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An analysis on the housing price channel: The case of BRICT

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Abstract. The asset prices channel, as one of the transmission channels of monetary policy, refers to the process of changing aggregate demand level by affecting the asset prices of a change in the central bank's monetary policy decisions. There are 3 basic components of the asset price channels: stock price channel, housing price channel and exchange rate channel. In this study, the operation of the housing price channel is investigated by applying Panel VAR analysis. For this purpose, the data between 2009Q1-2017Q4 period for BRICT countries are analyzed and tested. The findings show that the housing price channel is operating in these countries. The study consists of three parts. In the first part, the operation of the housing price channel is explained. In the second part, the literature research and in the third section, the empirical analysis are emphasized.
Keywords. Monetary transmission mechanism, Asset price channel, Stock price channel, Housing price channel.
JEL. O18, R21, R30, R31.

1. Introduction

Monetary transmission mechanism explains how an economy reacts to a monetary shock (Meltzer, 1995: 49). Transmission channels of monetary policy are analyzed under four groups: These are the interest rate channel, credit channel, asset prices channel and expectation channel. Interest rate channel processes through short term real interest rates; credit channel mechanism works through the amount of loan supply; asset prices operate through share prices, housing prices and exchange rates. Finally, expectation channel mechanism operates through the expectations of economic units relating to future.

Asset prices channel can be defined as the change in aggregate demand level by a change in monetary policy decisions of the central bank by affecting the asset prices (Erdoğan, 2011 :50). Asset prices channel has 3 main subcomponents: The first of one is the stock prices channel; the second one is housing prices channel; the third one is the exchange rate channel (Mishkin, 2001: 1). This research focused only on the housing prices channel.

Housing prices channel can be defined as real output and price level changing process by a change in monetary policy decisions via affecting housing prices,

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household investments, and consumption. Modigliani's lifecycle approach is effective in the process of housing prices (Milcheva & Sebastian, 2010: 3)

By making changes in short term interest rates, monetary policy affects the housing prices. Any change in interest rates will result in a direct change in the user cost of capital, housing supply and expectations of future house prices. Interest rate changes have also indirect effects on housing market such as wealth effects because of increasing/decreasing prices of houses, consumption changes and balance sheet changes. Direct effects such as the effects of capital utilization cost, interest rate and income effect, and indirect effects like housing and rent incomes as well as collateral effects affect investments and expenditures of firms or households. Direct and indirect effects of short term interest rates on the housing market and economic activity can be analyzed in four different ways (Mishkin, 2007: 5):

- *Direct Effects on Housing Expenditure:* Since long term interest rates are associated with the future short term rates; long term interest rates show a tendency to increase when the short term interest rates increase. Accordingly, user cost of capital increases and the capital asset demand decreases at the same time. The decrease in capital asset demand causes a decrease in investment expenditures towards these assets and this results in a reduction in total spending and demand (Boivin, Kiley & Mishkin, 2010: 9). Contrary, when an expansionary monetary policy is conducted, user costs of capital are lowered by the short and long term interest rates decrease. Finally, total investments and the total demand increase.
- *Expected Appreciation of Housing Prices and Interest Rate Effects:* Interest rates increase after a tightening monetary policy. This results in the user cost of capital increase via transmission mechanism and the housing demand decreases. As a result, housing prices decrease. Since the expected real appreciation ratio of housing prices decrease because of the future monetary policy tightening expectations, the user cost of capital will increase and there will be a decrease in demand for the housing and house construction. Naturally, a decrease in existing housing prices increases the housing demand by pegging user cost of capital; expected real rate of appreciation is pegged at the same time (Boivin, Kiley & Mishkin, 2010: 11). Contrary, expected real rate of appreciation increases when the interest rates decrease by applying an expansionary monetary policy. Finally, investments and total demand increase.
- *Effects of Interest Rate on Housing Supply:* Lower short term interest rate leads mortgage interest rates to decrease; housing prices also increase to provide supply and demand equilibrium. As a result of this process, since the transaction costs of housing collateral increase, lenders allow credit-restricted consumers to borrow more. Consequently, aggregate demand is stimulated. However, this process neglects the key features of the effect of monetary policy on the housing market: Borrowers' demand to credit increases faster than housing prices after an expansionary monetary policy. Thus, mortgage credit/value ratio increases after a monetary expansion. Secondly, a temporary decrease by 1% in policy interest rate not only increases transaction costs by 3% but also causes an increase in monthly housing sales by 20%. Sales volume of the housing market is generally more explicit than the emphasized price reaction. And generally, if borrowers do not fulfill their responsibilities, lenders apply collateral for its resale value. A high ratio of housing sales increases liquidity value which depends on costs those are necessary to find a buyer before moment of foreclosure and the final price at which the house is sold again to a new buyer. It is a fact that as housing sales rate increases, cost of foreclosures decrease. Because of that, while housing sales increase, there will be higher housing liquidation values and greater housing debt capacity by higher housing transaction prices. This brings an approach that monetary policy may cause

leverage ratios to reach a level that lender are ready to accept (Ungerer, 2015: 2).

- *The Wealth Effect of Housing Prices on Consumption:* In industrialized countries, housing activities occupy a great proportion of GDP and households' expenditures. Furthermore, housing is the main component of assets and the basic liability of the mortgage loan of households in those countries. Therefore, large housing price movements may have significant macroeconomic effects by affecting net wealth and loan and spending capacity of the households (Otrok & Terrones, 2005: 2).

There are two basic ways of high asset prices that can increase the demand. The first way is to enhance the attractiveness of new residential and nonresidential investment projects by increasing the market value of companies via replacement cost of capital by higher asset prices. This mechanism is so-called as Tobin's Q. The second way is that high asset prices increase the wealth of household. This stimulates consumption if it is thought that this is permanent. Besides, increasing wealth can be used as collateral to provide with intertemporal substitution (Mohanty & Turner, 2008: 13).

In brief, changes in housing prices affect the total economic activity. Any increase in house prices will be compensated by an increase in the opportunity cost of housing services. An increase in housing prices does not always convey a shift of budget constraints outwards. Instead, house price changes may lead redistribution of wealth, but not an increase in aggregate. Accordingly, housing prices are taken into consideration by policymakers and economists. It is assumed that consumption growth generally becomes more important if the housing prices increase rapidly. Synchronization of housing prices and consumption is majorly connected with expectations. If consumers are optimistic about future expectations, they can increase the consumption of housing and nonresidential goods. Individuals buy house with complementary goods like furniture and etc. Above all, housing prices may have a direct effect on consumption via credit market effects. Dwellings can be evaluated as collateral for landlords. An increase in housing prices can enhance the housing demand by making more collateral utilizable for the homeowner (Aoki, Proudman & Vlieghe, 2004: 9) .

In this vein, the direct and indirect relationship between housing prices and the volume of economic activities increases the importance of studies related to housing price channel. Thus, it should be determined to what extent housing prices are affected by the policy implementations. The purpose of this econometric research is to analyze the relationship between housing prices and monetary policy. The findings of this analysis can be used as the data source for decision makers.

The paper is composed of three parts. In the first part, the housing prices channel mechanism is explained. After the literature survey in the second part, the findings of empirical analysis are analyzed in the third part.

2. Literature

Goodhart (2001), Bernanke & Gertler (1999, 2001), Filardo (2001), Cecchetti *et al.,* (2000), Goodhart & Hofmann (2001) emphasized on the asset prices channel in their studies; they also analyzed the relationship between asset prices and output/inflation.

Literature has several studies on asset prices which cover single country analysis or panel analysis cover more countries. VAR and Panel VAR methods are generally used in analyses. Some of the articles about BRICT countries can be seen in this literature research. Gupta, Jungilas & Kabundi (2010) investigate the effect of monetary policy on real house prices in South Africa using data of period 1980:1-2006:04 by factor augmented vector auto regression (FAVAR) methodology. The

results stated that the monetary policy shocks affect house price inflation negatively. Koivu (2012) scrutinized wealth channel in his article about the effects of asset prices in China on the economy. Structural VAR analysis was utilized to review the dynamic interactions between monetary policy, asset prices, and expenses. With reference to findings, while a shock that happens in housing prices prominently increases the household expenditures, the effect of a shock in share prices is lower. In conclusion, the wealth effect is a weak channel just as being in developed countries. Xu & Chen (2012) analyzed the effects of the main monetary policy variables in the long term interest rates, money supply growth and mortgage credit interest on housing prices in China. Quarterly and monthly data of the 1998-2010 period were utilized for this purpose. While the empirical results show that expansionary monetary policy is in the tendency to accelerate the increase in housing prices, the growth in housing prices is in the tendency to slow down after the restrictive monetary policy. These results prove that monetary policy changes in China are the main driving force behind the increase in housing prices. Moreover, according to another result, cash flow has not a remarkable effect on the change in housing prices by controlling the growth in the money supply. Singh & Pattanaik (2012) used structural VAR analysis to review the interactions between monetary policy and asset prices in India. While the asset price channel of monetary policy can prominently be seen in empirical results, there is no evidence about an intervention for developments in asset prices by the monetary policy. Besides, with reference to impact-response analyses results, asset prices have no effect on inflation. Shocks in interest rates cause a decrease in aggregate output and loan demand. Despite the effect of a change in interest rates on the asset prices, the changes in asset prices do not affect the interest rates. It is understood that monetary policy does not react the asset prices; however, asset prices channel works. Ratti & Vespignani (2015) used structural factor augmented error correction (SFAVEC) model to analyze the effect of liquidity on commodity prices between 1999- 2012 for BRIC and G3 countries. They used global variable for global interest rates, global industrial production, global CPI index, global commodity prices and M2 aggregates. The effect of liquidity on commodity prices in BRIC countries is larger than in G3 countries. Positive shocks have larger effects on energy prices, mineral and metal prices and raw material prices in BRIC countries. Cunha (2017) scrutinized the transmission of monetary policy in Brazil through the wealth channel. The author researched wealth effects through public debt, share prices and housing prices. While the findings show that public debt and stock market wealth effect results are insignificant, housing prices have an important role in the transmission of monetary policy via wealth channel. Yang, Wu & Shen (2017) investigated the relationship between monetary policy, house prices and consumption in China by panel vector auto regression model (Panel VAR). They used consumption, household income, house prices, 7-day CHIBOR rate and M2 variables for quarterly data of 2004-2010 periods. The results stated that monetary policy instruments have significant effect on private expenditure of households with a regional pattern. In middle southern and western cities the monetary policy's effect on consumption is significant, however house prices have minimum contribution to monetary policy. In the Tier1 (cities with much a higher price level than all the other cities) and eastern cities house prices play a more important role in monetary policy transmission. Besarria, da Silva & de Jesus (2018) developed a dynamic stock general equilibrium to research the reason for the increase in housing prices in Brazil. Related research analyzed the hypothesis called "a general optimism about government policies toward housing industry supports the behavior of the housing prices". Results show that subventions which are accompanied by alleviating credit terms may positively affect the housing prices.

Furthermore, unexpected shocks have less influence on housing prices in comparison with the expected shocks. Erdoğan & Yıldırım (2014) researched the process of housing prices channel in Turkey for the period of 2010:1-2013:6 via the monthly data and VAR analysis. It is seen when impact-response analysis results are analyzed that housing prices do not react to the changes in the policy interest rate in the related period. According to the findings, the housing price channel does not efficiently work in Turkey in the related period. Mercan & Canbay (2017) also empirically analyzed the process of asset prices channel in Turkey. The effectiveness of housing prices channel was reviewed by quarterly data of 2010Q1-2016Q3 period by the help of VAR analysis method. Their findings prove the presence of housing prices channel in accordance with the literature. Darıcı (2018) reviewed the effect of changes in monetary policy in Turkey on the housing prices by ARDL model; monthly data between the years of 2010 and 2016 were used for this purpose. Findings showed the presence of a statistically significant and positive relationship between the variables. These findings reveal that expansionary monetary policy creates a housing prices-increasing pressure. In this process, financial instability may occur in case of occurring a balloon as the result of being composed more credit by banks to increase the profitability ratios.

3. Empirical analysis

In this study housing prices - GDP relationship of 5 developing countries, Brazil, Russia, India, China and Turkey, so-called "BRICT" countries, are investigated using panel data analysis. For this purpose, an empirical model has been formed by using quarterly data of period 2009:Q4 – 2017:Q1 belonging to these five countries. The variables included in the analysis are the housing price index (HPI), real credit used by the private sector from banks (CRE), industrial production index (IPI), interest rates (INT) and consumer price index (CPI). The real credit is calculated by the logarithm of total credit volume/CPI ratio.

The model created to implement the panel analysis can be shown as follows:

$$IPI_{it} = \alpha_i d_t + \beta_{1i} CPI_{it} + \beta_{2i} INT_{it} + \beta_{3i} HPI_{it} + \beta_{4i} lnCRE_{it} + u_{it}$$
$$u_{it} = \gamma_i f_t + \varepsilon_{it} \quad (1)$$
$$i = 1, \dots, N; \; t = 1, \dots, T$$

As a homogeneity test, delta test (Pesaran & Yamagata, 2008) was used to determine whether the variables were homogenous and then cross section dependency between series was investigated. Since heterogeneity and cross-sectional dependency are found, the Durbin-Hausman panel test (DHp) was used to check whether the series were in co-integration. Panel VAR method was used to determine the relationship between housing prices and economic growth.

3.1. Homogeneity tests

In determining the appropriate unit root and co-integration tests to be applied in panel analysis, homogeneous and heterogeneous variables play an important role. Delta test and corrected delta test statistics which are developed for this purpose Pesaran & Yamagata (2008) calculated by the following formulas:

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

Corrected delta test statistics:

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

The results of the delta tests are shown in Table 1 below.

Table 1. *Coefficient homogeneity test results*

Test	
$\tilde{\Delta}$	21.803***
$\tilde{\Delta}_{adj}$	22.941***

Notes: * %10 degree of significance; ** %5 degree of significance; *** %1 degree of significance.

Delta test results show that the null hypothesis expressing the homogeneity of the coefficient is rejected and the slope coefficients of the units forming the panel are heterogeneous. Therefore, an estimator that takes into account the heterogeneity of the slope coefficient should be used.

3.2. Cross-section dependency and Unit Root Tests

A cross-sectional dependency test is performed to determine whether there is a relationship between the units in the panel. Breusch & Pagan (1980) LM test is the most well-known test for this purpose. The LM statistic can be calculated with the following formula:

$$\mathrm{LM} = \mathrm{T}\sum_{\mathrm{i}=1}^{\mathrm{N}-1}\sum_{\mathrm{j}=\mathrm{i}+1}^{\mathrm{N}}\hat{\rho}_{\mathrm{ij}}^{2}$$

Examining the cross-sectional dependency test results, cross-section dependency between units has been determined in the series in question. In this case, appropriate co-integration test should be used in cases of cross sectional dependency and unit root presence. Pesaran CADF unit root test was preferred to detect unit root. Pesaran (2007) proposed a simple method to eliminate correlation between units. The Pesaran approach assumes that error terms can be decomposed into common and volume-specific components, such as:

$$u_{it} = \gamma_i f_t + \varepsilon_{it}$$

Simple CADF regression can be defined as follows:

$$\Delta Y_{it} = \alpha_i + \beta_i Y_{it-1} + \gamma_i f_t + \varepsilon_{it}$$

H_0 hypothesis states that all series are stationary. It provides unit root analysis by t-test in heterogeneous panels with cross-sectional dependency. In this method, to eliminate the correlation between units, ADF regression extended with averages of lagged cross-sections and first difference of the series are taken. Particularly in the models in which linear trend and residuals have serial correlation the negative effect of time is filtered out (Pesaran, 2007).

According to the test result, although there is a unit root in the industrial production index, house price index, credit and CPI series, there is no unit root in the interest rates series. Since there is no trend in the interest rate series the Z[t-bar] statistics intercept with no trend results are considered. In this case, production index, house price index, credit and CPI series will be used in the analysis by taking the

first differences. The cross-sectional dependency of the series and the unit root test with 2 lags results are shown in Table 2 below.

Table 2. *CADF unit root test and cross-sectional dependency test results (Series at level)*

	Z[t-bar] intercept	Z[t-bar] Intercept+Trend	Breusch-Pagan LM	Pesaran scaled LM	Bias-corrected scaled LM
IPI	-0.102	1.098	185.64***	38.15***	38.07***
INT	-1.935**	-0.255	35.64***	4.61***	4.52***
HPI	0.639	-1.239	106.69***	20.50***	20.41***
CRE	-2.014**	0.796	107.07***	20.68***	20.50***
CPI	1.887	-0.198	288.76***	61.21***	61.13***

Notes: * %10 degree of significance; ** %5 degree of significance; *** %1 degree of significance.

3.3. Co-integration test

As there is a cross-sectional dependency problem in the series used in the analysis: for the panel co-integration tests, second generation co-integration tests which take into account the cross-sectional dependency should be used. Therefore the Durbin-Hausman Panel (DHp) co-integration test developed by Westerlund (2008) is used to check whether the series are co-integrated. This test allows the co-integration relationship to be tested in case the series are stationary at different levels. A further advantage of the test is that it also takes into account cross-sectional correlations in residuals. The test results are shown in Table 3 below.

Table 3. *Westerlund (2008) Durbin-Hausman co-integration test results*

	Model without constant and trend	Model with constant	Model with constant and trend
Durbin-H Grup	-1.796**	-1.382*	0.240
Durbin-H Panel	-1.281*	-0.209	4.052

Notes: * %10 degree of significance; ** %5 degree of significance; *** %1 degree of significance.

Group statistics work under the assumptions of heterogeneity in the panel. When we look at the values in the table, the null hypothesis which stated that there is no co-integration is accepted. This result means that there is no co-integration between variables. In this case, it is possible to apply the panel VAR model by stabilizing the series containing unit root.

3.4. Panel VAR analysis

In this section, the test results of the panel VAR model with the assumption of constant effects will be included in order to demonstrate the interaction of production index, house price index, short-term interest rates, private sector real credit and CPI variables that are thought to be in mutual relation. The series used in the panel VAR must be stationary. The equations which are based on the panel VAR model which is stabilized by taking the difference of variables having unit root, and which shows the effect of the lagged value of each variable on the current value are as follows:

$$\Delta IPI_{it} = \alpha_{1i} + \sum_{j=1}^{m} \beta_{11ij}\Delta IPI_{it-j} + \sum_{j=1}^{m} \beta_{12ij}\Delta CPI_{it-j} + \sum_{j=1}^{m} \beta_{13ij} INT_{it-j} + \sum_{j=1}^{m} \beta_{14ij}\Delta HPI_{it-j} + \sum_{j=1}^{m} \beta_{15ij}\Delta lnCRE_{it-j} + u_{1it} \quad (2)$$

$$\Delta CPI_{it} = \alpha_{2i} + \sum_{j=1}^{m} \beta_{21ij}\Delta IPI_{it-j} + \sum_{j=1}^{m} \beta_{22ij}\Delta CPI_{it-j} + \sum_{j=1}^{m} \beta_{23ij} INT_{it-j} + \sum_{j=1}^{m} \beta_{24ij}\Delta HPI_{it-j} + \sum_{j=1}^{m} \beta_{25ij}\Delta lnCRE_{it-j} + u_{2it} \quad (3)$$

$$INT_{it} = \alpha_{3i} + \sum_{j=1}^{m} \beta_{31ij}\Delta IPI_{it-j} + \sum_{j=1}^{m} \beta_{32ij}\Delta CPI_{it-j} + \sum_{j=1}^{m} \beta_{33ij} INT_{it-j} + \sum_{j=1}^{m} \beta_{34ij}\Delta HPI_{it-j} + \sum_{j=1}^{m} \beta_{35ij}\Delta lnCRE_{it-j} + u_{3it} \quad (4)$$

$$\Delta HPI_{it} = \alpha_{4i} + \sum_{j=1}^{m} \beta_{41ij} \Delta IPI_{it-j} + \sum_{j=1}^{m} \beta_{42ij} \Delta CPI_{it-j} + \sum_{j=1}^{m} \beta_{43ij} INT_{it-j} + \sum_{j=1}^{m} \beta_{44ij} \Delta HPI_{it-j} + \sum_{j=1}^{m} \beta_{45ij} \Delta lnCRE_{it-j} + u_{4it} \quad (5)$$

$$\Delta lnCRE_{it} = \alpha_{5i} + \sum_{j=1}^{m} \beta_{51ij} \Delta IPI_{it-j} + \sum_{j=1}^{m} \beta_{52ij} \Delta CPI_{it-j} + \sum_{j=1}^{m} \beta_{53ij} INT_{it-j} + \sum_{j=1}^{m} \beta_{54ij} \Delta HPI_{it-j} \sum_{j=1}^{m} \beta_{55ij} \Delta lnCRE_{it-j} + u_{5it} \quad (6)$$

i = 1,2,…,34 and t = 2009Q4-2017Q2.

Δ is the difference operator, j shows the appropriate lag length and u_{it} indicates the error terms. The analysis table showing the variable coefficients and standard errors according to the results of the Panel VAR analysis, which was established to determine the relation between the production index; housing prices, credit volume, interest rates and CPI data of the countries included in the analysis is given in Table 4 of Appendix 1. Impulse-response analyzes were performed to determine how much impact the %1 standard error shock has on variables used in the model. The resulting graphs are in Appendix 1. The graphs which show the impulse-responses of all the variables used in the model imply that each variable has the greatest response to a shock associated with itself. However it is observed that all variables are interacting with each other and 1 unit shock in one variable affects other variables. These results indicate that the housing prices channel is working in these countries.

4. Conclusion

The asset prices channel of the monetary policy has three basic components. The first one is the stock prices channel, the second is the real estate prices channel and the third one is the exchange rate channel. The operation of the asset prices channel is extremely important to see the effects of the changes in monetary policy decisions. When the monetary authority changes its monetary policy practices by taking into account the current economic conditions, it is important to define the impact of the change in the asset prices on the aggregate demand level for the effectiveness of policy implementations. In this study, the housing price channel which is a sub-topic of the asset prices channel has been examined in the BRICT countries. While the relationship between monetary policy and housing prices is considered, the reflections of monetary policy decisions on the housing sector are taken into consideration in the literature. Especially in economies where the housing sector has an important place within the volume of economic activity, accurate determination of the relationship between monetary policy and housing prices is important for implementing policy applications. The empirical findings of the relationship between short-term interest rate decisions and housing prices are evaluated as an important data source for policy makers. The findings from the empirical analysis show that the housing prices channel is working in the BRICT countries.

Notes

This paper is partially based on the ongoing PhD Dissertation with the title of *"The Effects of Monetary Policy on Asset Prices: Selected Country Cases"* at Istanbul Medeniyet University, Graduate School of Social Sciences.

Appendix

Table 4. *Panel VAR Analysis*

```
Panel (LSDV) vector autoregression              Number of obs      =       135
Group variable: country                         Number of groups   =         5

                                                Obs per group      =        27
```

Equation	Parms	RMSE	R-sq	F	P > F
IPI	15	7.5072	0.2056	2.693999	0.0052
INT	15	1.23633	0.9272	26.39882	0.0000
HPI	15	3.78085	0.1960	.7674552	0.6597
CRE	15	6.18085	0.1250	.9330559	0.5057
CPI	15	1.05247	0.4512	5.841581	0.0000

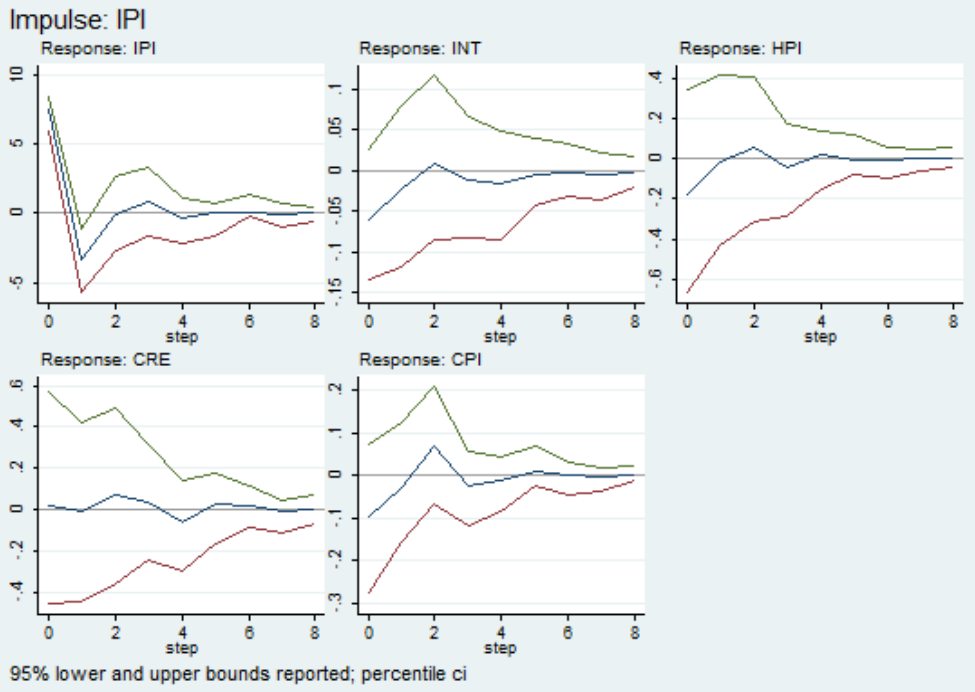

Figure 1. *Industrial Production Index Impulse-Responses*

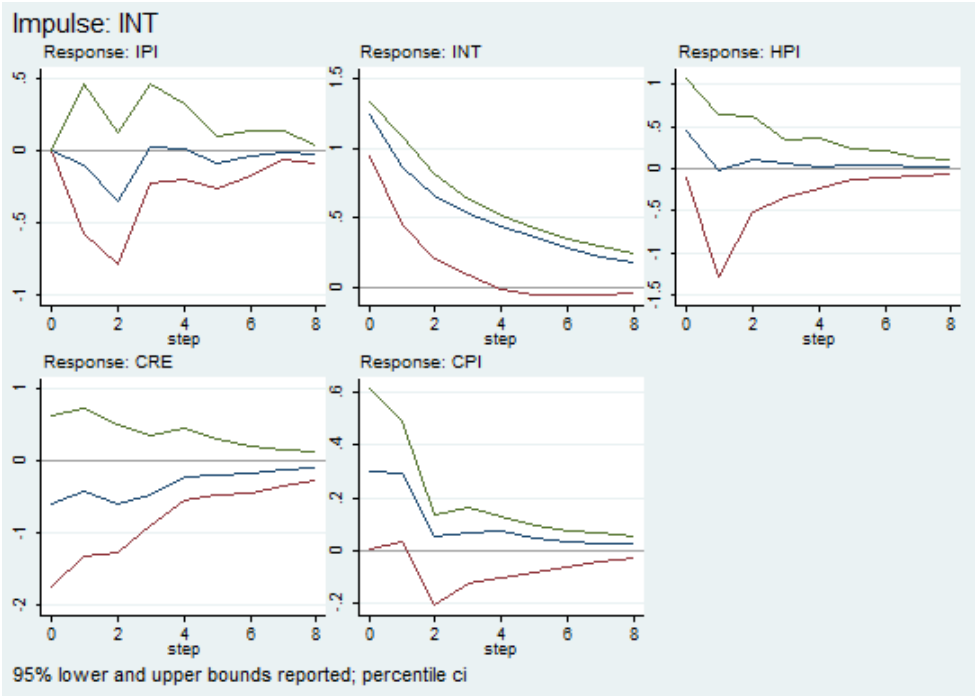

Figure 2. *Interest Rates Impulse-Responses*

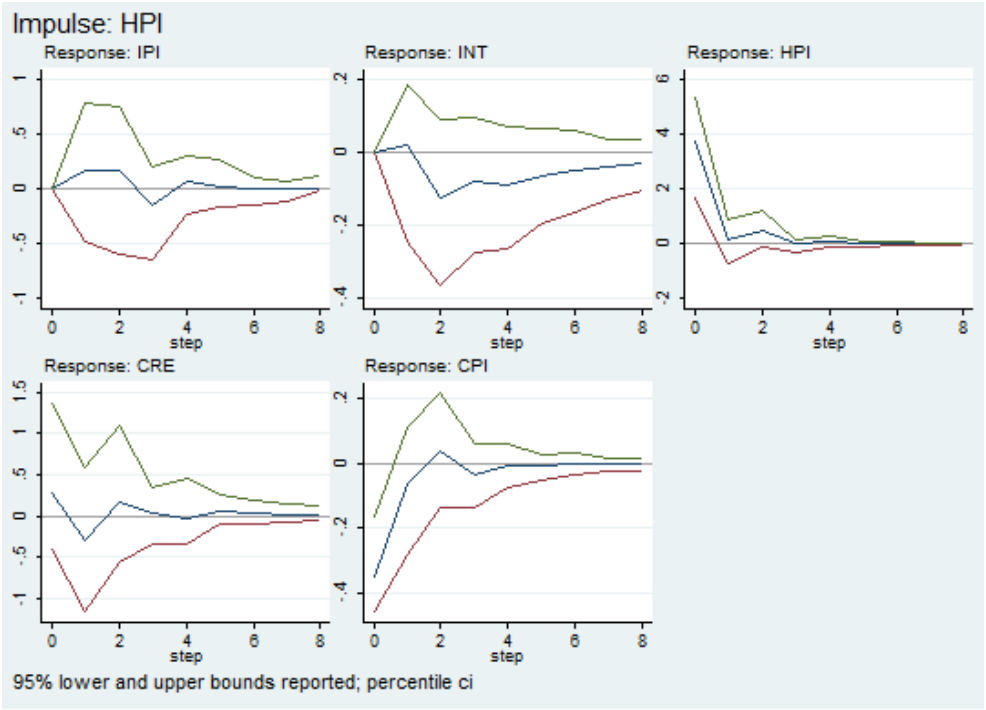

Figure 3. *House Price Index Impulse-Responses*

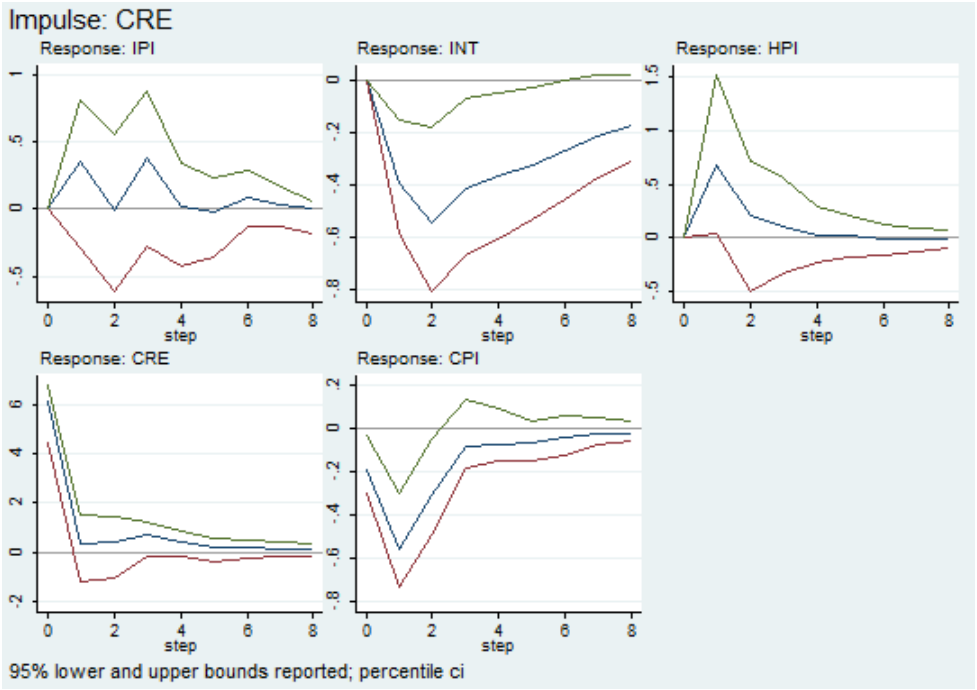

Figure 4. *Credit Impulse-Responses*

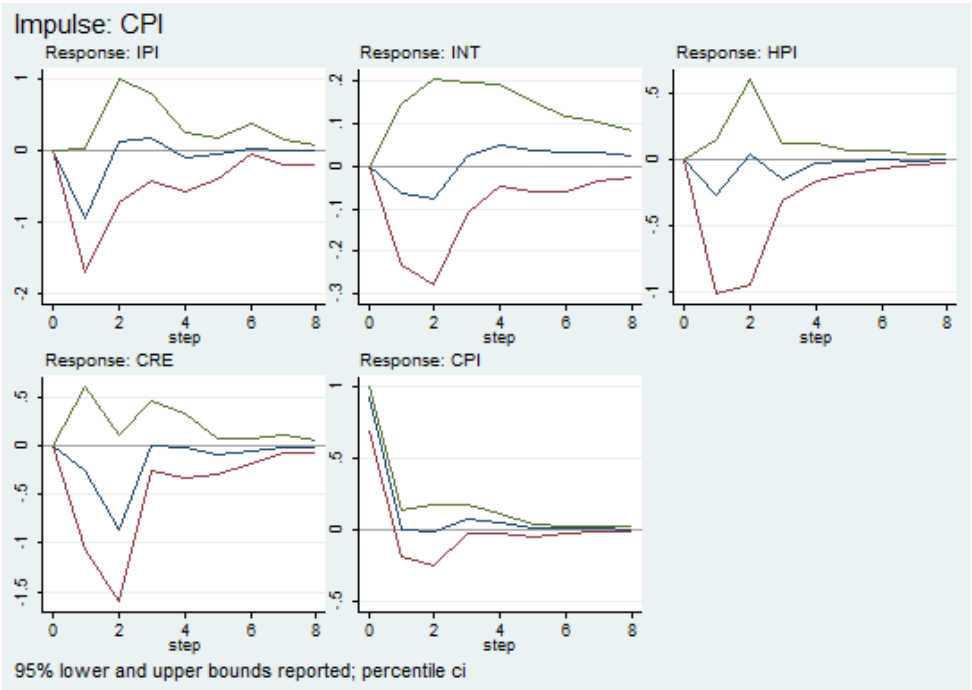

Figure 5. *CPI Impulse-Responses*

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