetary conditions change, this channel is also called narrow credit channel in the literature (Kuttner - Mosser, 2002, 16). In the bank credit channel, banks include not only the liability side but also the asset side, as in the interest rate channel of the monetary transmission mechanism. However, in the credit channel, banks are given particular importance due to the ability to solve the asymmetric information problem in the credit markets. In the transmission mechanism of the credit channel, a contractionary monetary policy that reduces the reserves of the banking system also limits loanable funds. Then, the external finance premium is expected to rise for bank-dependent borrowers. The effect of monetary shock on the external finance premium can be higher for small firms than large firms which can find funds other than bank loans. This also helps explain the fluctuations in production not only with the interest rate effect but also through the external finance premium (Romer - Romer, 1993, 1-2).

Two main conditions must be fulfilled in order to be able to operate via a credit channel within the monetary transmission mechanisms. First, banks should not be able to isolate balance sheets from changes in monetary policy fully. The other condition is that firms that depend on bank credit in terms of external financing in the economy should not be able to fully isolate their real spending from changes in credit opportunities (Farinha - Marques, 2001, 8).

In the bank credit channel, banks that have special tools for solving the asymmetric information problem in the credit market have a special role in the financial system. Due to the role of banks in financial markets, households, and small and medium-sized companies that have difficulty in meeting their funding needs can access credit markets, especially through banks. Because of this special role of banks, those who demand credit cannot reach the credit market without borrowing from the bank. Unless bank deposits are fully substituted with other funding sources, the bank credit channel can operate as follows (Mishkin, 1996, 9):

M ↑ → bank deposits ↑→ bank loans ↑→ I ↑→ Y ↑

The expansionary monetary policy (**M** ↑) increases bank reserves and bank deposits, increasing the volume of available bank credits. This increase in credits increases investment expenditures (**I** ↑). Therefore, as a result, total demand or total output (**Y** ↑) increases.

2.2.Balance Sheet Channel

The balance sheet channel is based on the theoretical inference that the external finance premium faced by firms in the credit market depends on the net value of the company's balance sheets. The net worth of the company is measured by the sum of its liquid assets and its marketable financial collaterals. The higher the firm's net worth, the lower the financing premium. Thus, borrowers can reduce their disputes with lenders over interest by financing a significant amount of their investment themselves or by offering more collateral against their liabilities. Based on this, the balance sheet value of the borrowing firms affects the external finance premium they face and the conditions of the credit they receive, so fluctuations in the balance sheet value of the firms affect the investment decision (Bernanke - Gertler, 1995, 11-12).

The balance sheet channel also arises due to the existence of asymmetric information problems in credit markets. The decline in the net worth of firms causes the problems of adverse selection and moral hazard to be more severe when lending to these firms. When net worth is lower, the loan collateral will also be lower, and losses due to the adverse selection will increase further. This will have an effect on reducing borrowing in the financing of investment expenditure. In addition, the decrease in the net value of firms will increase the problem of moral hazard by encouraging the owners to engage in riskier projects by decreasing the number of partnership shares. Since investing in riskier projects will lead to reduced debt repayments, a decrease in the net value of firms will reduce their loan borrowing and reduce investment expenditures (Mishkin, 1996, 11).

A contractionary monetary policy affects the balance sheet of the borrower in two ways. These effects occur as indirect and direct effects. The direct effect, first, is that rising interest rates directly increase firms' interest expenses, reduce net cash flow, and weaken the lender's financial position. Secondly, rising interest rates lead to a decrease in asset prices, thereby reducing the value of the borrower's financial collateral (Nualtarance, 2002, 2). In order for the monetary transmission mechanism to operate, the monetary

policy must have systematic effects on the external finance premium, and the external finance premium must have an impact on the total output. In the event that these two conditions are met, it can be stated that the monetary transmission channel works with the balance sheet channel (Holtemöller, 2002, 4).

Monetary policies can affect a company's balance sheets in different ways. The first of these is the relationship between monetary policy and net worth. It can be shown as follows (Mishkin, 1996, 11).

$$\mathbf{M} \uparrow \rightarrow \boldsymbol{P_e} \uparrow \rightarrow \begin{matrix} \textbf{adverse selection} \downarrow \\ \uparrow \end{matrix} \& \begin{matrix} \boldsymbol{moral\ hazard} \downarrow \\ \end{matrix} \rightarrow \boldsymbol{lending} \uparrow \rightarrow I \uparrow \rightarrow Y$$

The expansionary monetary policy (**M** ↑), which increases firms' equities ($\boldsymbol{P_e}$ ↑), increases the net wealth of firms, and reduces their adverse selection and moral hazard problems. This increases the investment expenditures (**I** ↑) of the companies by providing the companies with the opportunity to use more credits. Therefore, as a result of this equation, total demand and total output will (**Y** ↑) increase.

The second way monetary policies can affect firms' balance sheets is the relationship between monetary policy and cash flow. Cash flow is defined as the difference between cash income and cash expenditures of enterprises (Mishkin, 2000, 287). The most important feature of the cash flow channel is that it is affected by short-term nominal interest rates. Therefore, interest payments on short-term debt, not the long-term debt of enterprises, affect cash flows. The concept of interest here refers to the nominal interest rate, unlike the traditional interest rate channel, which argues that the real interest rate affects investment spending rather than the nominal interest rate. The operation of the second channel can be shown as follows (Mishkin, 1996, 11):

$$\mathbf{M} \uparrow \rightarrow \boldsymbol{i} \downarrow \rightarrow \begin{matrix} \textbf{cash flow} \uparrow \\ \uparrow \end{matrix} \rightarrow \begin{matrix} \textbf{adverse selection} \downarrow \\ \end{matrix} \& \begin{matrix} \boldsymbol{moral\ hazard} \downarrow \\ \end{matrix} \rightarrow \boldsymbol{lending} \uparrow \rightarrow I \uparrow \rightarrow Y \uparrow$$

The expansionary monetary policy (**M** ↑) lowers interest rates ($\boldsymbol{i}$ ↓), leading to increased cash flows and improved firms' balance sheets. In this case, adverse selection and moral hazard problems decrease, leading to increase in use of credit. Subsequently, investment expenditures (**I** ↑) and total demand (total output) (**Y** ↑) will increase.

The third way that monetary policies can affect firm balance sheets is the relationship between monetary policy and price level. The flow showing this relationship is as follows (Mishkin, 1996, 13):

$$\mathbf{M} \uparrow \rightarrow \boldsymbol{unanticipated\ P} \downarrow \rightarrow \mathbf{adverse\ selection} \& \boldsymbol{moral\ hazard} \downarrow \rightarrow \boldsymbol{lending} \uparrow \rightarrow I \uparrow \rightarrow Y \uparrow$$

Since debt payments are fixed in nominal terms through contracts, an unexpected increase in prices reduces the liabilities of the firms in real terms and, consequently, the real value of the firms' assets increases. Similarly, an expansionary monetary policy causes an unexpected rise in prices. Unexpected price increases increase the firm's net wealth, reducing the problems of adverse selection and moral hazard. Thus, loan facilities will increase investment spending (**I** ↑) and total demand (total output) (**Y** ↑).

3. Literature Review

There are many studies on the operation of the credit channel. Information and findings about some of these studies are given in Table 1.

Table 1: Literature review

Authors	Countries	Period	Method	Result (Credit Channel)
Bernanke & Blinder (1992)	US	1959:M7-1979:M12 1959:M7-1989:M12	VAR	λ
Ramey (1993)	US	1954:M1-1991:M12	VAR	X
Garretsen & Swank (1998)	Netherlands	1979-1993	VAR	√
Oliner & Rudebusch (1999)	US	1958:Q4-1992:Q4	VAR	√
Kashyap & Stein (2000)	US	1976:Q1-1993:Q3	Panel Data	√
Iturriaga (2000)	12 OECD Countries	1964-1994	VAR	√
Holtemöller (2002)	Germany	1975-1998	VAR	√
Çavuşoğlu (2002)	Turkey	1988-1999	GMM	X
Garretsen & Swank (2003)	Netherlands	1982:M12- 1996:M12	VAR	X
De Bondt (2004)	Euro Zone	1991:M1–2001:M6	VAR	√
Suzuki (2004)	Australia	1989:Q2-2002:Q2	VAR	X
Sichei (2005)	South Africa	2000:Q1-2004:Q4	Dynamic Panel Data	√
Hülsewig et al. (2006)	Germany	1991:Q1-2003:Q2	VAR	√
Gómez-González & Grosz (2007)	Colombia and Argentina	1995:M01-2005:M09 2003:M08-2005:M11	Panel Data	√
Goh & Yong (2007)	Malaysia	1994:M10-2005:M10	ARDL	√
Suzuki (2008)	New Zealand, USA and Australia	1988:Q4-2005:Q4	VAR	√

Örnek (2009)	Turkey	1990:Q1-2006:Q1	VAR	X
Gambacorta & Rossi (2010)	12 European Countries	1985-2005	AVECM	√
Erdoğan & Beşballi (2010)	Turkey	1996:M06-2006:M09	VAR	λ
De Mello & Pisu (2010)	Brazil	1995:M12-2008:M06	VECM	√
Jacobs & Rayner (2012)	Australia	1983:Q4-2011:Q4	VAR	√
Saumitra & Toto (2012)	India	1996-2007	Dynamic Panel Data	√
Bhatt & Kishor (2013)	India	1996-2008	OLS	√
Montes & Machado (2013)	Brazil	2003-2010	EKK, GMM and VAR	√
Leroy (2014)	Euro Zone	1999-2011	GMM	√
Mukhtarov et al. (2016)	Azerbaijan	2001:Q1-2014:Q3	VECM	√
Mirasedoğlu (2017)	Turkey	2006:M01-2017:M02	VAR	λ

√ :Operate, λ: Partially Operate, X: Not Operate

When the studies in the literature are examined, the majority of the findings obtained showed that the credit channel is operating in the country or country groups in general. But besides these findings, it is seen that there are some researchers who have reached the findings that the credit channel is partially operating or not. It is considered that the main reasons for these different results because of the countries or groups of countries, the methods used, and the time frame.

4. Model and Data

The aim of this study is to determine the causal relationship between credit volume, interest rates, consumer price index and economic growth within the fragile fives countries. A panel data analysis is conducted with the 5 countries that are subject to analysis (Brazil, Indonesia, India, South Africa, and Turkey). Due to availability of data for our chosen variables, 2001:Q1-2019:Q4 quarterly data are used. The functional expression of the empirical model created in closed form is as follows:

$$IPI_{it} = f(CRE_{it}, INT_{it}, CPI_{it}) \qquad (1)$$

The subscripts i and t denote unit and time period respectively. The variables used in the analysis are credit volume (CRE), industrial production index (IPI), policy interest rates (INT) and consumer price index (CPI). The variables in the model are determined based on the studies in the literature. The IPI series are taken as seasonally adjusted. CPI series are seasonally adjusted by CENSUSX-13 method. The credit volume series included in the model are taken as the percentage of GDP rate. IPI and CPI series are based on 2010. Series are compiled from International Monetary Fund (IMF) and Bank for International Settlements (BIS) databases. Descriptive information about variables is in Table 2.

Table 2: Description of variables

Variable	Definition of Variable	Source
IPI	Industrial production index	IMF
CRE	Credit volume	BIS
INT	Policy interest rates	IMF
CPI	Consumer price index	IMF

The BIS quarterly statistics on credit to the non-financial sector capture borrowing activity of the private non-financial sector and the government sector in more than 40 economies. On the lending side, two credit data series are provided. "Total credit" comprises financing from all sources, including domestic banks, other domestic financial corporations, non-financial corporations and non-residents. "Bank credit" includes credit extended by domestic banks to the private non-financial sector. On the borrowing side, "total credit" to the non-financial sector is broken down into credit to the government sector and the private non-financial sector, and the latter is further split between non-financial corporations and households (BIS, 2020).

In order to investigate the operation of the credit channel in these countries, the relations between the variables are analyzed by panel data analysis method. Although panel data analysis has features specific to both time series and cross section data analysis, it also eliminates the disadvantages of these analyzes. For example, when the time series and cross section analyzes do not control heterogeneity, serious deviations can be seen in parameter estimates. Panel data analysis techniques, on the other hand, takes into account the heterogeneities specific to the cross sections and allow the control and measurement of these heterogeneities within the model (Tarı, 2011, 476). In the panel analysis for each country i=1,..,N, at time t=1,..,T, we consider the following linear model:

$$IPI_{it} = \alpha + \beta_1 CRE_{it} + \beta_2 INT_{it} + \beta_3 CPI_{it} + u_{it} \qquad (2)$$

5. Empirical Findings

5.1. Slope Homogeneity

In panel data analysis, first of all, slope homogeneity is examined with the help of delta test. Determination of slope homogeneity in cross sections is effective in determining the

appropriate tests for the unit root and cointegration analysis. Whether there is heterogeneity is determined by the delta test. Delta test and corrected delta test statistics are calculated as follows (Pesaran - Yamagata, 2008: 56-57):

$$\tilde{\Delta} = \sqrt{N}\frac{N^{-1}\tilde{S}-k}{\sqrt{2k}} \qquad (3)$$

$$\tilde{\Delta}_{adj} = \sqrt{N}\frac{N^{-1}\tilde{S}-\mathrm{E}(\tilde{z}_{it})}{\sqrt{Var(\tilde{z}_{it})}} \qquad (4)$$

The results of the delta tests are shown in Table 3 below.

Table 3: Slope Homogeneity Tests

Test	
$\tilde{\Delta}$	**76.69*** **
	(0.001)
$\tilde{\Delta}_{adj}$	**79.86*** **
	(0.001)

* %10, ** %5, *** %1 level of significance.

Null hypothesis is the parameters are homogeneous. As a result of the test, null hypothesis is rejected at 1% significance level and it is decided that the slope coefficients of the cross sections forming the panel are heterogeneous. In this case, unit root and cointegration tests that take into account the heterogeneity of slope coefficients should be used.

5.2. Cross-Sectional Dependency and Unit Roots

For series determined to be heterogeneous with the help of delta test, it is important to investigate the cross sectional dependency. Cross sectional dependency tests are used to examine whether there is a relationship between the units on the panel. If cross-sectional dependency exists, then second generation unit root tests should be used. In this study, Bias-Adjusted LM test is used to investigate cross sectional dependency. This test is calculated as follows (Pesaran et al., 2008):

$$LM(p)_{adj} = \sqrt{\frac{2}{p(2N-p-1)}}\left(\sum_{s=1}^{p}\sum_{i=1}^{N-S}\frac{(T-k)\hat{\rho}_{i,i+s}^{2}-\mu_{T_i,i+s}}{v_{T_i,i+s}}\right) \qquad (5)$$

Null hypothesis is cross sections are independent. According to the LM_AD test results, null hypothesis is rejected at 1% significance level and it is decided that there is cross-sectional dependency between the units forming the panel. In this case, stationarity analysis can be done using second generation unit root tests.

Stationarity analysis is performed using Pesaran (2007) CIPS and Hadri and Kurozumi (2012) panel KPSS unit root tests, which are the second generation unit root tests that take into account the cross-sectional dependency. For the CIPS test, the null hypothesis is existence of unit root, while the panel KPSS test null hypothesis is that all series are stationary. Unit root test results with 4 lags are shown in Table 2. This lag number is chosen since the selected period is quarterly. Pesaran (2007) CIPS, Hadri Kurozumi (2012) Z_A^{SPC} and Z_A^{LA} statistics shows that industrial production index and consumer price index series unit root. The results are given in Table 4.

Table 4: Tests for cross-sectional dependence and unit root.

	IPI	CRE	INT	CPI
CIPS int.	-1.13	**-2.30***	**-2.36****	-0.84
CIPS int.&trend	-2.68	**-2.40***	**-2.93****	-1.57
Z_A^{SPC} int.	**2.80*****	**8.04*****	-0.47	1.56
Z_A^{SPC} int.&trend	0.95	-2.08	-1.31	**3.84*****
Z_A^{LA} int.	**6.37*****	**4.92*****	0.87	**10.20*****
Z_A^{LA} int.&trend	**6.74*****	-0.62	**2.59*****	**10.65*****
LM_AD int.	**154.92***** **(0.001)**	**119.66***** **(0.001)**	**134.71***** **(0.001)**	**153.36***** **(0.001)**
LM_AD int.&trend	**152.67***** **(0.001)**	**118.61***** **(0.001)**	**132.99***** **(0.001)**	**150.73***** **(0.001)**

* %10, ** %5, *** %1 level of significance. Respectively %1,%5,%10 CIPS critical values including intercept: -2.54, -2.33, -2.21 and CIPS critical values including intercept+trend: -3.04, -2.83, -2.72. Critical values for the CIPS test are obtained from Pesaran (2007).

5.3. Cointegration

Since there is a cross-sectional dependency in the series used in the analysis; in panel cointegration tests, second generation cointegration tests should be used which take into

account the cross-section dependency. In addition, Westerlund (2008) Durbin Hausmann cointegration test is used because the series are stationary at different orders. Null hypothesis is no cointegration for all units. When the panel statistics are examined in the table, out of six test statistics, five confirm the presence of cointegration among the variables. So the null hypothesis is rejected and it is concluded that there is cointegration between variables. The test results are shown in Table 5:

Tablo 5: Westerlund (2008) DH Cointegration Test

Test	No intercept and trend	Intercept	Intercept and trend
Durbin-H Group Statistic	**-1.753** **(0.04)**	**-1.837** **(0.03)**	-0.792 (0.21)
Durbin-H Panel Statistic	**-1.517*** **(0.06)**	**-1.585**** **(0.05)**	**-1.581**** **(0.05)**

* %10, ** %5, *** %1 level of significance.

5.4. Heterogeneous Panel Causality Test

In panel data analysis, causality relationship between variables can be estimated by Dumitrescu and Hurlin (2012) test. The advantage of this test is that it can be used in panels with cross-sectional dependency and heterogeneity. This test uses the average of the individual Wald tests calculated for the cross section units. Wald test statistics are as follows (Dumitrescu - Hurlin, 2012, 1453):

$$W_{N,T}^{H_{nc}} = \frac{1}{N}\sum_{i=1}^{N} W_{i,T} \qquad (6)$$

This test requires variables to be stationary (Bhattacharya et al, 2016); so the first difference are applied of the IPI and CPI series. The null hypothesis is no Granger causality in all units of the panel, while the alternative is the Granger causality in all units. When the null hypothesis is rejected, that indicates the existence of a causal relationship between the variables. This test determines the direction of causality between credit, interest rates, inflation and economic growth. Findings obtained show that interest rates are the Granger cause of the credit volume. Also there is bidirectional causality between growth and inflation. In addition, growth and inflation appear to be the Granger cause of interest rates. There is also a one-way causality from credit to inflation. The absence of a

causal relationship between growth and credit implies that the credit channel is partially operating in these countries. Dumitrescu and Hurlin (2012) causality test results are shown in Table 6:

Table 6: Dumitrescu and Hurlin (2012) Panel Causality Test

Test	Zbar-Stat	Prob
CRE does not Granger-cause IPI	-1.15	0.24
IPI does not Granger-cause CRE	-0.29	0.77
INT does not Granger-cause CRE	**4.38*** **	**0.00**
CRE does not Granger-cause INT	1.25	0.20
INT does not Granger-cause IPI	0.87	0.38
IPI does not Granger-cause INT	**8.09*** **	**0.00**
CRE does not Granger-cause CPI	**9.14*** **	**0.00**
CPI does not Granger-cause CRE	-1.17	0.23
IPI does not Granger-cause CPI	**2.55*** **	**0.01**
CPI does not Granger-cause IPI	**1.93** **	**0.05**
INT does not Granger-cause CPI	-0.30	0.76
CPI does not Granger-cause INT	**2.39*** **	**0.01**

* %10, ** %5, *** %1 level of significance.

Conclusion

The channels of the monetary transmission mechanism guide policymakers by reflecting the monetary exchanges on total demand. Based on this fact, it is regarded as important to know how monetary transmission mechanism works in order to understand better the relations between the real sector and the financial sector and to interpret better the fluctuations seen in the financial markets.

In this study, the operation of the credit channel is investigated by examining the relationships between credit volume and important macroeconomic variables in fragile fives countries. Panel data analysis is conducted with quarter data of the 2005Q1-2019Q4 period for Brazil, Indonesia, India, South Africa and Turkey. The econometric model consists of testing the policy interest rates, consumer price index, credit volume and the industrial production index relationships with the panel Granger causality model. An important contribution of this study to the literature is the use of econometric tests that take into account the cross-sectional dependency and heterogeneity of the panel for the

study of the credit channel in fragile fives countries. According to the results, the interest rates Granger-cause the credit volume and the credit volume Granger-causes inflation. But the credit volume fails to Granger-cause growth. The absence of a causal relationship between growth and credit implies that the credit channel is partially operating in these countries.

The level of development of countries enables monetary policy to affect the economy by changing the monetary policy transmission mechanism processes with the help of various factors. Structural and fundamental problems arise in small open and developing economies such as uncertainties, high exchange rate pass-through, asset and liability dollarization, external financing constraints, fiscal dominance, and sudden and high changes in commodity prices. These problems limit the operation of the monetary transmission mechanisms and reveal problems in transmission the monetary policy changes to the economy.

Financial crises which arise frequently in developing countries affect monetary policy negatively. In order to prevent financial crises, structural economic reforms should be implemented. Also inflation, which has a disruptive effect on financial markets and the economy, should be reduced. It is also important to increase production and competition in the market. As a result of structural changes in the economy, the monetary policy transmission will become more affective.

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