

A Review on Currency Shocks and Inflation Volatility: Evidence from a DCC-GARCH Model

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Abstract

In the present research, the relationship among the exchange rate and inflation in Turkey was investigated by considering the monthly dataset among 1990:1-2022:4 years. The consumer price index, producer price index, industrial production index, nominal exchange rate, and money supply are used as variables to represent inflation. Impulse-Response analyzes were used to find the short-term effects of the variables, decomposition of variance analysis for the causes of the changes in the variances of the variables, and the medium and long-term relationships of the variables in pairs were determined by DCC-GARCH models. While the models were being created, they were seasonally adjusted, and the inputs of the DCC-GARCH models were determined consequently the VAR analysis. In the results of the impulse-response analysis, it is seen that the reaction of inflation to the exchange rate shock is positive and lasts for five periods, after which the response fades. In the results of the impact-response analysis of the exchange rate, it has been determined that the reaction of the exchange rate to inflation has been stable for twelve periods. In the results of the variance decomposition analysis for inflation, at the end of twelve periods, 4.83% of the change in inflation was caused by the exchange rate; In the exchange rate variance decomposition analysis, it was concluded that 8% of the difference in the exchange rate was caused by inflation. While GARCH models show a negative interaction between inflation and exchange rate, DCC-GARCH results show that the permanence degree of short-term shocks between inflation and exchange rate is 0.43%. In addition, while a semi-strong GARCH process was found between inflation and money supply, a strong GARCH process was found between inflation and producer price index.

Keywords: Dcc-garch; exchange rate; inflation; impulse-response; variance decomposition

INTRODUCTION

The movements in the exchange rates significantly impact the macroeconomic performance indicators of the economies. The reflection of the volatility of the exchange rate on the economy is most evident in the stability of prices. From the perspective of developing countries, exchange rate shocks can affect inflation. Alterations in exchange rates in these economies have a significant influence on prices. When the value of foreign money versus domestic currency increases, the general level of prices also increases; when the price of foreign currency decreases in domestic currency, the general level of prices tends to decrease. Since developing countries such as Turkey are foreign-dependent, that is, production is dependent on imports, the change in foreign exchange enhances the imported inputs prices and production costs. It is essential to test the influence of the rate of exchange volatility on inflation, especially in countries where the exchange rate is constantly fluctuating. For this reason, the exchange rate is frequently used as one of the variables explaining inflation in the models established while conducting economic analysis.

Whether the volatility in exchange rates affects inflation, and if so, to what extent this effect is and how long this effect will last are very important in terms of the policies that countries will implement. How inflation responds to changes in exchange rates is essential for the post-inflationary period. Various exchange rate policies, such as exchange rate fluctuations and fixed exchange rate policies, have been implemented in Turkey in the past. After the 2001 crisis, a free-floating exchange rate policy was adopted in our country. Afterward, in 2022, the implicit inflation targeting system was introduced by the fact Central Bank to provide price maintenance, so since 2006, the explicit inflation targeting system has been adopted. If there is an inflation-targeting system in economies, the volatility in exchange rates should not be too high and be stable. Because the currency rate volatility can prevent reaching the inflation target (Ari, 2010).

The present study aimed to examine whether inflation impresses the currency rate in Turkey by using monthly data between the 1990:1 and 2022:4 periods. Due to the importance of price stability for our country, it is necessary to examine inflation and, since we are a country that is open to foreign countries and has a high demand for imported products, the volatility in exchange rates should be examined so as currency rate variances

will affect costs. Present study differs from other studies in that it consists of up-to-date data. It includes variables other than the exchange rate, which are effective on inflation, in the analysis. In addition, the study is essential in terms of the policies to be implemented due to the high monetary depreciation with the increasing current rate trend, especially in recent periods.

RESULTS

According to the impulse-response analysis, it was concluded that the reaction of inflation to the exchange rate shock lasted for five periods in the positive direction and the reaction decreased after five periods. As a result of the impact-response analysis for the exchange rate, it was determined that the reaction of the exchange rate to inflation remained constant for twelve periods. In the results of variance decomposition analysis for inflation, it was determined that 4.83% of the change in inflation at the end of twelve periods was caused by the exchange rate. In the exchange rate variance decomposition analysis, it was concluded that 8% of the exchange rate difference was caused by inflation. While the results of GARCH models show a negative interaction between inflation and exchange rate, DCC-GARCH results show that the persistence degree of short-term shocks between inflation and exchange rate is 0.43%. In addition, a semi-strong GARCH process was found between inflation and money supply, while a strong GARCH process was found between inflation and producer price index.

DISCUSSION

In this study, impulse-response and variance decomposition analyzes were performed first. According to the results of these analyzes, the inputs of the GARCH models were determined by looking at the responses of the variables. Then, the dynamic relationship between the binary variables defined by Dynamic Conditional Regression analyzes was examined.

CONCLUSION

Fluctuations in exchange rates cause changes in domestic prices, and this change is observed at higher rates, especially in underdeveloped countries. This change is called the transition effect. Due to the decrease in inflation rates after 1990, this transition effect started to decrease. In Turkey, which was examined in the study, the transition to the floating exchange rate system after 2000 and the implementation of inflation targeting policies continue, although the effect of the transition effect has decreased.

In our study, the response of inflation to these shocks in the face of a one-unit random shock in PPI, MS, and EXC according to the inflation impulse-response analysis was examined for a 12-period period, and it was seen that the response of inflation to the EXC shock was positive for five periods and then the response faded. It was determined that the response of inflation to PPI, MS, and IPI lasted for four periods and then decreased. As a result of the impulse-response analysis of the exchange rate, it was observed that it responded positively to the endogenous standard deviation shock, while the reaction to inflation was positive and stable for twelve periods.

According to the results of the CPI variance decomposition analysis, it was determined that although the most effective shock in inflation was itself, the effect decreased over time, and 2% of the change in inflation from the second period was caused by the exchange rate. However, at the end of the twelfth period, as 4.83% of the change in inflation was due to the exchange rate and 3.72% was due to the PPI, it was concluded that the main reason for inflation was demand inflation. It has been concluded that the money supply and industrial production index do not have a serious effect on the change in inflation in the short run and the effects of these variables on inflation show similarities in the short, medium and long run. In the results of EXC variance decomposition analysis, it was observed that approximately 8% of the change in exchange rate was caused by inflation and this effect decreased from the first period to 4% at the end of the twelfth period. This shows that inflation affects the exchange rate more in the short term, while its effect decreases in the medium and long term.

The GARCH models analyzed for CPI concluded that the exchange rate increase negatively affected the inflation change. Finally, the relationships between CPI-EXC, CPI-MS, and CPI-PPI were examined in DCC-GARCH models to determine the long-term relationships between the two series. According to the CPI-EXCH model, it was concluded

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that the short-term persistence time between the variables was 0.43%. The results of CPI-MS models, a semi-strong GARCH process was found, and a strong GARCH process was found in CPI-PPI.

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Tables and Figures

Tables

Table 1. GARCH Model Results

	CPI				EXC				MS			
	Equation of Mean		Equation of Variance		Equation of Mean		Equation of Variance		Equation of Mean		Equation of Variance	
	Coefficient	Z-stats	Coefficient	Z-stats	Coefficient	Z-stats	Coefficient	Z-stats	Coefficient	Z-stats	Coefficient	Z-stats
C	-0.004083	-2.827480			1.304261	34.58723			-0.030442	-	2.393078	
REXC	-0.000155	-0.289610							0.017400	5.005614		
DRMS	0.007806	0.421134			0.034733	0.633132						
DRPPI	0.168209	18.56608										
DRCPI					0.071861	3.518298			0.028199	1.056792		
DRCPI(-1)			0.005690	17.34316								
α_0			0.000252	4.059840			0.001094	2.633044			0.000428	4.075970
α_1			0.396224	9.305726			1.043881	6.953117			0.860859	12.35826
β_1			0.672718	21.96541			0.089053	2.083127			0.324037	8.774124
Obs.	375				375				375			
R^2	0.256363				0.982701				0.375974			
DW	1.634885				0.063798				2.367037			

Table 2. DCC-GARCH Models

CPI-EXC				
	Coefficients	Z-Stats	Prob.	AIC
ϱ_1	0.438091	8.197080	2.22e-16	-1.886954
ϱ_2	0.0026311	0.333520	0.738742	
Observations	387			

CPI-MS				
	Coefficients	Z-Stats	Prob.	AIC
ϱ_1	-0.030913	-7208.790	0.000000	-4.548526
ϱ_2	0.874413	7785.486	0.0000	
Observations	387			

CPI-PPI				
	Coefficients	Z-Stats	Prob.	AIC
ϱ_1	0.130351	329566.9	0.000000	-3.146827
ϱ_2	0.876002	173156.6	0.0000	
Observations	387			

Figures

Figure 1. Impulse-Response Analysis of CPI

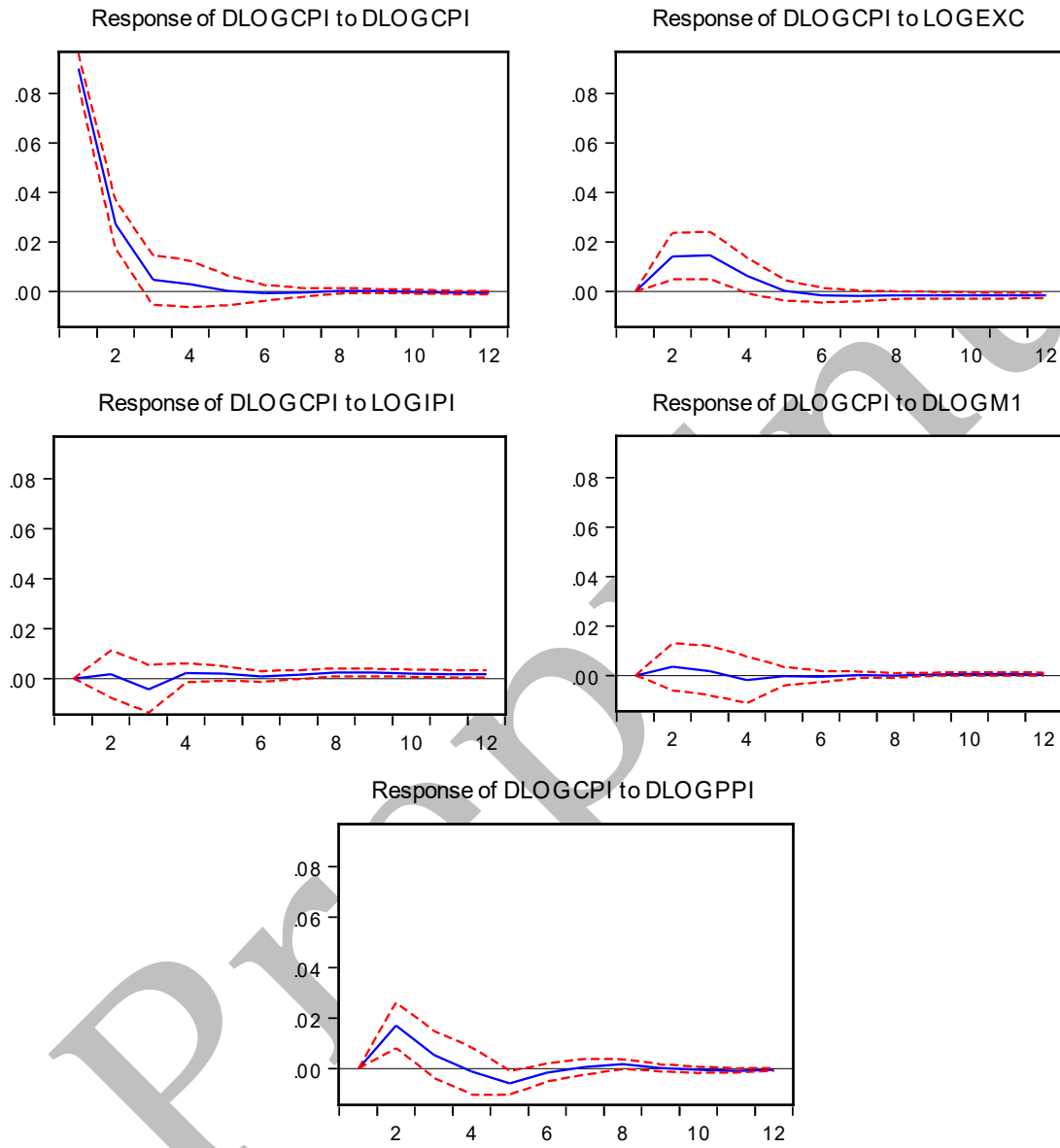


Figure 2. Impulse-Response Analysis of EXC

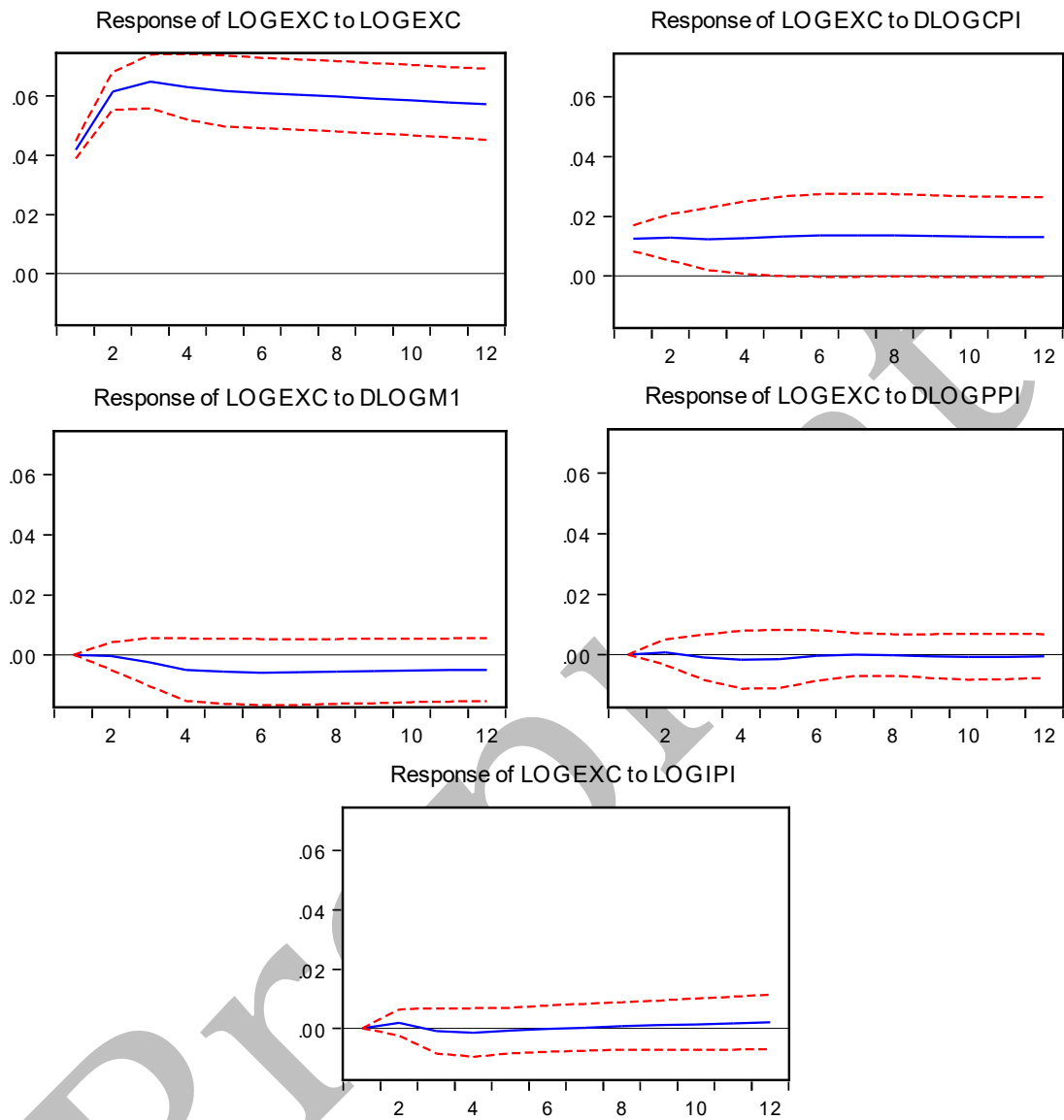


Figure 3. Impulse-Response Analysis of M1

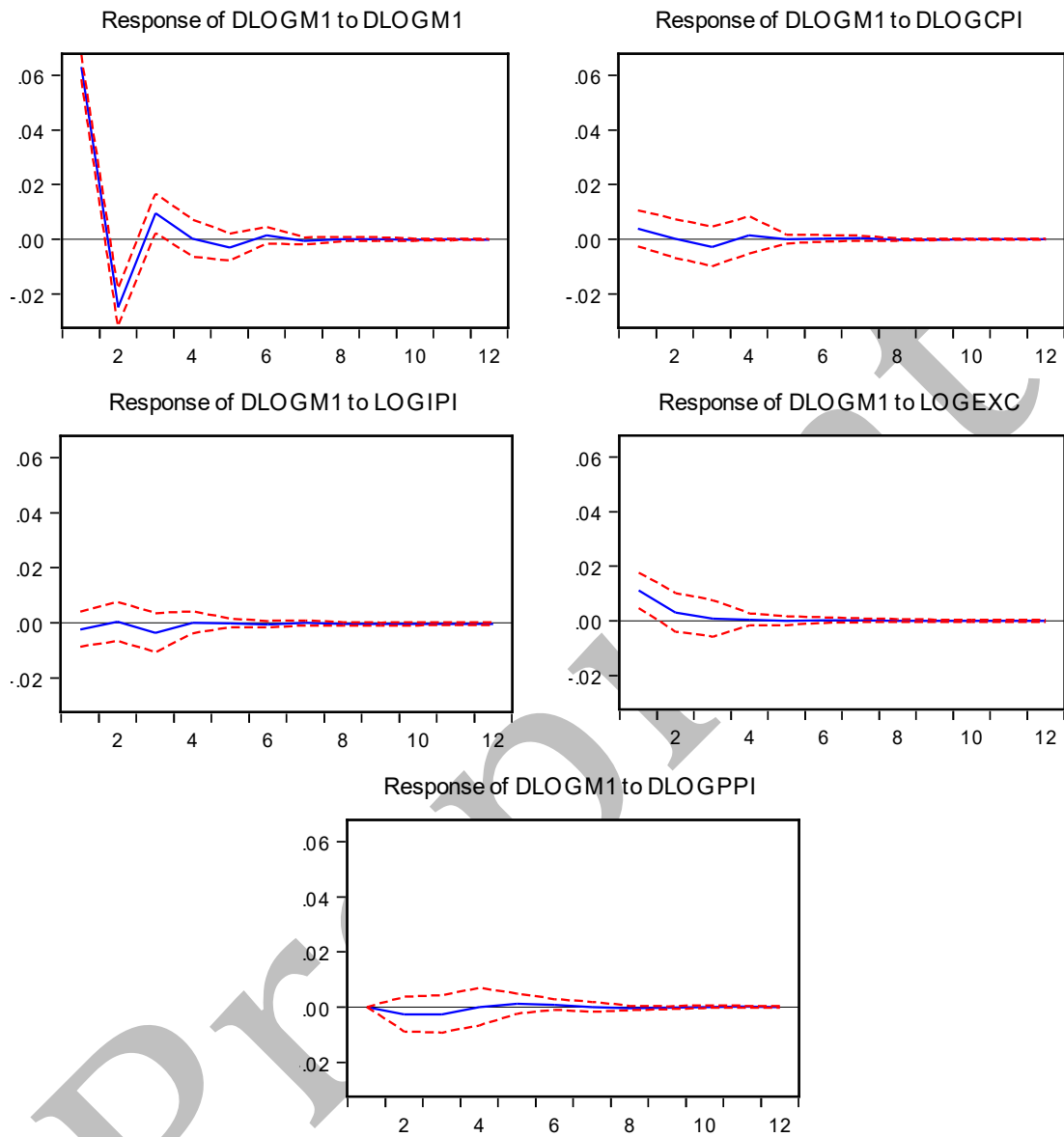


Figure 4. Impulse-Response Analysis of PPI

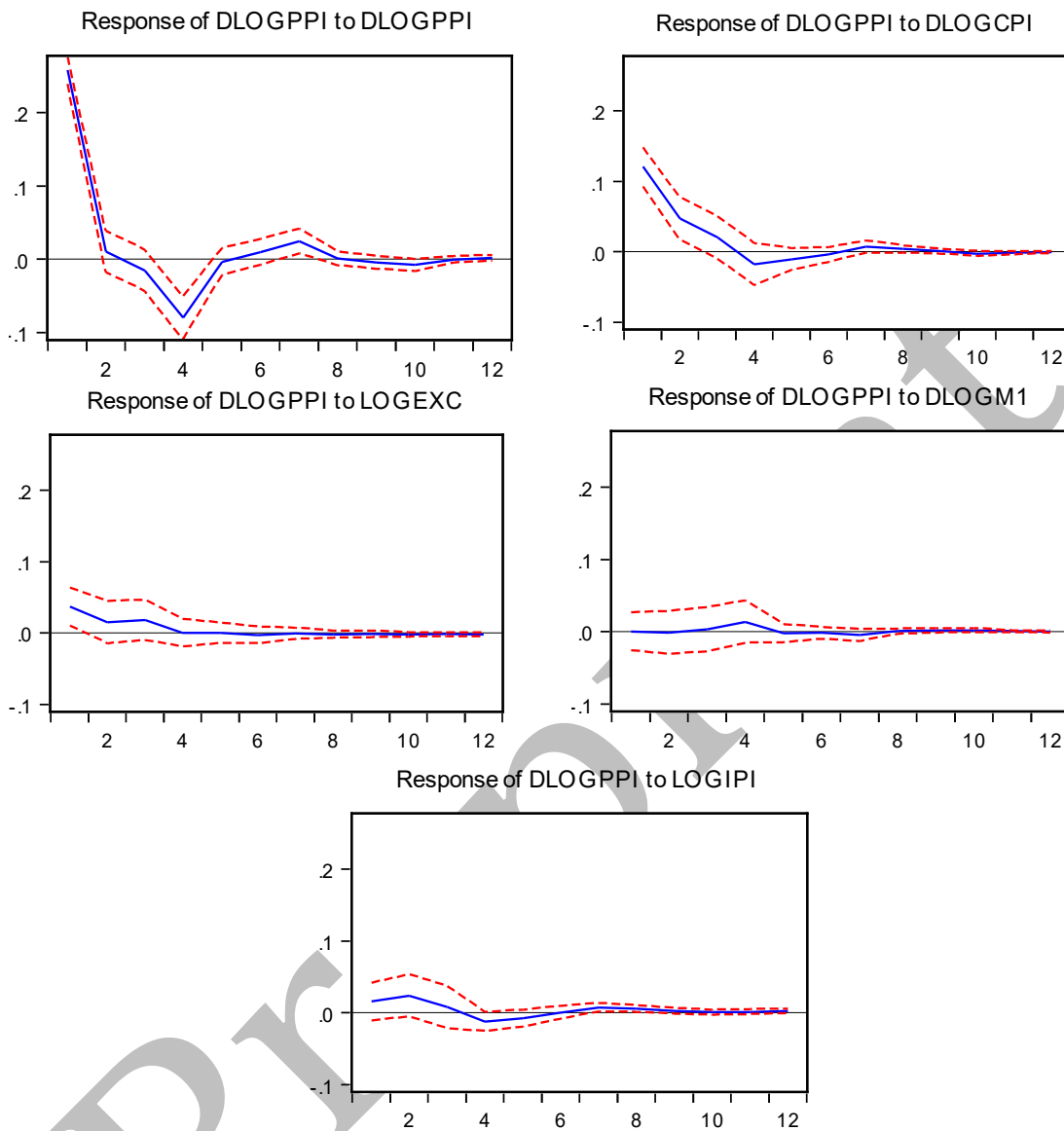


Figure 5. Impulse-Response Analysis of IPI

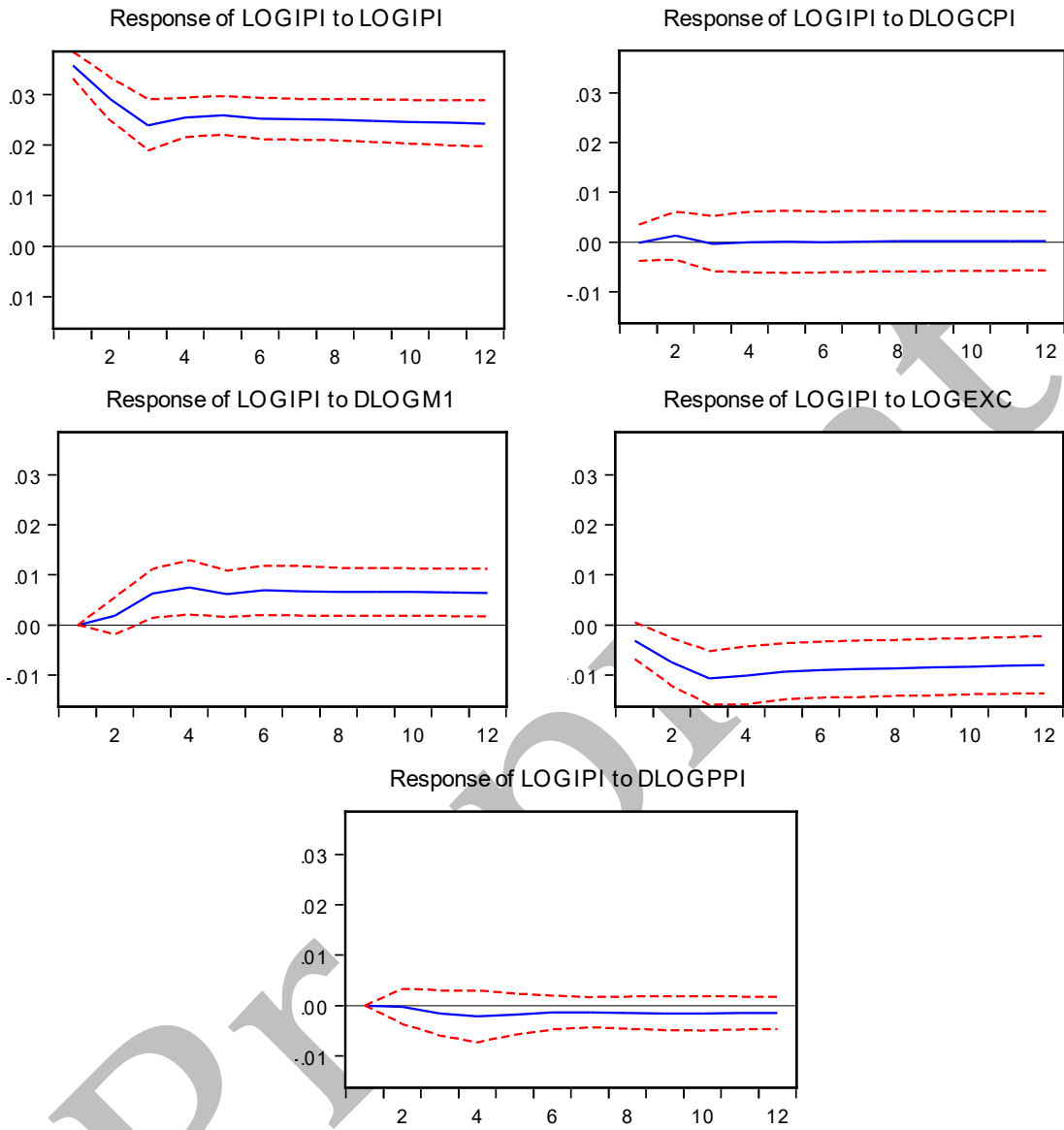


Figure 6. Variance Decomposition Analysis of CPI

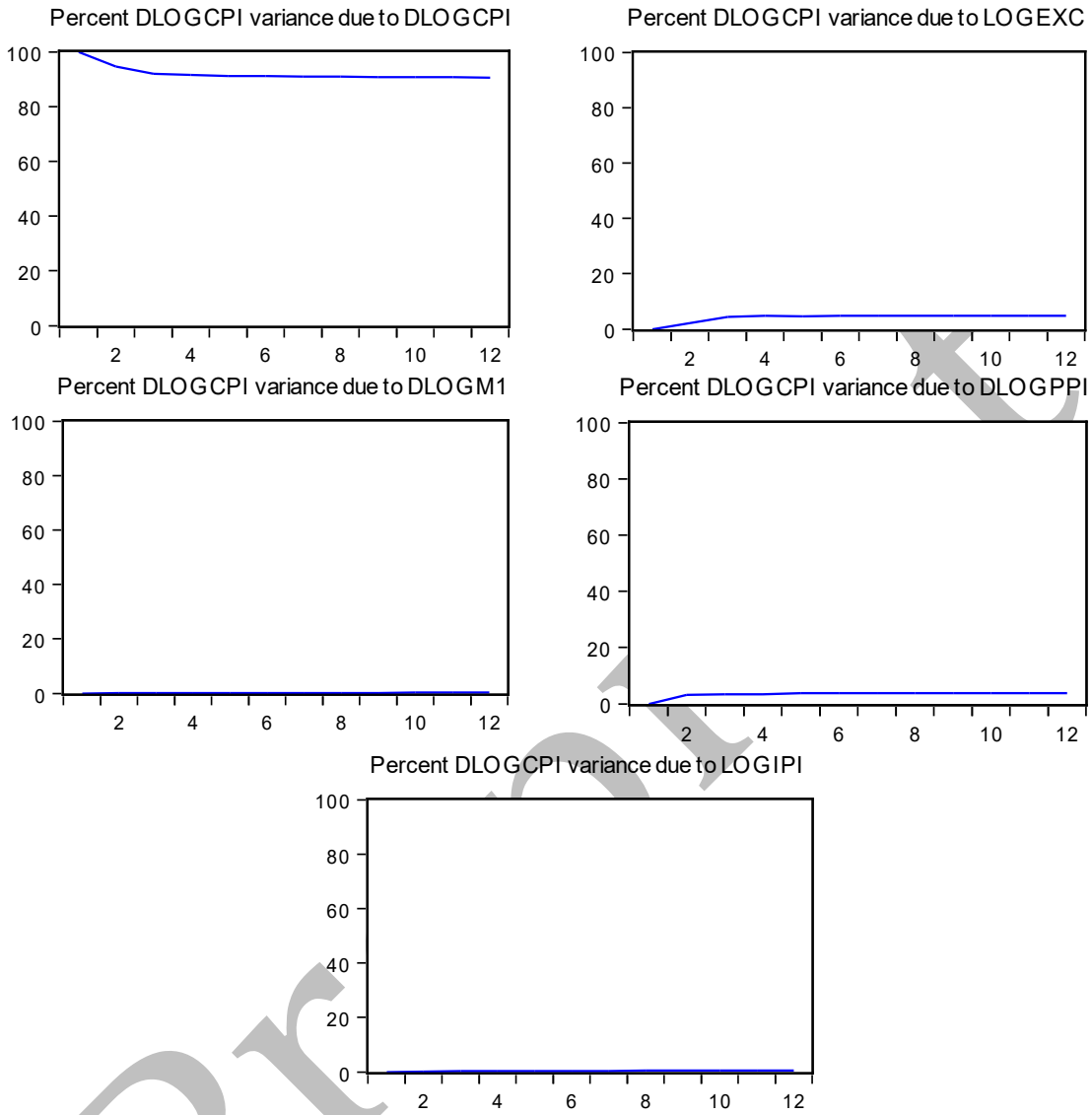


Figure 7. Variance Decomposition Analysis of EXC

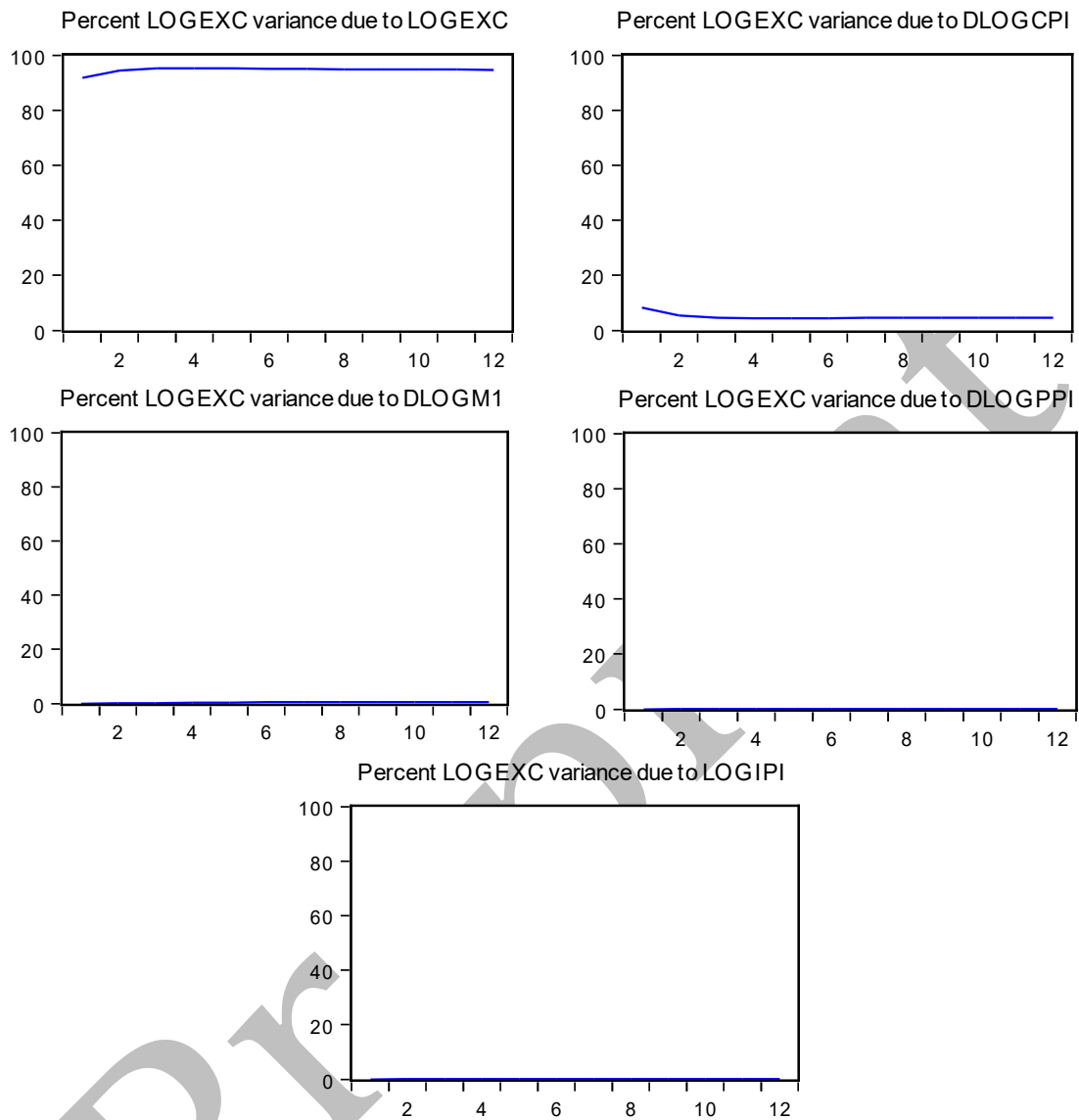


Figure 8. Variance Decomposition Analysis of MS

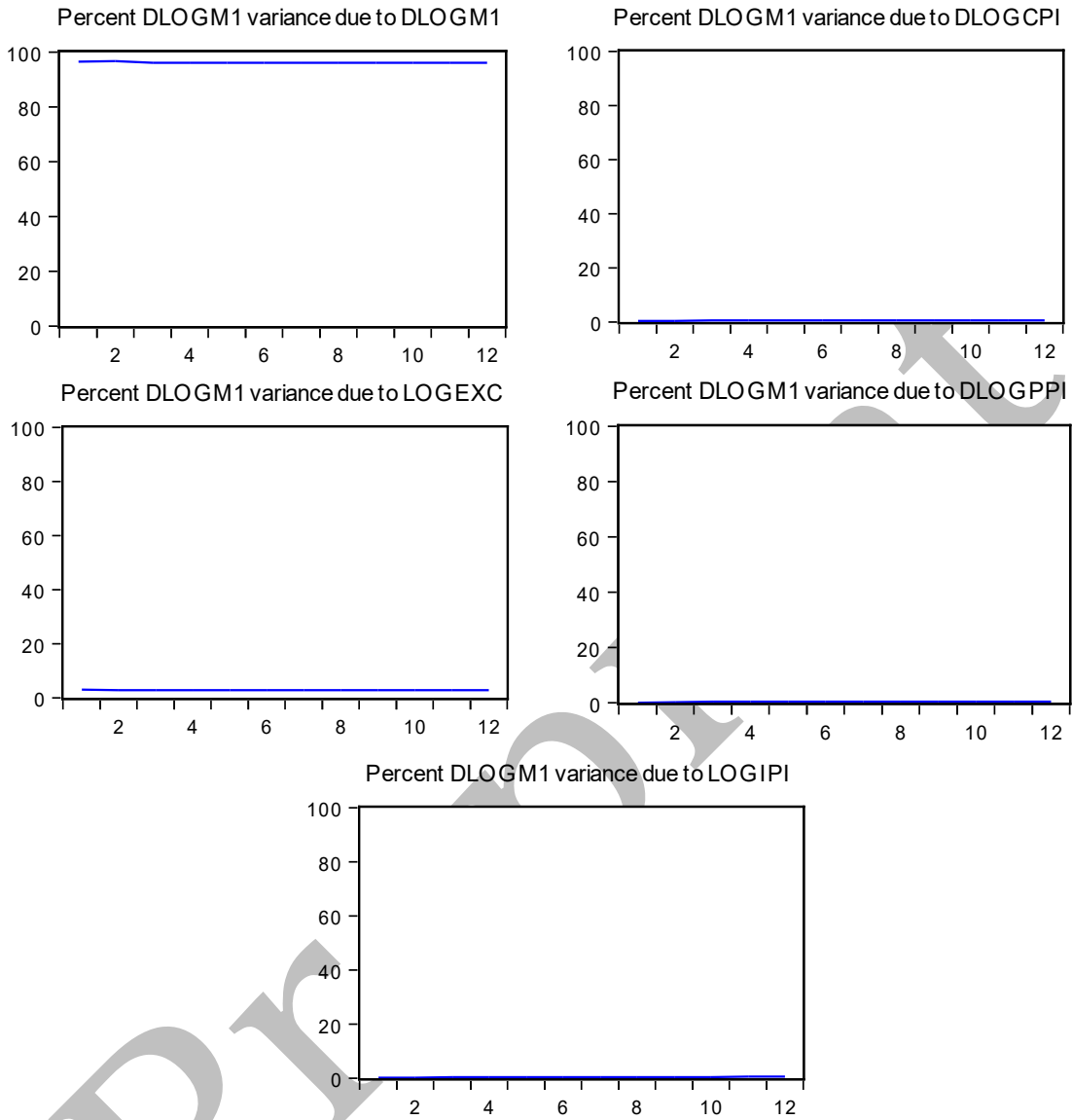


Figure 9. Variance Decomposition Analysis of PPI

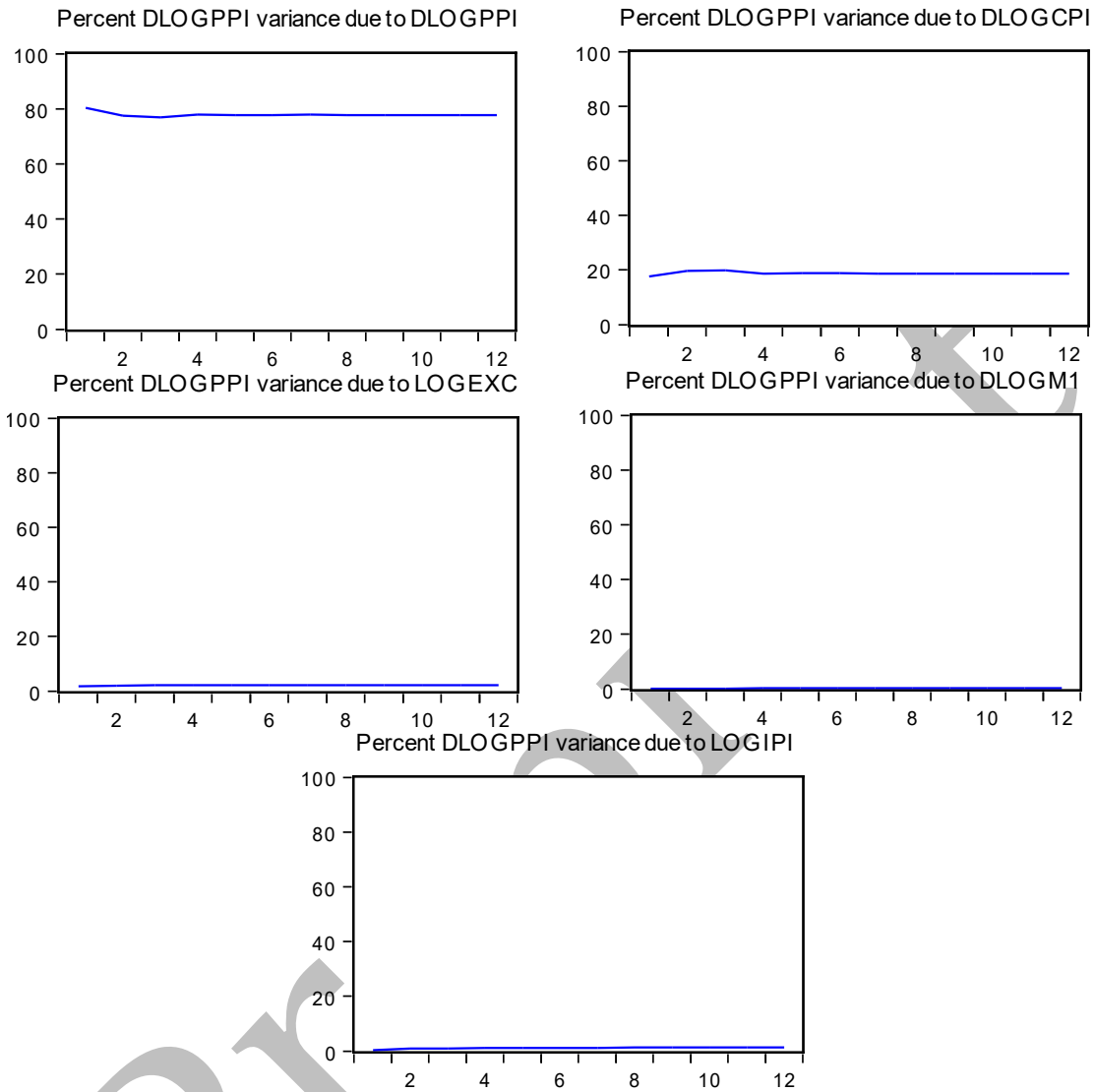


Figure 10. Variance Decomposition Analysis of IPI

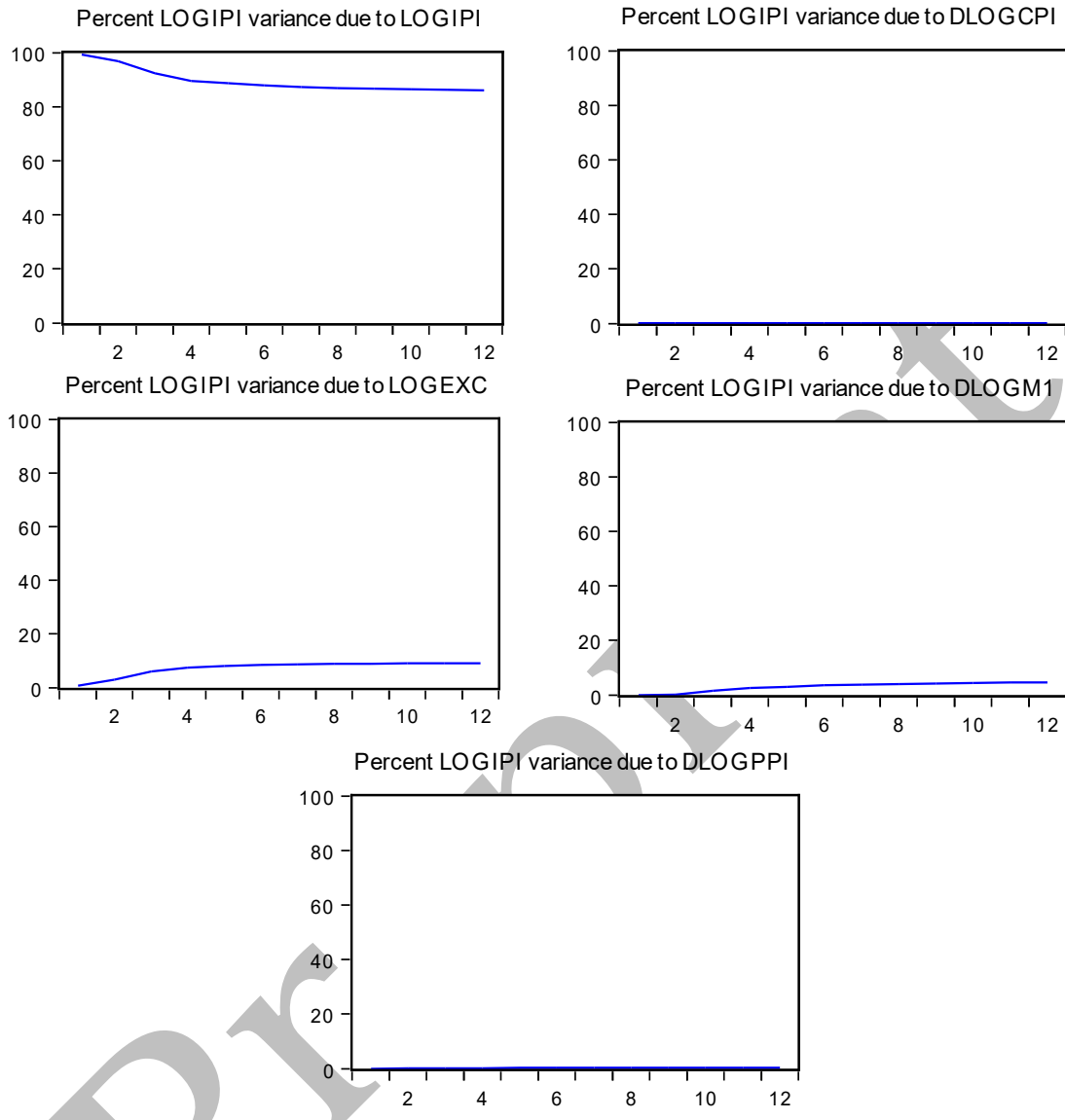
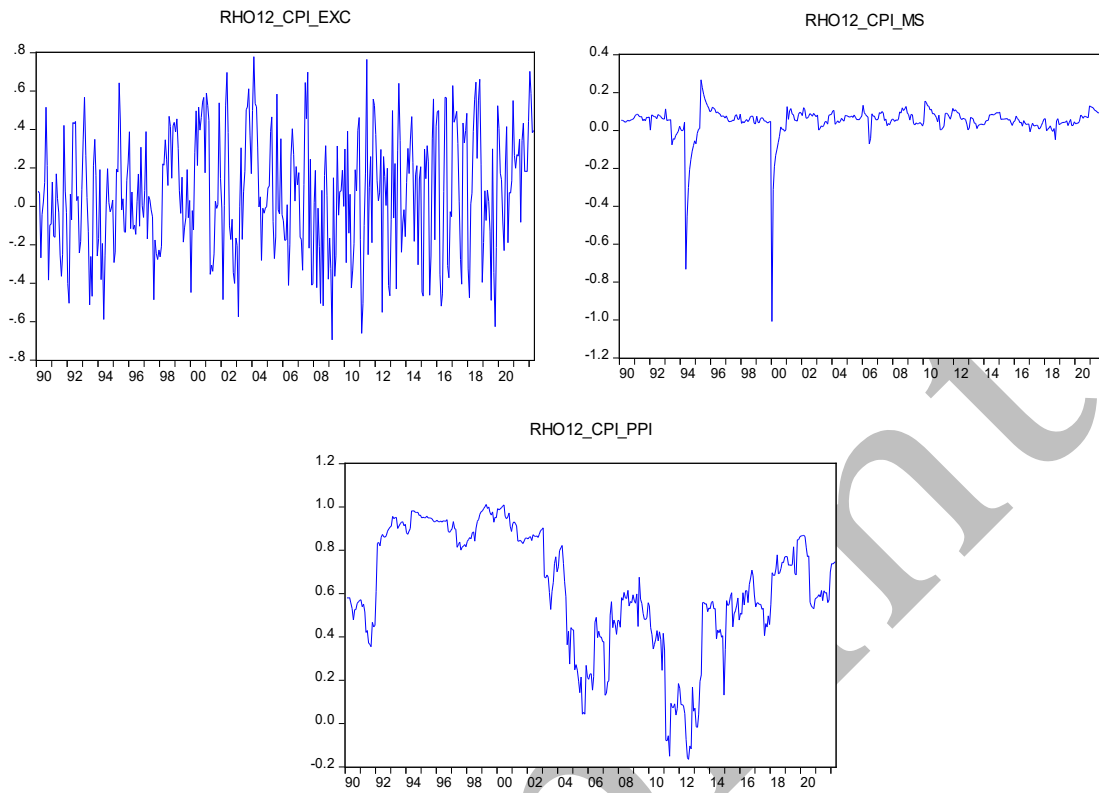


Figure 11. DCC-GARCH Graphs



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