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DOES THE RISK-TAKING OR RISK-SHIFTING CHANNEL OF MONETARY POLICY WORK IN DEVELOPING COUNTRIES? EVIDENCE FROM TVP-VAR APPROACH? *

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ABSTRACT

In the study, the validity of the risk-taking channel was investigated using the monthly data between 2003 and 2018, in particular for Brazil, South Africa and Turkey countries. According to test results, for Turkey the response of leverage rate to unexpected increases in policy interest rate was measured positively; for Brazil it was measured positively and for South Africa, it was measured positively during the sample period.

Finally, for all countries the reaction of industrial production to shocks in the policy interest rate was calculated to be negative during the sample period. Thus, it is concluded that the risk-taking channel is effective for these countries during the analysis period (especially in times of crisis), and that monetary policy could be used as an effective tool for managing macroeconomic risk.

Keywords: *Risk-Taking Channel, TVP-VAR, Monetary Transmission Mechanism, Developing Countries.*

Jel Codes: *E52, C32, G32.*

1. INTRODUCTION

The Central Banks ability to choose the effective monetary policy instruments and to be able to reach their goals is only insofar possible as their ability to accurately assess the impacts of the implemented policies on the economy. Therefore, it is very important to determine what channels the effects of the monetary policy implementations on macroeconomic variables such as pricing, interests, supply and demand and how long it would take for such effects to materialize. Therefore, for the purpose of determining in what process and density the monetary policies affect the economic activities. The

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studies that demonstrate the workings of the monetary transmission mechanism have accelerated since the 1980s.

The monetary transmission mechanism, which, in classical sense, indicates in what capacity and what channels the monetary variables effect the macroeconomic variables, after the initial analyses, which is based on the traditional interest channel, has been transformed into a more comprehensive structure that also has different scopes of influence such as credits, assets, expectations and foreign currency channels (CBRT, 2013). Since the onset of the 2008 Global Financial Crisis, the connection between the financial system and the monetary policy has increasingly begun to form a growing interest. This new area of research that has recently emerged and is usually termed as the risk-taking channel focuses on the transmission of the monetary policy over the risk taking behaviour of the banks.

Emergence of such crisis in an environment, where the price stability is achieved but risks regarding the financial stability also appear, led the monetary authorities on a search for alternative policies, which cover the financial stability as well. It can be seen that along with the global crisis, the subject of financial stability has begun gaining prominence as it has begun to be considered as one of the basic instruments that should be aimed by the Central Banks with the price stability. Nowadays, central banks face the questions such as how they can form a policy framework that aims the price stability along with the financial stability, and which policy instruments should be implemented while considering the risk taking behaviour of the banks. One of the most important lessons, experienced regarding the financial crisis, was the necessity for the central banks to adopt a new approach, which does not dismiss the financial risks, being accumulated in financial system and the price bubbles in the commodity prices while focusing on the price stability.

After the 2008 financial crisis, the fact that the current market structure "has failed" is obvious. The system allowed the markets to take on excessive risks, did not correctly price the assets, and showed significant flaws in terms of transparency. As the impacts of the crisis affected the economic climate of the developed and developing countries, it also forced the monetary economics and the monetary policy implementations to set a search. It is theorized that the crisis initially spread to the global markets under the influence of traditional interest rate channel. In USA, as an exit strategy after the 2001 recession, a decline in interest rates, related to the monetary expansion, was experienced. The US Central Bank (FED), which acted in order to avert the recession, brought the short-term interest rates (Federal Funds Rate), which had been around %6,40 at the end of 2000, down to % 1,82 at the end of 2001 (FED, 2015). The interest rate decreases, operated by FED, continued until the end of 2003 and the interest rates consequently declined down to %1, which was the lowest for the last 46 years. The fall of the interest rates increased the investment and consumption expenditures by decreasing the cost of the capital and thus this led to the boom in aggregate demand, especially in the loan demand. As a result, interest channel was soon followed by credit channel and accordingly, excessive expansion in mortgage loans was observed. Low interest rates and monetary policies in effect did not only affect the loan volume in

this process, they also modified the risk taking behaviour of the financial institutions (Delis and Kouretas, 2011; Abbate and Thaler, 2014). Within this context, the financial intermediary institutions assumed a new function through "risk taking" in the transmission of the monetary policies. In an environment where the price stability is achieved, the course of low interest rates for a long period decreased the risk conception of the banks and other market participants and thus increased the risk tolerance. In this process, the tendency of the investors to steer the individuals with low credit worthiness and to risky financial assets in order to seek for higher yields increased as well (Yellen 2011). In other words, the low yields in conventional investment instruments, due to the low interest rates, directed the investments to obtain more yield by taking more risks. This situation, which is referred as the risk-taking channel of the monetary policy in economics literature, gave the monetary transmission mechanism a new dimension (Borio and Zhu, 2008). After this process, the asset price channel stepped in and thus significant rises occurred in financial and non-financial asset prices. In this regard, the volume of the sub-prime mortgage housing loans increased and the majority of the receivables, arising from such high-risk loans began to be securitized. The financial institutions, which obtained a significant source of liquidity thanks to the securitization of the receivables arising from the subprime mortgage loans, gained the ability to offer more loans and to make more investments. The proliferation of the use of loans (especially for the consumers with a bad credit history) and subsequently, the housing prices increased due to the rising demand in housing markets. The increasing housing prices in this period have made the housing an important investment instrument. This situation has led to an increase in aggregate demand by creating an increase of wealth effect. Increasing demand has necessitated the increase of the interest rates by triggering the inflation and this phase has led to a recession in loan market again through the loan channel. This in turned caused a fall in the total loan demand and obstructed the return of the current loans, which were directed from the prime clients (clients with higher credibility) to sub-prime clients (clients with lower payment ability). The market price of the housing and residential mortgage backed securities or mortgage covered bonds have fallen rapidly in parallel with the demand shrinkage (reverted back to their real values). Financial institutions, facing with liquidity crisis, failed to get the necessary response for their fund requests from the markets. The boom, formed in asset prices, ultimately came up to an unsustainable scale, leading the system to a total collapse. In line with these developments, the future related expectations of the financial units took a turn to worse and the tendency to return to liquidity accelerated (bank run) and the crisis, through the expectations channel, they completed the spreading phase (Oktar et al., 2013). On the road to the crisis, it was observed that a stable price level, low interest rates and the abundance of liquidity pushed the financial institutions' financial intermediaries to take excessive risks by bloating the asset prices and supporting the financial leverages (Dell'Ariccia et al., 2014). As a result, the latest crisis brought the relationship between the interest rates and the risk taking behaviours of the financial intermediaries to the prominence in the recent monetary policy debates.

The analyses towards the emergence and spreading mechanisms of the crisis shall shed some light on under what conditions and what kind of measures may be taken in this regard. Therefore, analyzing the monetary transmission channels, specific to risk-taking channels, which is considered highly influential on the emergence and spread of the 2008 financial crisis, is also considered to be beneficial for providing effective policy making and new political measures to policy makers for the future in terms of analyzing the causes of the crisis and producing monetary solution policies. Within this context, the aim of this paper is to reveal whether the implementation of monetary policy in emerging economies affects the risk taking behaviours of the banks or not.

This paper contributes in two aspects to ongoing debates on the risk-taking channel of monetary policy in the literature. First, this paper provides evidence from major emerging economies. Since the financial crisis of 2007–08 and the subsequent global economic recession, most of the studies usually focus on developed countries, particularly on data from the US banking system (for instance Altunbas et al. (2010), Maddaloni and Peydro (2011), Buch et al. (2014), Dell'Ariccia et al. (2017), Paligorova and Santos (2017), Delis et al. (2017), Adrian et al. (2019)) and the Eurozone (for instance Altunbas et al. (2010), Delis and Kouretas (2011) and Maddaloni and Peydro (2011) for Euro-area, Jimenez et al. (2014) for Spain; Gersl et al. (2015) for Czech Republic and Gaggl et al. (2010) for Austria). Only a limited number of them deals with developing countries, such as Tabak et al. (2010) for Brazil, Aklan et al. (2014) for Turkey, Drakos et al. (2016) for Russia, Gumata and Ndou (2017) for South Africa, Huang at al. (2019) for China. Given the increase the mutual economic and financial relations among the emerging economies constantly, the expansionary monetary policy, which is preferred to achieve high growth targets in emerging economies, may lead to an increase in credit quantity as well as a decrease in credit quality. To overcome such a sample gap in the previous literature, the sample of this study consists of three major emerging market economies—Brazil, South Africa and Turkey to examine whether and to what extent monetary policy leads to an increase in banks' risk-taking tolerance. These countries stand out with their high growth potential (high growth rates are observed after 2000) with similar economic development levels and attract a high portion of foreign direct investments. Emerging economies, which have been the fastest growing market in the world for most products and services over the past 20 years, have potential to be the main drivers of global economic growth for the next two decades. In this process, the economies are expected to offer significant opportunities for domestic and foreign banks, insurance companies and fund managers to increase their global market share. To achieve this aim, causal connections among emerging economies, financial sector and financial stability are of great importance in this process. In emerging countries, which demanded to realize their economic development faster, the financial sector's various problems in adapting to the process and increasing investment demands increasing their risk-taking tendency have led to the questioning of the opinions about the contribution of monetary policies to economic growth. Therefore, the relationship between

monetary support policies led by this structural transformation in emerging markets and the risk-taking behavior of banks has been the main subject of the paper.

Although the literature on the monetary policy transmission mechanism is very large, it is seen that there is a relatively limited number of analyzes using nonlinear methods. It can be said that studies investigating the effectiveness of the monetary transmission mechanism with nonlinear methods are very limited. In this context, the second contribution of our study is to consider the effectiveness of the monetary transmission mechanism with nonlinear methods. The third contribution relates to the advantages of the empirical method adopted, which leads to more effective results than previous empirical studies. To capture possible time-varying changes in banks' risk-taking perceptions and the link between monetary policy and bank risk taking in a flexible and robust manner, this paper adopts a time-varying parameter VAR (TVP-VAR) model.

To this end, the remainder of the paper is organized as follows. Section 2 reviews the theoretical and empiric literature that focuses on the relationship between the monetary policies and the risk taking behaviours of the banks will primarily be analyzed. Section 3 describes the data, methodology and empirical results. Finally, The Section 4 includes conclusion and policy recommendations.

2. LITERATURE REVIEW

Although there are a large number of studies in the literature on the monetary transmission mechanism, the number of the studies that analyze the efficiency of the transmission mechanism, which is also dubbed as the risk-taking channel, is fairly limited. Since the onset of the crisis, an ever-increasing interest on the connection between the financial system and the monetary policies has surfaced. It is widely believed that the 2008 global crisis was the result of the wrong incentives in the financial markets that led to the financial institutions to take excessive financial leverage and more risk (Delis and Kouretas, 2011; Lopez et al., 2012; Abbate and Thaler, 2014; Angeloni et al., 2015). Here, the main idea is the thesis that the expansive monetary policy, in other words the low interest rates and abundance of liquidity (and add the not properly functioning supervision and control mechanisms to this formula) may increase the financial market imbalances by encouraging the financial units towards riskier assets.

Analyzing the studies on the efficiency of the risk-taking channel, there is a general opinion that the monetary policy has an impact on the financial stability by affecting the risk-taking tendencies of the financial institutions, although not a complete consensus. Some studies have provided evidence in support of the risk-taking channel of monetary policy hypothesis, which assumes that there is a reverse relationship between low interest rates and bank risk-taking and that the monetary policies affect banks' perceptions and attitudes towards risk (Gambacorta, 2009; Tabak et al., 2010; Altunbas et al., 2010; Maddaloni and Peydró, 2011; Delis and Kouretas, 2011; Aklan et al., 2014; Angeloni et al., 2015; Bonfim and Soares, 2018; Adrian et al., 2019). However, other studies such as Drakos et al. (2016),

Buch et al. (2014), Dell'Ariccia et al. (2017) have found either no evidence or weak evidence in favor of the risk-taking channel hypothesis.

As one of the important studies on the subject, Tabak et al. (2010), in their study, in which they analysed the risk-taking reactions of the banks for Brazil, have reached to the conclusion that the low interest rates lead to higher credit risk thus supporting the existence of the risk-taking channel. For banks operating in the European Union and the United States, Altunbas et al. (2010) found similar findings that unusually low interest rates for a long time led to an increase in the banks' risk. In another study, Maddaloni and Peydro (2011) have investigated whether or not the policy interest rates have an impact on the risk taking behaviour of the banks through the data obtained from Euro zone and US banking system. They presented evidence, supporting the work of the risk-taking channel. In the study, conducted on Eurozone Banks, Delis and Kouretas (2011) have found strong empiric evidence, indicating that the low interest rates significantly increase the risk taking behaviour of the banks. The result of their analysis reveals a negative relationship between the risk taking of the banks and the interest rates. Therefore, it has been concluded that in an environment, where the low interest rates prevail for a long time, the banks would have a tendency to increase the risky assets within their portfolio. In addition, the results indicate that the impact of the interest rates on the risky assets decreases for the banks with comparatively higher equity capital, but increases for the banks with higher off-balance sheet items. Aklan et al. (2014) have investigated the effects of monetary policies on the risk taking behaviour of the banks with dynamic panel approach in Turkey. According to their analysis results, low interest rates in Turkish banking system impacts the risk taking behaviour of the banks. In this regard, a decrease in short term interest rates, the ratio of the outstanding loan within the total loans, is also reduced. On the other hand, when the policy interest rate falls below the balance value, in connection with the banks heading to the new and risky credits, their tendency to head towards riskier assets also increase. Buch et al (2014), who conducted a similar work for US banking system, analyzed the relationship between the policy interest rates and risk taking behaviours of the banks by making distinctions for different loan risk categories and banking groups. In addition, the results failed to reveal evidence, supporting the risk-taking channel hypothesis for large and foreign bank groups. However, it is apparent that the monetary policy has an effective risk-taking channel for the small-scale bank groups. Furthermore, it has been concluded that the small-scale banks tend to decrease the terms of the high-risk credits after an expansionary monetary policy shock. Angeloni et al. (2015) investigated the effects of the monetary policy on banking risks to verify the existence of the risk-taking channel. The results of the analyses show that the risk-taking channel exists and it has a definitive effect on the financing activities of the banks. In addition, it was revealed that in the face of the monetary expansion, the banks increase the leverage ratio and the risk. Drakos et al. (2016) analyzed the association between the risk taking behaviour of the banks and the interest rates by classifying the ownership structure of 10 banks in Central and Eastern European countries and Russia. The findings revealed that the risk-taking behavior of banks differs between

domestic and foreign banks. It was observed that the appetite of the foreign banks to take risk against the low interest rates that prevail for a long period of time increase as this case is not applicable for the local banks. In addition, it was revealed that this situation is more apparent for the banks with higher capitals. More recently, Bonfim and Soares (2018) have provided evidence in favour of risk-taking channel of monetary policy. They show that when the policy interest rates are low, financial institutions, the small banks being first, tend to grant more loans to the economic units without credit history. Neuenkirch and Nöckel (2018) used data on the euro area banks and found that an expansionary monetary policy has led to lower banks' lending standards in particular, banks in the Netherlands, Portugal, Spain, and Ireland. Similar findings were found by Adrian et al. (2019) for the US financial system. In another study on emerging economies, Huang at al. (2019) studied the case of China and validated the search-for-yield mechanism of monetary policy's risk-taking channel, while they could not provide consistent evidence in favor of the risk shifting mechanism.

3. DATA, METHODOLOGY & EMPIRICAL RESULTS

3.1. Data

In the study, the validity of the risk-taking channel was investigated using the monthly data between 2003 and 2018, for three major emerging market economies—Brazil, South Africa and Turkey- that have a long history of free market economies and a high growth potential. Variables used in the study; interest rate (f) is the leverage ratio (k) of banks, country risk (r) and industrial production index (s). While the Central Bank policy interest rate variable is taken into account as the interest rate variable, banks' liabilities / assets are taken into account as the leverage ratio variable. While the country risk variable is calculated from EMBI spread data, the industrial production index is calculated in real terms and is adjusted for seasonal effects. The data were obtained from the World Bank Global Economic Monitor and International Monetary Fund International Financial Statistics databases. Natural logarithms of EMBI spread and industrial production index variables were taken into consideration in the analysis.

Nonetheless, Russia, China and India, which are among the BRICS-T countries representing major emerging economies, could not be included in the analysis due to lack of data. Descriptive statistics of the variables used in the study are shown in Table 1. According to the data in Table 1, while the highest average interest was realized in Brazil during the sample period, the country with the highest leverage ratio was determined as South Africa. On average while Turkey has the highest country risk, the country with the lowest industrial production has identified as South Africa.

Table 1. Descriptive Statistics

		f	*k*	*r*	*s*
Brazil	Mean	0.128	0.714	5.652	24.402
	Median	0.120	0.718	5.503	24.398
	Std. Deviation	0.043	0.039	0.449	0.080
	Skewness	1.124	-0.486	1.003	-0.291
	Kurtosis	4.522	3.367	3.779	1.951
Turkey	Mean	0.122	0.805	5.666	23.661
	Median	0.080	0.812	5.649	23.614
	Std. Deviation	0.081	0.078	0.320	0.259
	Skewness	1.927	0.083	1.142	-0.072
	Kurtosis	7.198	1.712	4.617	1.987
South Africa	Mean	0.074	0.933	5.253	22.923
	Median	0.070	0.941	5.329	22.937
	Std. Deviation	0.021	0.036	0.472	0.050
	Skewness	1.224	-1.692	-0.247	-0.372
	Kurtosis	3.763	5.928	2.863	2.599

3.2. TVP-VAR Model

Vector Autoregression (VAR) model is a frequently used method in determining dynamic relationships between variables in econometric analysis. The time-varying parameter VAR (TVP-VAR) model with stochastic volatility developed by Primiceri (2005) has a wide application in macroeconomic analysis. The TVP-VAR model allows us to flexibly and reliably predict the potential time-varying structure of the economy. It is assumed that all parameters in the VAR model form exhibit first-order random walk process, so that both temporary and permanent changes in parameters are allowed. Therefore, the assumption of stochastic volatility is of great importance in the TVP-VAR model (Nakajima, 2011; 108).

The TVP-VAR model is an extended version of the classic VAR model and the Bayesian analysis is used to obtain time-varying coefficients in the TVP-VAR model. In this analysis method, the Markov Chain Monte Carlo (MCMC) algorithm is used to create a sample from the posterior distribution of the TVP-VAR model.

Before revealing the econometric structure of the TVP-VAR model, the conventional structural VAR model is defined as follows:

$$Ay_t = F_1 y_{t-1} + \cdots + F_t y_{t-s} + u_t, \quad t = s+1, \ldots, n \tag{1}$$

where y_t is a k x 1 vector of observed variables, A and $F_1, \ldots, F_s$ are k x k matrices of coefficients. Error term u_t shows k x 1 dimensional structural shocks and under the assumption $u_t \sim N(0, \Sigma)$ the variance-covariance matrix is defined as follows:

$$\Sigma = \begin{pmatrix} \sigma_1 & 0 & \dots & 0 \\ 0 & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \dots & 0 & \sigma_k \end{pmatrix} \quad (2)$$

If the simultaneous relationships of structural shock are defined by recursive identification, matrix A is assumed to be lower-triangular as follows:

$$A = \begin{pmatrix} 1 & 0 & \dots & 0 \\ a_{21} & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ a_{k1} & \dots & a_{k,k-1} & 1 \end{pmatrix} \quad (3)$$

Thus, the reduced form of the structural VAR model in Equation (1) is obtained as follows:

$$y_t = \beta_1 y_{t-1} + \cdots + \beta_t y_{t-s} + A^{-1} \sum \varepsilon_t, \quad \varepsilon_t \sim N(0, \mathrm{I}_k) \quad (4)$$

Here $i = 1, \dots, s$ is defined as $B_i = A^{-1} F_i$. If we define the elements of the matrix B_i in the form of β ($k^2 s$ x 1 dimensional vector) and $X_t = I_k \otimes \left(y'_{t-1}, \dots, y'_{t-2} \right)$ ($\otimes$ Kronecker multiplier), the model can be written as follows:

$$y_t = X_t \beta + A^{-1} \Sigma \varepsilon_t \quad (5)$$

All parameters in Equation (5) are constant and cannot change over time. The TVP-VAR model is an extended version of Equation (5) that allows parameters to change over time. The TVP-VAR model with stochastic volatility is formulated as follows:

$$y_t = X_t \beta + A^{-1} \Sigma \varepsilon_t, \quad t = s+1, \dots, n \quad (6)$$

Here, β_t coefficients, A_t parameters and $\sum_t$ are time variables. There are many methods in the literature for the process of modeling time-varying parameters. Considering the approach of Primiceri (2005), if $a_t = \left(a_{21}, a_{31}, a_{32}, a_{41}, \dots, a_{k,k-1} \right)'$ is located in the vector of the lower-triangular elements of the A_t and for $j = 1, \dots, k$ and $t = s+1, \dots, n$ h_t is defined as $h_t = \left(h_{1t}, \dots h_{kt} \right)'$ and here $h_{jt} = \log \sigma_{jt}^2$. The parameters in Equation (6) are modeled as a random walk process as follows:

$$\beta_{t+1} = \beta_t + u_{\beta t}, \quad a_{t+1} = a_t + u_{at}, \quad h_{t+1} = h_t + u_{ht}$$

$$\begin{pmatrix} \varepsilon_t \\ u_{\beta t} \\ u_{at} \\ u_{ht} \end{pmatrix} \sim N\left(0, \begin{pmatrix} I & 0 & 0 & 0 \\ 0 & \Sigma_\beta & 0 & 0 \\ 0 & 0 & \Sigma_a & 0 \\ 0 & 0 & 0 & \Sigma_h \end{pmatrix}\right)$$

Here for $t = s+1,\ldots,n$, $\beta_{s+1} \sim N(\mu_{\beta_0}, \Sigma_{\beta_0})$, $\alpha_{s+1} \sim N(\mu_{\sigma_0}, \Sigma_{\sigma_0})$ and $h_{s+1} \sim N(\mu_{h_0}, \Sigma_{h_0})$.

Many assumptions are required for the TVP-VAR model form. First, the lower-triangular matrix assumption for A_t requires recursive identification for the VAR system. Secondly, it is assumed that the parameters do not follow a stationary process or even exhibit random walk in the form of AR (1). Third, the variance-covariance structure for the error terms of parameters with time variables is obtained by Σ_{β_0}, Σ_{σ_0} and Σ_{h_0} parameters. Fourth, when the TVP-VAR model is applied according to Bayesian inference, the prior distributions should be chosen carefully because the TVP-VAR model has many state variables and the process is modeled for non-stationary random walk. Finally, the prior distribution of the initial states of time-varying parameters should be determined.

The MCMC algorithm can be defined as follows:

Let $y = \{y_t\}_{t=1}^n$ and $\omega = (\Sigma_\beta, \Sigma_a, \Sigma_h)$ and the prior probability density for ω is considering as $\pi(\omega)$. Given data *y*, we create a sample from the posterior distribution for $\pi(\beta, a, h, \omega | y)$ using the MCMC method. The following MCMC algorithm is applied:

1. Initialize β, *a*, h, ω,
2. Sample $\beta | a, h, \Sigma_p, y$
3. Sample $\Sigma_\beta | \beta,$
4. Sample $a | \beta, h, \Sigma_a, y,$
5. Sample $\Sigma_a | a,$
6. Sample $h | \beta, a, \Sigma_h, y,$
7. Sample $\Sigma_h | h,$
8. Go to step two.

Step 2 and Step 4 is performed with simulation smoothing, while Step 6 requires multi-move sampler for stochastic volatility. For Σ_h diagonal matrix assumption being independent of series creates

conditional posterior distribution of $\{h_{jt}\}_{t=s+1}^{n}$ and the sample algorithm for *h* is simplified. Steps 3, 5, and 7 are straightforward, and a sample is made from the Wishart or Gamma distribution under the assumptions of conjugate priors.

3.3. Empirical Results

In order to determine whether the risk-taking channel is valid, TVP-VAR models were estimated for Turkey, Brazil and South Africa. In the VAR model, the variables are ordering as interest rate, leverage ratio, country risk and industrial production index, and the impulse-response function was calculated recursively. For the VAR model, the optimal lags length is determined as 2 for Turkey and South Africa and as 4 for Brazil. 10000 replications are made for the Monte Carlo simulation with Markov Chain, and the first 1000 repeats are used to obtain prior distributions.

We present the estimation results for values for posterior means, standard deviations, 95% confidence interval, Geweke (1992) CD statistics and ineffectiveness factors in Appendix. Note that the CD statistics and inefficiency factor can be used to determine whether the MCMC simulations are efficient. In this context, Geweke (1992) suggested a test statistic to compare means of the first n_0 and the last n_1 draws for the Monte Carlo simulation. If the sequence of MCMC simulation sampling is stationary, CD statistics converge to normally distribution. The ineffectiveness factor is used to calculate how well the MCMC chains mixes. When the ineffectiveness factor is equal to *m*, it indicates that it requiring to draw *m* times as many MCMC sample as uncorrelated samples. According to the CD statistics results in Appendix, the null hypothesis stating that convergence was achieved for the posterior distribution could not be rejected at the 5% significance level for all countries. This result shows that the burn-in period of Markov chains is sufficient to ensure convergence in the estimates.

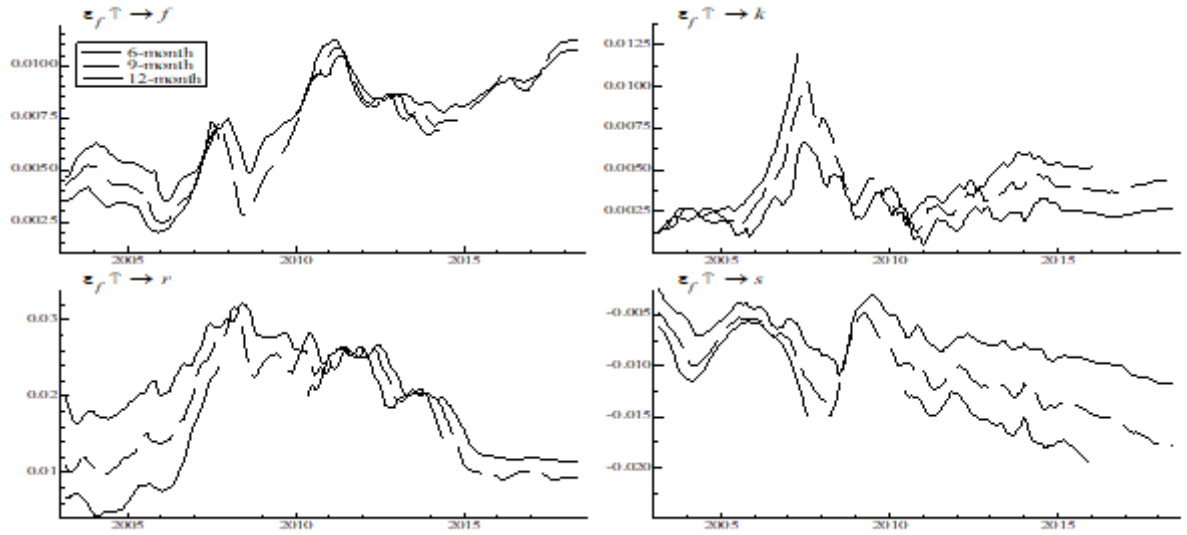
The low inefficiency rate indicates that the sampling is effective for the parameters of the TVP-VAR model. We present the sample autocorrelation function, sample path, and posterior densities for the selected parameters in Appendix Figure A1. According to the results in Figure A1, the sample path appears stable after the initial samples are discarded and the sample autocorrelations quickly die out. These results show that the MCMC sampling provides efficient results in terms of producing the samples that have low autocorrelation for all countries.

The time-varying impulse-response analysis results are shown in Figure 1. In Figure 1, we present the responses of the leverage ratio, country risk and the industrial production index to an unexpected shock in the policy interest rates (the unexpected shocks are defined as positive increase in the interest rate). While calculating the responses in question, the periods of 6 months, 9 months and 12 months after the shock occurred were taken into account.

According to the results in Figure 1, the responses of leverage rate to unexpected increases in policy interest rate are measured positively during the sample period. This result shows that banks

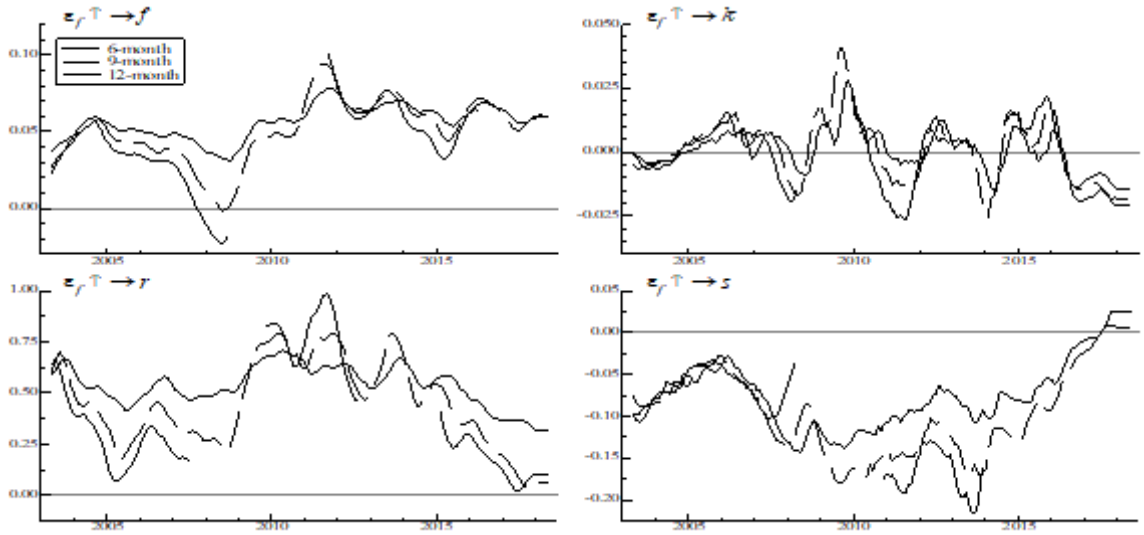
increase the leverage rate when an unexpected increase in the policy interest rate occurs. It is observed that the reaction of leverage ratio reached the highest level especially between 2008 and 2009. Similarly, it is seen that an unexpected increase in interest rates negatively affects country risk. Because the responses of country risk to unexpected shocks in interest rates are measured positively during the sample period. As in the leverage ratio, the reaction reached the highest level between 2008 and 2009. On the other hand, the responses of industrial production to shocks in the policy interest rate are calculated as negative during the sample period.

Figure 1. Impulse-Response Analysis Results for Turkey



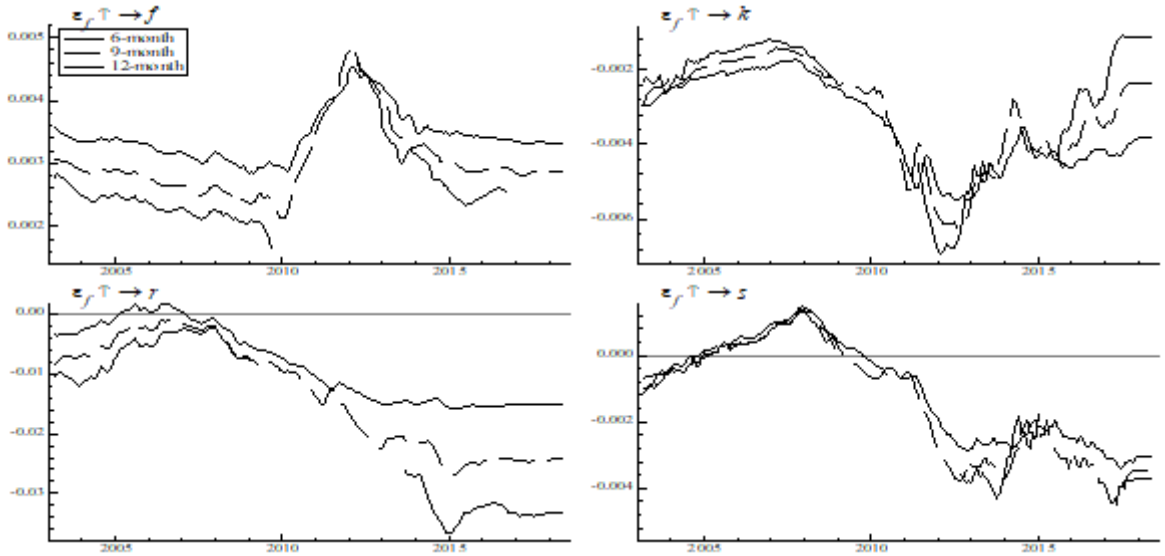
We present time-varying impulse-responses analysis results for Brazil in Figure 2. According to the results in Figure 2, the responses of leverage rate to an unexpected shock in policy interest rate are measured positively during the sample period. This result shows that bank leverage increases due to an increase in the policy interest rate. It is observed that the responses of leverage ratio reached the highest level especially in 2008-2009 periods. Similarly, it is seen that an unexpected increase in interest rates negatively affects country risk. Because the responses of country risk to unexpected shocks in interest rates are measured positively during the sample period. As in the leverage ratio, the reaction reached the highest level in 2008-2009. On the other hand, the responses of industrial production to shocks in the policy interest rate are calculated to be negative during the sample period.

Figure 2. Impulse-Responses Analysis Results for Brazil



Impulse-responses analysis results for South Africa are shown in Figure 3. According to the results in Figure 3, the responses of leverage to an unexpected shock in policy interest rate are measured positively during the sample period. This result shows that banks leverage increases when an unexpected increase in the policy interest rate occurs. It is observed that the responses of leverage reached the highest level especially in 2008-2009 periods. Similarly, it is seen that an unexpected increase in interest rates negatively affects country risk. Because the responses of country risk to an unexpected shock in interest rates are measured positively during the sample period. As in the leverage ratio, the reaction reached the highest level in 2008-2009. On the other hand, the responses of industrial production to a shock in the policy interest rate are calculated to be negative during the sample period.

Figure 3. Impulse-Responses Analysis Results for South Africa



4. CONCLUSION AND IMPLICATIONS

Risk-taking channel provided a new aspect to the monetary transmission mechanism by adding the risk conception of the financial institution to the relationship between the monetary policy and the financial stability. When the role of the securitization process on the global crisis is considered, it is imperative to perform the supervision and control mechanisms during the course of the securitization of the bank loans and other financial assets and the development of the asset based financial products in an effective manner. Managing this process well and keeping the impacts of the risks on the economy under control, by envisaging the financial sector borne risks, have utmost importance in terms of the general health of the economy.

In this study, the validity of the risk-taking channel was investigated using the monthly data between 2003 and 2018, in particular for Brazil, South Africa and Turkey countries. It is aimed to provide policy recommendations to manage macroeconomic risk and potential production losses of these countries, which stand out with high growth potential, cheap labor and a high rate of direct foreign investment inflow. The effectiveness of the risk-taking channel has been discussed recently in managing financial risk with monetary policy transmission. The risk-taking channel is a monetary policy channel that has increased in popularity especially after the 2008 crisis and is addressed for developed countries. To our knowledge, there is no other study dealing with the risk-taking channel with the TVP-VAR method.

According to test results, for Turkey the response of leverage rate to unexpected increases in policy interest rate was measured positively during the sample period. This result shows that banks increase the leverage rate when an unexpected increase in the policy interest rate occurs. On the other hand, the reaction of country risk to unexpected shocks in interest rates was measured positively during the sample period. According to test results for Brazil the response of leverage rate to unexpected increases in policy interest rate was measured positively during the sample period. This result shows that banks increase the leverage rate when an unexpected increase in the policy interest rate occurs. Similarly, it is seen that an unexpected increase in interest rates negatively affects country risk. According to the results for South Africa, the response of leverage rate to unexpected increases in policy interest rate was measured positively during the sample period. It is seen that an unexpected increase in interest rates negatively affects country risk.

Finally, for all countries the reaction of industrial production to shocks in the policy interest rate was calculated to be negative during the sample period. Thus, it is concluded that the risk-taking channel is effective for these countries during the analysis period, and that monetary policy could be used as an effective tool for managing macroeconomic risk and for product losses.

The bank leverage ratios provide important information about the financial architecture of countries. The high levels of bank leverage put increasing pressures on the macroeconomic risks. On

the other hand, it has been experienced that high leverage ratios may lead to country-based or global crises. Within the scope of our study, developing countries with financial fragility and high growth potential are discussed. According to results of Turkey, Brazil and South Africa, it is seen that after the increase in policy interest rates for each country, banks increased their leverage ratios and consequently the macroeconomic risk increased.

The banks' high leverage ratios are an important component of macroeconomic risk. As a result, it is seen that the increase in leverage ratios increases the country risk. In this context, it is seen that policy makers can manage country risk through leverage ratios. In other words, risks arising from leverage ratios can be managed with monetary policy strategies. It is observed that monetary policy strategies can affect leverage ratios, which is an important financial risk component, and thus macroeconomic risk can also be affected. This effect reaches its highest level during the crisis period for these countries. In other words, considering the characteristics of developing countries, it is seen that monetary policy can be used effectively to manage country risk and financial risk in times of crisis. Another important point here is that the efficiency of monetary policy reached its highest level during the crisis period. When the literature on unconventional monetary policy instruments, it is seen that there is a common opinion that the policy strategies of developed countries' central banks lose their effectiveness, especially in times of crisis. On the other hand, there is no common opinion regarding developing countries. In this context, the results obtained from our study show that monetary policy has the highest efficiency in managing financial risks during crisis periods.

In the risk-shifting channel of monetary policy, there is a positive relationship between policy rates and bank leverage. In this model, there is an asymmetric information between banks and their borrowers. Thus, the asymmetric information problem protects the banks creditors from the pricing risk at the margin. The stronger this effect the higher bank capitalization rate. In other words, the effect of monetary policy on risk taking behaviour will be powerful by the degree of bank capitalization. The higher policy rates increase bank risk appetite with increasing the cost of banks' liabilities. Also, the bank can have a target level of leverage ratio, then the bank gets back to their target by increasing by buying riskier assets or expanding credit to riskier projects. According to this model, an increase in policy rates cause bank deposit interest rates. Since the deposit interest rates of banks increase, leverage rates and risk taking will increase with the poor managerial incentives. Thus, we concluded that in this study the risk-taking channel operates efficiently through risk-shifting model. Finally, developing countries with fragility can manage financial sector risks with their monetary policy strategy especially in times of crisis. For this, policy makers can introduce stronger banking standards such as the Basel III system to struggle with poor managerial incentives. In this way, they can prevent risk-taking behavior with high probability of negative consequences due to poor managerial incentives.

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