







Inflationary Effects of the Foreign Currency Shocks with Different Sources: The Response of Monetary Policy in a Developing Economy

Abdorasoul Sadeghi^{a,*} , **Hosein Marzban^a** , **Ali Hussein Samadi^a** ,
Karim Azarbaiejani^b , **Parviz Rostamzadeh^s** 

a. Department of Economics, Shiraz University, Shiraz, Iran

b. Faculty of Administrative Sciences and Economics, University of Isfahan, Isfahan, Iran

* Corresponding author, E-mail: abdorasoul.sadeghi@shirazu.ac.ir

Article History: Received: 02 May 2022, Revised: 21 August 2022, Accepted: 12 September 2022

Publisher: University of Tehran Press.

©Author(s).

Abstract

The inflation rate has constantly been volatile in Iran's economy. At the same time, the considerable fluctuations in the foreign exchange market, the inflationary environment and its impact on inflation expectations, the role of the central bank, and whether or not expectations are consistent with monetary policy indicate a likely correlation between these variables. Therefore, this study aims to investigate separately for different real sectors of an economy during the periods 2001:1-2010:4 and 2011:1-2018:4 whether Iran's economy was exposed to foreign currency shocks with domestic and external sources. Moreover, the responses of monetary policy to these shocks were examined using the vector autoregressive method (VAR). The results showed that the price index of all commodity groups increased in response to foreign exchange shocks, regardless of domestic or external sources. The inflationary effects of foreign currency shocks with domestic sources persisted in the medium and long term, while the inflationary effects of foreign exchange shocks with external sources were moderate in the medium term and neutralized in the long term. In addition, the speed of corrections in the deviation from a long-term equilibrium has significantly been greater after the shock of international economic sanctions than the policy of exchange rate unification. Monetary policy was expansionary and strengthened after the occurrence of the domestic-source foreign shock, and inflation expectations did not move in the same direction. On the other hand, monetary policy was contractionary and moderated the inflationary impact of the foreign currency shock, and inflation expectations went in the same direction.

Keywords: Exchange Rate Unification, Foreign Currency Shocks, International Sanctions, Monetary Policy, Price Index.

JEL Classification: C22, E31, F51, F59.

1. Introduction

The purchasing power of consumers is a crucial factor in the demand for consumer goods and, consequently, in the growth of production and the profitability of the

manufacturing sector. The stability of purchasing power is made possible by the stabilization of the general price level, considering that nominal wages are rigid during the term of the labor contract. However, the data published by the Central Bank of Iran show the significant fluctuations in the general price level and its instability in recent decades. These fluctuations have affected the welfare levels of many households, and moreover, have posed significant challenges to the manufacturing sector due to the instability of input prices and consumer purchasing power, which has negatively affected the demand and supply side. In this respect, the role of the central bank in terms of its share in stabilizing prices through the use of monetary policy instruments and accompanying economic agents' inflation expectations can potentially be effective if there is sufficient confidence in the objectives of its monetary policy.

On the other hand, structural weaknesses arising from the heavy dependence of the various real sectors of the economy on imports have always been a problem in Iran's economy, as the production sector is highly dependent on imported inputs and intermediates and the demand side is dependent on imports of final consumer goods. Thus, an important part of the monetary authorities' concern has constantly been the likely transition of the inflationary impact of exchange rate fluctuations on domestic prices, and more importantly, the monetary policy response to it (Ha et al., 2020). The issue discussed above is of particular importance to the Iranian economy because the exchange rate is fixed and the total foreign exchange reserves of the Central Bank of Iran are highly dependent on oil exports. Therefore, the probability of fluctuations in the foreign exchange market and their transition into the domestic inflation rate is remarkably high after any oil shock. Sadeghi & Tayebi (2018) have confirmed that the international sanctions on Iran's oil exports have greatly affected the inflation rate through the increase in the exchange rate. Garzon and Hierro (2022) also emphasize that the inflationary effects of a shock in oil price can transmit to domestic prices by the channel of exchange rate fluctuation.

The inflation rate has not shown a suitable condition in Iran's economy. After a change in political structure in 1979, it has experienced a single-digit rate only for 3 years. The same as the inflation rate, the foreign exchange rate also has faced an upward trend after 1979, and was accompanied by shocks with different domestic and abroad sources. In addition, Iran's statistical center and Customs show that the price indices of the goods groups having a major share in the consumer and producer price index, have also had a significant share in the whole value of imports. This point shows the existence of a probable relationship between being influenced of the price indices of these groups of goods by foreign currency shocks due to their foreign currency dependence. In addition, as pointed out above, Iran's economy experienced the different domestic and abroad sources of foreign

currency shocks. As recent studies state that the inflationary effects of foreign currency shocks depend on economic structures, the sources of the shocks, the response of monetary policy (Ha et al., 2022), and that various sectors of an economy can differently affected by foreign currency shocks (Osbat et al., 2021).

The above cases have thus led to some questions, the answers to which may explain the causes of the fluctuations in the general price level. Questions such as whether the structural weakness of a high dependence of the production and consumption sectors on imports transmits the inflationary effects of foreign exchange shocks to domestic prices? How were the prices of different commodity groups affected by the inflationary impact of foreign currency shocks? Does the source of the foreign currency shocks matter? Do the inflationary effects of the foreign exchange shocks with a domestic source differ from the inflationary effects of the shocks with an external source? Was the central bank's monetary policy tightened or weakened when the economy faced foreign currency shocks of domestic or external sources? Moreover, is there a likelihood of inflationary spillovers to domestic prices? Did economic agents' inflation expectations accompany monetary policy because there was confidence in the central bank' objectives? The purpose of the current paper is to answer these questions.

Previous studies have not paid enough attention to the likelihood that different commodity groups are affected to different degrees by foreign exchange shocks, given their degree of import dependence. Nor have they considered the possibility of differential effects on domestic prices of foreign exchange shocks of domestic or external source. Furthermore, the moderating or amplifying effects of monetary policy have not been assessed. That is why the contributions of this study aim to fill this gap.

The remainder of this paper is organized as follows. Section 2 reviews the literature on the subject matter. Section 3 addresses the empirical model, and Section 4 provides the empirical results. Section 5 discusses the results, and finally Section 6 concludes the paper, and gives some policy recommendations.

2. Literature Review

The pass-through of the impact of exchange rate fluctuations on domestic prices is terminologically referred to as the “exchange rate pass-through” (Cuitino et al., 2022; Osbat et al., 2021; Elnagger and Richter, 2021; Ha et al., 2020; Jiménez-Rodríguez and Morales Zumaquero, 2016; Comunale and Simola, 2018). It links the domestic economy to external or domestic sources of foreign currency shocks and, consequently, can transmit the inflationary effects of exchange rate fluctuations to exported and imported goods and, more generally, to consumer and producer price indices (Comunale and Simola, 2018). Shocks are sudden and unpredictable fluctuations that can originate from within or outside a country's

geographical boundaries (Ha et al., 2020; Kramarz et al., 2020). Confirming this issue and its significant importance, the extensive empirical studies have found a significant relationship in terms of the transition of inflationary effects of foreign currency shocks on domestic prices for different economies with different economic structures (Osbat et al., 2021; Aisen et al., 2021; Nasir et al., 2020; Ghartey, 2019; Kurtović et al., 2018; Helmy et al., 2018; Delgado et al., 2018; Forbes et al., 2018). Şen et al. (2020) found that there is a co-movement between exchange rate fluctuations and the inflation rate.

Yazdani (2018) found a significant direct relationship between exchange rate fluctuations and inflation rate. De Mendonça and Tiberto (2017) also concluded that there is a significant relationship between the inflation rate and exchange rate fluctuations. Sasaki et al. (2022) pointed out that the transition of inflationary effects of exchange rate fluctuation to the producer price index is negligible. While some historical events confirmed the inflationary impact of foreign currency shocks with the different domestic and foreign sources, others did not. The sharp depreciation of the British pound after the 2008-2009 financial crisis and after the January 2016 referendum on separation from the European Union led to a sharp increase in domestic prices. In contrast, the effects of an appreciation of the pound in 2015-2013 were not transmitted to domestic prices (Forbes et al., 2018).

The transition may be complete or incomplete. The rigidity of nominal prices means that not all inflationary effects of exchange rate movements are transmitted to domestic prices in the short-run (López-Villavicencio and Mignon, 2017; Devereux and Yetman, 2010). Another reason is that some firms change their prices in a given period, while the others do so at different intervals. In other words, not all companies change their prices in the same period (Walsh, 2010; Betts and Devereux, 2000). The other reason is the experience of Asian countries, which have strengthened the domestic goods market and have been more responsive to consumer preferences. This policy has been noticeably important because structural reforms have led to a reduction in import dependence and, consequently, not all inflationary effects of foreign currency shocks have been transmitted to domestic prices (Devereux and Yetman, 2014). Kurtović et al. (2018) found that in some economies there was an incomplete pass-through of the inflationary effects of exchange rate fluctuations to domestic prices, while in some others this pass-through is complete. Yanamandra (2015) came to an interesting conclusion about an overcompleted transition in the Indian economy.

Predicting the impact of foreign currency shocks on the inflation rate in order to respond sufficiently is a major challenge for central banks and their monetary policies (ji, 2022; Cuitino et al., 2022; Aisen et al., 2021; Ghartey, 2019; Forbes et al., 2018; Lueangwilai, 2012). This is because the monetary policy actions taken in response to an increase in the exchange rate and, consequently, an increase in

domestic prices can have a different outcome, moderating or reinforcing (ji, 2022; López-Villavicencio and Mignon, 2017; Devereux and Yetman, 2010; Woodford, 2001). For example, if expansionary monetary policy is pursued in response to an increase in the exchange rate, the inflationary effect of that increase on domestic prices may be amplified. However, Antwi et al. (2020) concluded that there is no significant causality relationship between the inflation rate and monetary policy instruments with exchange rate fluctuations. Civcir and Akçağlayan (2010) found that exchange rate fluctuations significantly affect the inflation rate and the Central Bank of Turkey responded appropriately in some periods but not in others. Ha et al. (2020) realized that the transition of the inflationary effects of exchange rate fluctuation to domestic prices is considerably associated by monetary policies. In addition, they pointed out that the measure of exchange rate pass-through is depended on the nature of currency shocks. On the other hand, the degree of exchange rate pass-through is affected by the source of foreign currency shocks (domestically or globally), economies' structures, and the response of monetary policy (Ha et al., 2020). In addition to these factors, different sectors of an economy can be differently affected by the inflationary effects of foreign currency movements (Osbat et al., 2021).

One factor that may affect the degree to which exchange rate fluctuations are effective on domestic prices is the volume of tradable goods in the consumer's basket of goods and domestically produced goods. Firms that have a large share of imported inputs and intermediate goods in their production process are likely to be more affected by exchange rate fluctuations and factor them into their goods prices (Ahn and Park, 2014; Shi and Xu, 2010). Hence, exchange rate fluctuations can potentially affect the price of imported consumer goods, inputs, and intermediate goods, and thus affect the production of domestic goods and the prices of domestically produced consumer goods (Choudhri and Hakura, 2015). In this regard, the impact of exchange rate fluctuations on non-imported and domestically produced goods may be much smaller (Ahn and Park, 2014). In contrast, in economies with a high share of imported consumer goods, intermediate inputs, and intermediate goods, the degree of dependence and the impact of foreign currency shocks on domestic prices can be significantly larger (Buyandelger, 2015). Şen et al. (2020) found that the impact of exchange rate fluctuations on domestic prices depends on an economy's dependence on imported inputs.

3. Empirical Model

In order to study the inflationary effects of foreign currency shocks and the monetary policy response to them, the vector autoregressive method (VAR) was used. This method empirically assesses the relationships among several variables and their prediction in the form of a pattern (Stock and Watson, 2003). The

response of the variables to dynamic shocks is evaluated using the impulse response functions, and then the contribution of the different shocks to the variation of the variables is analyzed by variance decomposition (Shin and Park, 2005). Hence, Since the objectives of the present study depend on the interrelationships between variables -the effects of foreign currency shocks on price indices and the response of monetary policy to these shocks- so these kinds of models can be useful. In other words, we are supposed to find out what similarities and differences there will be in the responses of various goods groups to foreign currency shocks with different sources by employing the vector autoregressive method. The contribution of foreign currency shocks and monetary policies in the fluctuations of the price indices of various goods groups is another reason causing the use of these models. As Ha et al. (2020) state that the measure of exchange rate pass-through depend on the source of foreign currency shocks (domestically or globally), economies' structures, and the response of monetary policy, and Osbat et al. (2021) pointed out that pass-through exchange rate might be different in the different sectors of an economy.

Assuming that there are two variables (Y, X); if the lags of all variables are equal to p , the effects of both variables on each other can be analyzed simultaneously in terms of the following relationships:

$$Y_t = B_{10} + B_{11} Y_{t-1} + \dots + B_{1p} Y_{t-p} + b_{11} X_{t-1} + \dots + b_{1p} X_{t-p} + U_{1t} \quad (1)$$

$$X_t = B_{20} + B_{21} Y_{t-1} + \dots + B_{2p} Y_{t-p} + b_{21} X_{t-1} + \dots + b_{2p} X_{t-p} + U_{2t} \quad (2)$$

In this study, first, the response of the price indices of the different groups of goods to foreign currency shocks with domestic source after the application of the exchange rate unification policy in the period 2001:1-2010:4 and to foreign currency shocks with external source after the international economic sanctions in the period 2011:1-2018:4 are evaluated separately using the impulse response functions.

Second, the contribution of foreign currency shocks, inflation expectations, and monetary policy to the fluctuations of all groups of goods is analyzed and compared separately. Third, the response of the price indices of the various goods groups to monetary policy and then the response of monetary policy to foreign currency shocks are examined. This is because monetary policy can also respond to exchange rate fluctuations (Senay and Sutherland, 2019; El Alaoui et al., 2019; Mohanty and Klau, 2004). In other words, we are supposed to find out whether monetary policy mitigates or amplifies the inflationary effects of foreign currency shocks. The advantage of separating the different groups of goods is that it is possible to clarify in a remarkable way which group is more affected by exchange

rate fluctuations and for which of them monetary policy mitigates or amplifies the inflationary effects.

The vector of endogenous variables includes the price index for various groups of goods: all goods and services (CPI), goods (CPIGOOD), services (CPISERVICE), food (CPIFOOD), housing (CPIHOUSE), health care (CPIHEALTH), and the producer price index (PRODUCER). The money supply as an instrument of monetary policy (M), the lags of the price index of commodity groups as inflation expectations, and the cycle component of the value of the Iranian currency (Rial) against the USD as foreign currency shocks extracted using the Hodrick-Prescott filter. For the seasonal time series, we used the World Bank and Central Bank of Iran sources, which were adjusted using the X-12 method.

In the Iranian economy, the central bank cannot adjust the nominal interest rate proportionally to the changes in the inflation rate due to the suppression of the nominal interest rate and the restrictions on the change of the nominal interest rate, as well as the inflationary environment of the economy and its strong fluctuations. Therefore, some studies (Shahmoradi and Sarem 2013) have used money supply as a monetary policy tool. In contrast, in advanced and emerging economies, given the significant relationship between inflation and nominal interest rate (Taylor's rule), central banks use interest rate as a monetary policy tool to achieve their objectives (Caporale et al., 2017; Güney, 2016; Popescu, 2014).

3.1 Data Description

When examining the price index response to exchange rate shocks from 2001-2010:4 and 2011:1-2018:4 using monthly data, we consider two points to make our study more comparable, reliable, and comprehensive. First, close attention must be paid to the sources of foreign currency shocks. Thus, we use two sources of the policy of exchange rate unification in 2001:1-2010:4, and international sanctions in 2011:1-2018:4. Second, we are aware of the importance of separating the price index of different goods groups. Thus, we attempted to select the goods groups that have the considerable share in households' consumption basket and in the whole value of imports, and consequently, in domestic prices. In this regard, we selected food, healthcare, housing, services, goods, producer (PPI), and consumer price indexes (CPI). This separation enables us to determine whether or not the differences and similarities between the responses of the above price indexes to exchange rate shocks with different sources are significant.

As shown in Tables 1 and 2, which contains data descriptive for quarterly data from 2001-2010:4 and 2011:1-2018:4. In both time intervals, when foreign currency shocks have happened in Iran's economy due to the implementation of the policy of exchange rate unification and international economic sanctions, the price indexes of food and healthcare showed the highest average among the price

index of various goods groups. The highest price index is also assigned to the price indices of healthcare and food. On the other hand, the price indices of services and housing had the highest standard deviation showing the highest degree of fluctuations after the exchange rate unification policy. Whereas after the international economic sanctions, the most fluctuations are for healthcare and food. The result of the Jarque-Bera test also show that the data sets have a normal distribution.

Table 1. Descriptive Statistics of 2001:1-2010:4

	CPI	FOOD	HEALTH	HOUSE	SERVICE	PRODUCER	M	R
Mean	2.055779	2.069388	2.069199	2.054163	2.056371	2.041373	5.905367	3.953116
Median	2.040412	2.047455	2.064707	2.047772	2.051739	2.034068	5.908855	3.956139
Maximum	2.390152	2.448112	2.456033	2.396977	2.409353	2.394398	6.449876	4.033073
Minimum	1.750508	1.763428	1.707570	1.667453	1.673942	1.753583	5.297672	3.902104
Std. Dev.	0.194913	0.209794	0.221404	0.221659	0.225116	0.179245	0.354469	0.039603
Jarque-Bera	2.758320	2.906153	2.456883	2.630649	2.637605	2.419339	3.103794	2.393670
Prob	0.251790	0.233850	0.292748	0.268387	0.267455	0.298296	0.211846	0.302149
Sum	90.45426	91.05306	91.04473	90.38318	90.48031	89.82040	259.8362	173.9371
Observations	40	40	40	40	40	40	40	44

Source: Research finding.

Note: CPI, FOOD, HEALTH, HOUSE, SERVICE, and PRODUCER are orderly the price index of consumer, food, healthcare, house, services, and producer. M and R are money supply and foreign exchange rates, as published by Iran's Central Bank. Jarque-Bera is a test statistic for testing whether or not the series is normally distributed. The null hypothesis of the Jarque-Bera test indicates that the sample data has a normal distribution.

Table 2. Descriptive Statistics of 2011:1-2018:4

	CPI	FOOD	HEALTH	HOUSE	SERVICE	PRODUCER	M	R
Mean	2.222596	2.256420	2.247908	2.157265	2.187562	2.212702	5.502342	4.477329
Median	2.258173	2.316263	2.239803	2.134602	2.168427	2.261015	6.427886	4.525283
Maximum	2.413152	2.451895	2.541555	2.396977	2.409353	2.394398	6.977833	5.123010
Minimum	1.972687	1.958369	1.979455	1.984357	1.981167	1.980325	3.888140	4.013551
Std. Dev.	0.142954	0.155315	0.188641	0.123403	0.140491	0.132051	1.279289	0.281374
Jarque-Bera	3.566932	3.755429	3.696388	2.644077	3.294545	3.987507	5.694168	0.318390
Prob	0.168055	0.152939	0.157521	0.266591	0.192574	0.136183	0.058013	0.852830
Sum	80.01346	81.23112	80.92470	77.66156	78.75221	79.65726	198.0843	161.1838
Observations	32	32	32	32	32	32	32	32

Source: Research finding.

Note: All data is published by Iran's Central Bank.

4. Empirical Results

4.1 Foreign Currency Shocks after the Application of the Exchange Rate Unification

Given the seasonal time series data, it is necessary to ensure the stationarity of the variables. To this end, we used the augmented Dickey-Fuller and Phillips-Perron tests. The results show that all variables are non-stationary at the level, and stationary at the first difference. After determining the optimal number of lags and ensuring that no spurious regression occurs by using the cointegration tests, the response of the price index of all commodity groups to foreign currency shocks, inflation expectations, and monetary policy is analyzed separately by using the VAR method and one standard deviation impulse response functions. Then, the contribution of foreign currency shocks, monetary policy and inflation expectations to their fluctuations is examined separately by analyzing the variance decomposition. Finally, the response of the monetary policy instrument of money supply to foreign currency shocks was also examined. The results of the cointegration tests of autoregressive distributed lag (ARDL) show that there are real long-term relationships between the levels of the variables. Therefore, in order not to lose some long-term useful information in the form of differential form of variables, their levels are used.

Since the period 2001:1-2010:4 covers ten years and 40 quarters, the impulse response functions and variance decompositions are evaluated for forty periods, so that the response of price indices is specified by the respective quarter at the time the shocks occur. In addition, for the foreign currency shock in the first quarter of 2002, the quarters are divided into three periods. Quarters 2-4 of 2002 are approximated for the short-term, 2003:1-2007:4 for the medium-term, and 2008:1-2010:4 for the long-term.

4.1.1 Price Index for All Goods and Services (CPI)

According to Figure 1, at the time of the foreign currency shock in 2002 (quarter 5, 2001:1-2010:4), the price index increasingly responded to it with a severe slope, and its response to the money supply was similar, but with a gentler slope and less severe. Moreover, the positive response of the price index to the foreign currency shock was longer and more stationary than changes in the money supply (the upward response to the foreign currency shock lasted up to four years later, whereas the monetary policy response lasted only the next two years). In addition, the inflationary effects of monetary policy and the exchange rate shock persisted over the medium- and long-term. In other words, inflationary effects did not diminish over time.

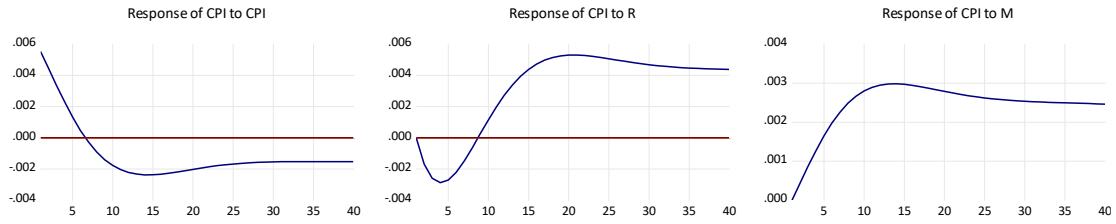


Figure 1. Impulse Response Function of CPI to Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (The Lags Of CPI) over the Period 2001:1-2010:4

Source: Research finding.

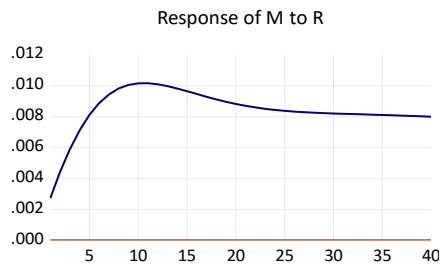


Figure 2. Impulse Response Function of the Monetary Policy Instrument of Money Supply (M) to Foreign Currency Shocks (R) over the Period 2001:1-2010:4

Source: Research finding.

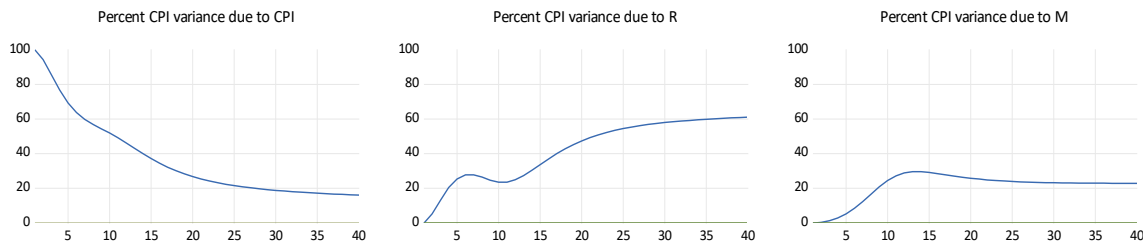


Figure 3. Variance Decomposition of CPI to Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of CPI) over the Period 2001:1-2010:4

Source: Research finding.

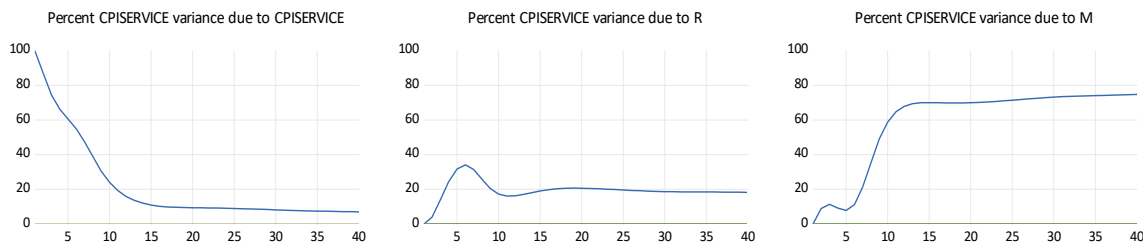


Figure 4. Variance Decomposition of CPISERVICES on Foreign Currency Shocks (R), Money Supply (M), And Inflation Expectations (the lags of CPISERVICES) over the Period 2001:1-2010:4

Source: Research finding.

Figure 2 shows that the money supply responded expansively to the foreign currency shock and amplified the inflationary effects of the foreign currency shock. Figure 1 indicates that the response of the price index to inflation expectations was regressive and in a direction completely opposite to monetary policy.

Considering the variance decomposition in Figure 3 with respect to the share of foreign currency shocks, money supply and inflation expectations in the fluctuations of the price index, the share of inflation expectations declined after the occurrence of the currency shock. Conversely, the share of foreign currency shocks and money supply has increased, although the intensity of the increase in the share of foreign currency shocks has been higher.

In what follows, the price index is divided into two groups of goods and services, and the analysis of the variance decomposition is examined separately for them. Taking this separation into account, the differences between the share of foreign currency shocks and money supply in the variation of the price index for goods and services can be seen in Figures 4 and 5. In the goods group, the share of foreign currency shocks was significantly higher, whereas in the services group, the share of money was significantly larger.

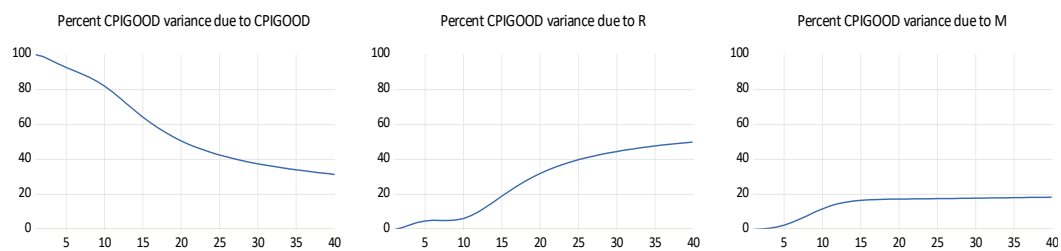


Figure 5. Variance Decomposition of CPIGOODS on Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of CPIGOODS) over the Period 2001:1-2010:4

Source: Research finding.

4.1.2 Housing Price Index (CPIHOUSE)

Figure 6 shows that the response of the CPIHOUSE index to the foreign currency shock, money supply, and inflation expectations was generally similar to the response of the CPI index at the time of the shock. The response to the foreign currency shock and money supply increased with a steep increase, and the response to inflation expectations decreased with a sharp increase. In other words, inflation expectations moved in the opposite direction of monetary policy. One difference is that, unlike the CPI index, the CPIHOUSE index is more sensitive to changes in the money supply than to foreign currency shocks. A common feature is that, despite some adjustments in the medium- and long-term, the inflationary effects of

monetary policy and foreign currency shocks persisted in the medium- and long-term.

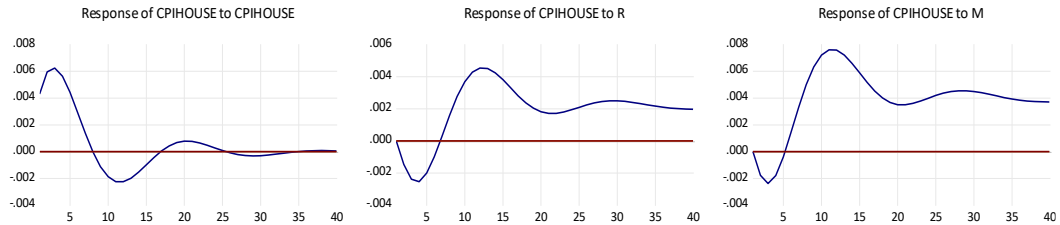


Figure 6. Impulse Response Function of the CPIHOUSE to Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of the CPIHOUSE) over the Period 2001:1-2010:4

Source: Research finding.

Figure 7 shows that the monetary policy instrument of money supply responded expansively to a foreign currency shock and amplified the inflationary effects of the foreign currency shock at the time of the shock. Subsequently, however, it is contractionary and moderating. Figure 6 shows that the inflationary effects of the foreign currency shock and the money supply have undergone some adjustment three years after the application of the exchange rate unification policy in 2006 (quarter 16, 2001:1-2010:4).

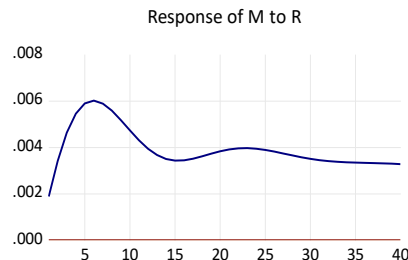


Figure 7. Impulse Response Function of the Monetary Policy Instrument of Money Supply (M) to Foreign Currency Shocks (R) over the Period 2001:1-2010:4

Source: Research finding.

From the variance decomposition in Figure 8, it can be seen that unlike the CPI index, where the foreign currency shock accounted for the largest share of the fluctuations, the money supply accounted for the largest share of the fluctuations in the CPIHOUSE index, with the trend increasing over time. The share of foreign currency shocks also increased slightly over time. Like the CPI index, the share of inflation expectations in CPIHOUSE fluctuations has also declined over time, with a decreasing trend index, suggesting that monetary policy and inflation expectations have moved in opposite directions.

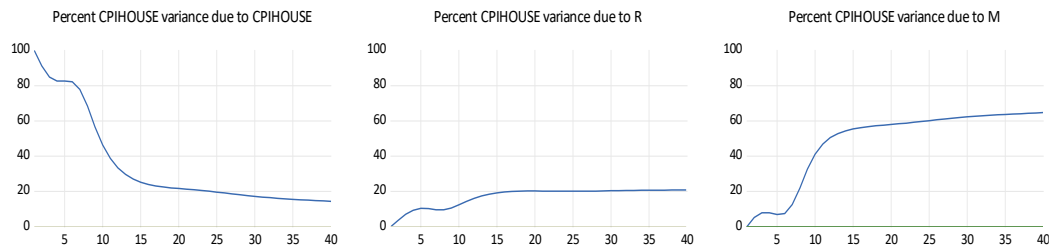


Figure 8. Variance Decomposition of the CPIHOUSE on Foreign Currency Shocks (R), Money Supply (M) and Inflation Expectations (the Lags of the CPIHOUSE) over the Period 2001:1-2010:4

Source: Research finding.

4.1.3 Price Index of Food (CPIFOOD)

Figure 9 indicates that the CPIFOOD index generally responds similarly to the CPI index. In this regard, the CPIFFOD index increasingly responds to foreign currency shocks with a strong slope, and its response to money supply is similar but with a gentler slope and less strong. In addition, the positive response of the CPIFOOD index to the foreign currency shock was longer and more persistent than the changes in the money supply. The response of the CPIFOOD index to inflation expectations was diminishing with a steep slope and in a direction completely opposite to monetary policy. All three price indices CPI, CPIHOUSE, and CPIFOOD are similar in that the inflationary effects of monetary policy and foreign currency shocks persisted over the medium- and long-term. In contrast, looking at Figure 10, we see that the monetary policy instrument of money supply responded expansively to the foreign currency shock and strengthened inflation expectations.

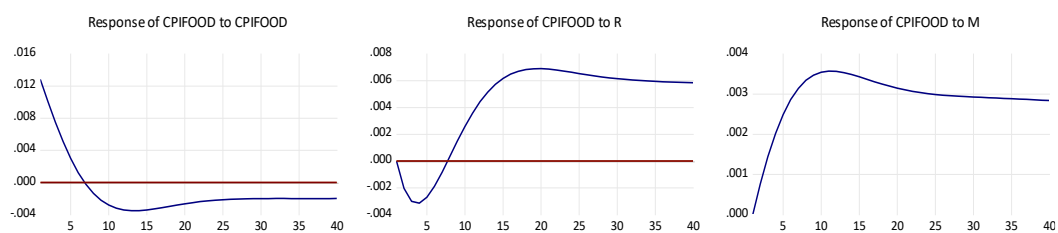


Figure 9. Impulse Response Function of CPIFOOD to Foreign Currency Shocks (R), Money Supply (M) and Inflation Expectations (The Lags of CPIFOOD) over the Period 2001:1-2010:4

Source: Research finding.

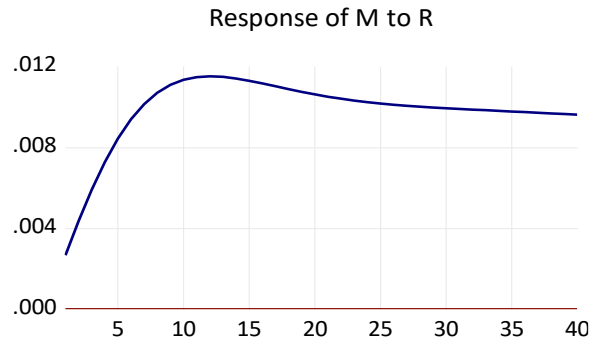


Figure 10. Impulse Response Function of the Monetary Policy Instrument of Money Supply (M) to Foreign Currency Shocks (R) over the Period 2001:1-2010:4

Source: Research finding.

Regarding Figure 11, the variance decomposition shows that the share of inflation expectations in the CPIFOOD index has decreased over time, as was the case for the CPI and CPIHOUSE indices. The share of the foreign currency shock has increased with a severe slope, and the share of the money supply has also increased with a more even slope, as was the case with the CPI index. The share of monetary policy in the CPIHOUSE index, on the other hand, has increased more than the share of foreign currency shocks.

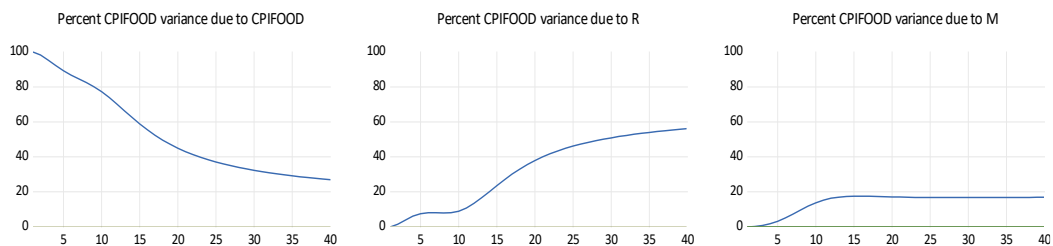


Figure 11. Variance Decomposition of CPIFOOD on Foreign Currency Shocks (R), Money Supply (M) and Inflation Expectations (The Lags of CPIFOOD) over the Period 2001:1-2010:4

Source: Research finding.

4.1.4 Health Care Price Index (CPIHEALTH)

Considering Figure 12, the CPIHEALTH index responded positively to the foreign currency shock, similar to the previous price indices. More specifically, the CPIHEALTH index responds to both the foreign currency shock and the money supply in an increasing manner, with a steeper slope, longer and more stationary to the foreign currency shock than to the money supply. Moreover, the CPIHEALTH index has responded to inflation expectations in a decreasing manner, in a direction completely opposite to that of monetary policy. The inflationary effects of monetary policy and foreign currency shocks continued over the medium- and long-term, as was the case with the CPI, CPIHOUSE, and CPIFOOD indices. On the other hand, Figure 13 shows that the monetary policy instrument of money supply responded expansively to the foreign currency shock and strengthened inflation expectations.

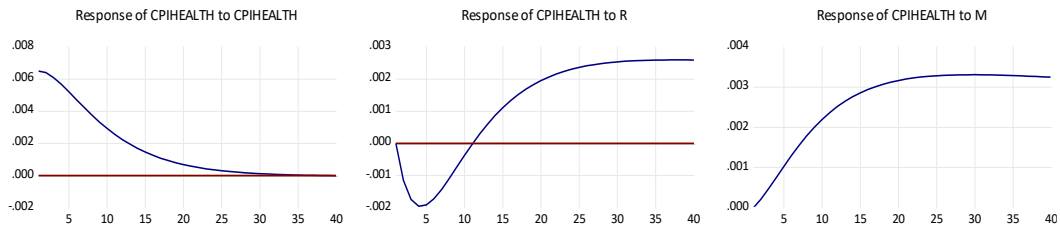


Figure 12. Impulse Response Function of the CPIHEALTH to Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of the CPIHEALTH) over the Period 2001:1-2010:4

Source: Research finding.

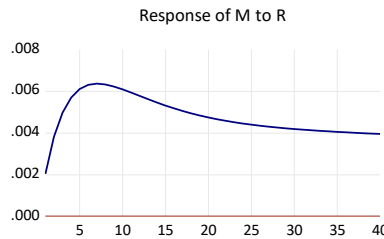


Figure 13. Impulse Response Function of the Monetary Policy Instrument Money Supply (M) to Foreign Currency Shocks (R) over the Period 2001:1-2010:4

Source: Research finding.

Figure 14 indicates that the share of foreign currency shock and money supply has increased over time. In addition, the intensity of the increase in the share of monetary policy has been greater than the share of the foreign currency shock, similar to the CPIHOUSE and different from the CPI and CPIFOOD indices. Conversely, the share of inflation expectations declined, as was the case for all previous price indices.

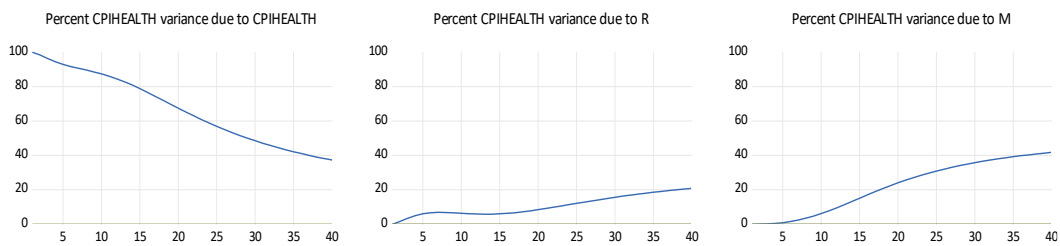


Figure 14. Variance Decomposition of CPIHEALTH on Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of CPIHEALTH) over the Period 2001:1-2010:4

Source: Research finding.

4.1.5 Producer Price Index (PRODUCER)

Figure 15 shows that the response of the index PRODUCER differs from the response of the price indices of the previous groups of goods. In this respect, it did not respond to inflation expectations, the foreign currency shock, and monetary policy at the time of the currency shock and also in the medium-term. However, in the long-term, i.e., almost 28

quarters after the foreign currency shock, it did respond to these factors. In the long-term, it responded positively to the foreign currency shock and inflation expectations, with inflation expectations showing a higher slope than the foreign currency shock. Conversely, it responded negatively to the money supply. Moreover, the development of inflation expectations was in a completely opposite direction to monetary policy, as it was the same for all previous commodity group price indices.

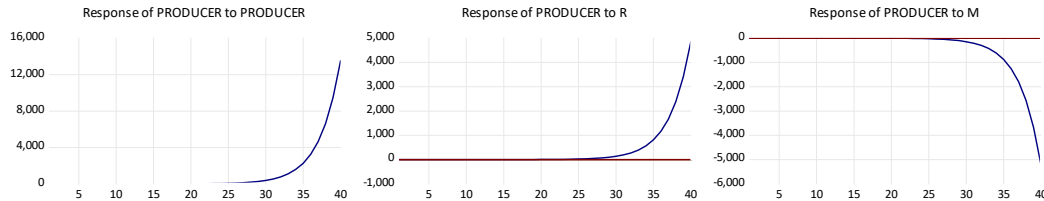


Figure 15. Impulse Response Function of PRODUCER to Foreign Currency Shocks (R), Money Supply (M) and Inflation Expectations (the lags of PRODUCER) over the Period 2001:1-2010:4

Source: Research finding.

Figure 16 indicates that, unlike all other commodity group price indices, the PRODUCER index responded to the foreign currency shock only in the long-term, almost 26 years after the shock. It has also mitigated the inflationary impact of the foreign currency shock in the long-term.

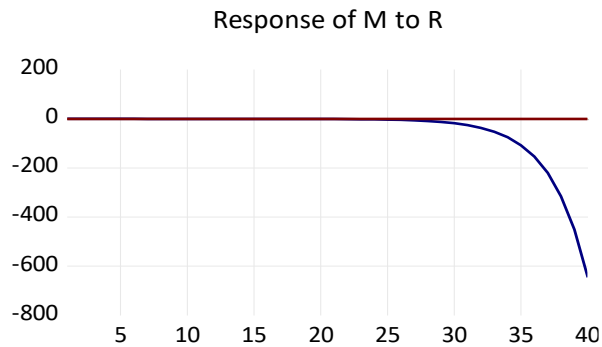


Figure 16. Impulse Response Function of the Monetary Policy Instrument of Money Supply (M) to Foreign Currency Shocks (R) over the Period 2001:1-2010:4

Source: Research finding.

Figure 17 shows that, unlike all previous price indices for commodity groups, the share of foreign currency shocks and money supply in the fluctuations of the PRODUCER index was much smaller than the share of inflation expectations. In other words, unlike all previous price indices for commodity groups, where the share of inflation expectations showed a downward trend, the high share of inflation expectations in the PRODUCER index persisted even in the medium- and long-term.

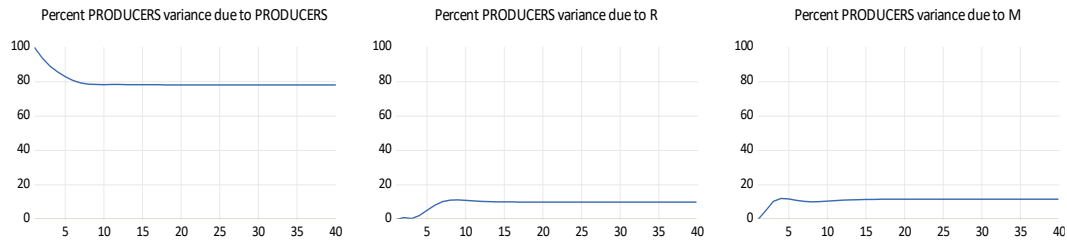


Figure 17. Variance Decomposition of PRODUCER on Foreign Currency Shocks (R), Money Supply (M) and Inflation Expectations (the lags of PRODUCER) over the Period 2001:1-2010:4

Source: Research finding.

4.1.6 One Result for the Foreign Currency Shock after Exchange Rate Unification

The share of inflation expectations was initially very high for the price index of all commodity groups, but after the occurrence of the foreign currency shock, its share declined sharply. The only exception was the PRODUCER index, where the high share of inflation expectations persisted. The price index of all groups responded positively to the foreign currency shock with a steep increase, and monetary policy was expansionary, reinforcing the inflationary effects of the foreign currency shock. The only exception was the index of PRODUCER, which responded positively to the foreign currency shock only in the long-run (about 26 quarters since the shock occurred). Monetary policy mitigated the inflationary impact of the shock, in contrast to the price indices of the other groups of goods. The inflationary effects of the foreign currency shock have persisted for all groups of goods, not only in the short-run, but also in the medium- and long-term. The only exception was the manufacturing sector, which was only affected by the inflationary impact of the shock in the long-term. Inflation expectations and monetary policy moved in opposite directions, indicating a lack of confidence in the central bank's monetary policy after the foreign currency shock.

4.2 Foreign Exchange Shock with an External Source after International Sanctions

First, the results of the augmented Dickey-Fuller and Phillips-Perron tests show that all variables are non-stationary at the level, and stationary at the first difference. After determining the optimal number of lags and using the ARDL cointegration test to ensure that there is no spurious regression showing in the Table 3, the response of the price index of all groups of goods to the foreign currency shock, inflation expectations, and monetary policy is analyzed separately by applying the VAR method and the impulse response functions with one standard deviation. The source of the foreign currency shock was the international economic sanctions in 2011:1-2018:4, and then the contribution of the foreign currency shocks, monetary policy, and inflation expectations to their fluctuations are analyzed separately by variance decomposition analysis. Finally, the response of

the monetary policy instrument of the money supply to foreign currency shocks was also examined. Since the 2011:1-2018:4 interval spans eight years and 32 quarters, the impulse response functions and variance decompositions are evaluated for 32 periods so that the response of price indices is specified by the respective quarter at the time the shocks occur. In addition, concerning the foreign currency shock in the second quarter of 2011, the quarters are divided into three periods quarters 2-4 of 2011 and 1-3 of 2012, when international sanctions were tightened (Tayebi and Sadeghi, 2017), are approximately determined for the short-term period, 2012:4-2014:4 for the medium-term period, and 2015:1-2018:4 for the long-term period.

Table 3. ARDL Cointegration Test for 2001:1-2010:4

Equation	F-Statistic	Critical Values (5%)	Ho: No Level Relationship
CPI	817/31	87/3	Rejected
CPIFOOD	994/10	87/3	Rejected
CPIHOUSE	202/8	87/3	Rejected
CPIHEALTH	734/11	87/3	Rejected
CPISERVICE	859/7	87/3	Rejected
PRODUCER	566/7	87/3	Rejected

Source: Research finding.

Note: The Null hypothesis of the ARDL cointegration test shows that there is no relationship at a level.

Table 4. ARDL Cointegration Test for 2011:1-2018:4

Equation	F-Statistic	Critical Values (5%)	Ho: No Level Relationship
CPI	018/5	87/3	Rejected
CPIFOOD	332/7	87/3	Rejected
CPIHOUSE	288/4	87/3	Rejected
CPIHEALTH	717/7	87/3	Rejected
CPISERVICE	717/8	87/3	Rejected
PRODUCER	592/9	87/3	Rejected

Source: Research finding.

Note: The Null hypothesis of the ARDL cointegration test shows that there is no relationship at a level.

4.2.1 Price Index for All Goods and Services (CPI)

According to Figure 18, the CPI index responded positively to a foreign currency shock in the second quarter of 2011 (coinciding with international economic sanctions) and inflation expectations, and then moderated and declined after seven quarters since the shock (near the Geneva political agreement in 2013 to lift some economic sanctions), and neutralized around quarter 18 (near the Joint Comprehensive Plan of Action (JCPOA) agreement in 2015:3 to lift the main economic sanctions). Thus, the inflationary effects of the foreign currency shock

occurred only in the short-term, weakened in the medium-term, and did not persist in the long-term.

Turning to Figures 18 and 19, the response of the CPI index to monetary policy shows that monetary policy was contractionary and mitigated the inflationary effects of the foreign currency shock. Moreover, inflation expectations and monetary policy have also moved in the same direction.

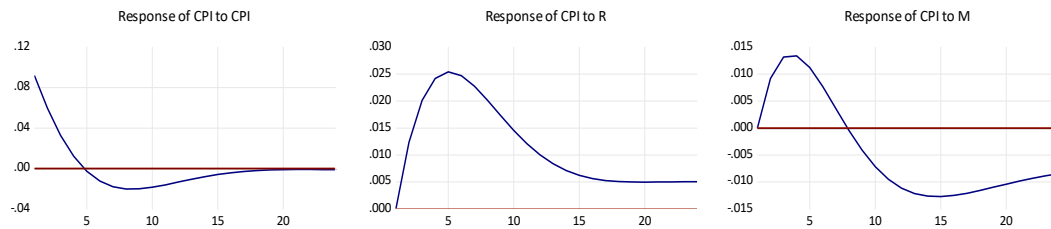


Figure 18. Impulse Response Function of CPI to Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of CPI) over the Period 2011:1-2018:4
Source: Research finding.

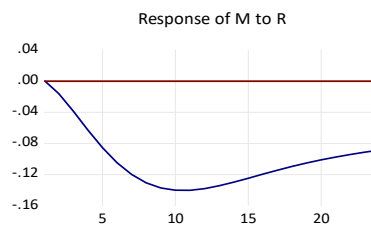


Figure 19. Impulse Response Function of the Monetary Policy Instrument Money Supply (M) to Foreign Currency Shocks (R) over the Period 2011:1-2018:4
Source: Research finding.

Given Figure 20, the variance decomposition of the CPI index shows that inflation expectations had the highest share and money supply had the lowest share in the fluctuations. The share of foreign currencies increased after the shock and remained constant for seven quarters after the shock (just before the Geneva political agreement in 2013 to lift some economic sanctions).

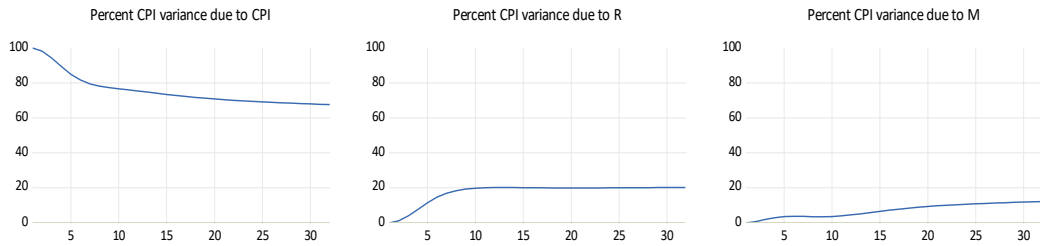


Figure 20. Variance Decomposition of CPI for Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of CPI) over the Period 2011:1-2018:4

Source: Research finding.

After we separate the two groups of services and goods, the variance decompositions in Figures 21 and 22 show that inflation expectations have the highest share, and money supply has the lowest share in the fluctuations of the two groups of services and goods. In other words, the results show no significant difference between the share of foreign currency shocks, monetary policy and inflation expectations for both groups of goods and services.

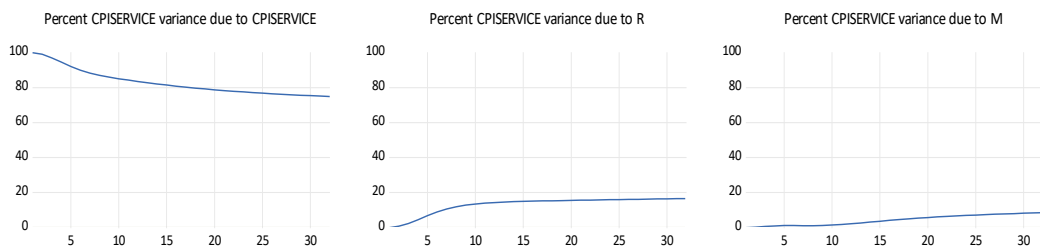


Figure 21. Variance Decomposition of CPISERVICE on Foreign Currency Shocks (R), Monetary Policy (M), and Inflation Expectations (the lags of CPISERVICE) over the Period 2011:1-2018:4

Source: Research finding.

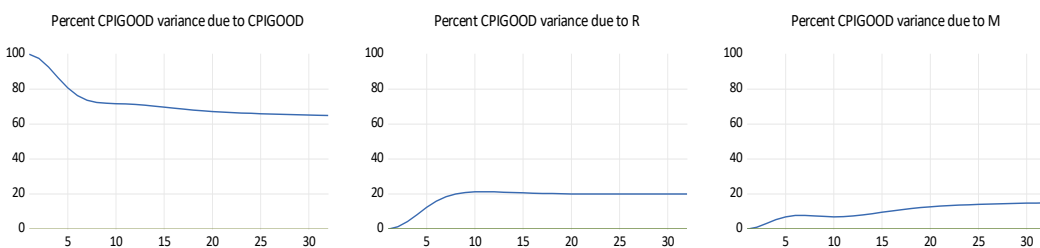


Figure 22. Variance Decomposition of CPIGOOD on Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of CPIGOOD) over the Period 2011:1-2018:4

Source: Research finding.

4.2.2 Housing Price Index (CPIHOUSE)

Figure 23 shows that the response of the CPIHOUSE index to the foreign currency shock increased and then moderated after seven quarters since the shock (just

before the Geneva political agreement in 2013, which provided for the lifting of some economic sanctions) and approached the starting point in quarter 18 (just before the JCPOA agreement). On the other hand, the CPIHOUSE index responded positively to inflation expectations with a significantly steep slope that moderated near the Geneva agreement and returned to the pre-shock starting point in quarter 18 coinciding with the JCPOA agreement. In summary, the response of the CPIHOUSE index to the foreign currency shock, money supply, and inflation expectations was influenced by the political agreements, as was the case for the CPI index.

The response of the CPIHOUSE index to the money supply was downward. Figure 24 also shows that the monetary policy instrument of money supply responds contractionarily to the foreign currency shock and mitigates the inflationary impact of the shock. Strikingly, inflation expectations and monetary policy moved in the same direction, as was the case with the CPI index.

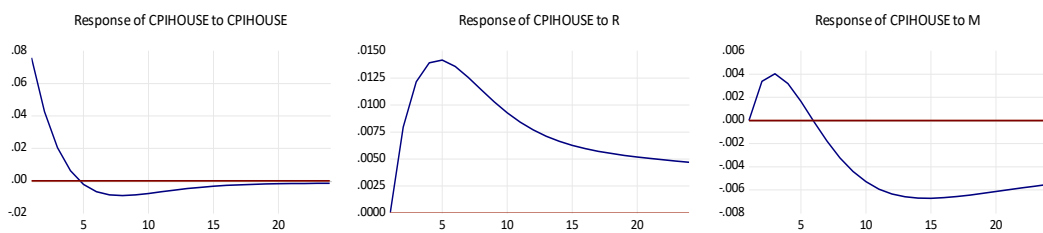


Figure 23. Impulse Response Function of the CPIHOUSE to Foreign Currency Shocks (R), Money Supply (M) and Inflation Expectations (the lags of the CPIHOUSE) over the Period 2011:1-2018:4

Source: Research finding.

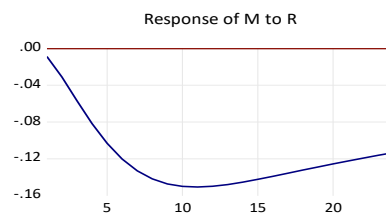


Figure 24. Impulse Response Function of the Monetary Policy Instrument Money Supply (M) to Foreign Currency Shocks (R) over the Period 2011:1-2018:4

Source: Research finding.

Considering Figure 25, the variance decomposition of the CPIHOUSE index show that the share of the foreign currency shock in its fluctuations increased after the second season of 2011 coincided with international economic sanctions. In contrast, the share of inflation expectations has declined since the foreign currency shock. Moreover, the share of monetary policy in the fluctuations of the CPIHOUSE index is very small. A likely explanation for this is that due to the high capital gains associated with the sharp fluctuations in housing prices and, on the

other hand, due to the suppression of nominal interest rates and the inflationary environment of the Iranian economy, which have led to a negative real interest rate on bank loans, taking bank loans to invest in the housing sector has been very profitable.

As a result, the CPIHOUSE index was not affected by monetary policy in 2011:1-2018:4. On the other hand, after a foreign currency shock of domestic source in 2001:1-2010:4, the contribution of monetary policy to the fluctuations of the CPIHOUSE index was very high due to the small fluctuations of housing prices and, consequently, the small capital gains.

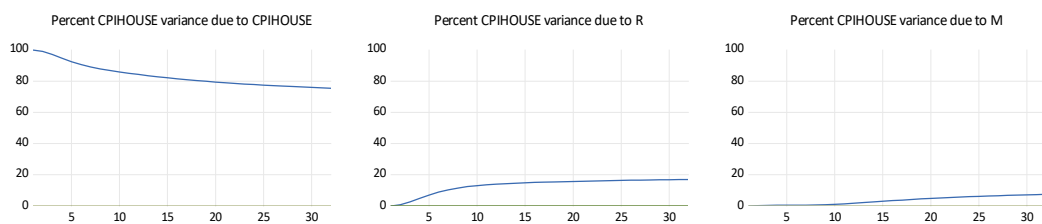


Figure 25. Variance Decomposition of the CPIHOUSE on Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of the CPIHOUSE) over the Period 2011:1-2018:4

Source: Research finding.

4.2.3 Price Index of Food (CPIFOOD)

Figure 26 indicates that the response of the CPIFOOD index to the foreign currency shock increased with a rather steep slope and then weakened after seven quarters since the shock occurred (just before the Geneva political agreement) and returned to the starting point in quarter 20 (just before the JCPOA agreement). The response, which was significant, is similar to the response of the CPI and CPIHOUSE indices. Figure 27 shows that the monetary policy response to the foreign currency shock was contractionary and mitigated the inflationary effects of the shock. For this reason, the CPIFOOD response to the money supply in Figure 26 is decreasing after 3quarters since the shock. In short, the response of the CPIFOOD index to the foreign currency shock was affected by the political arrangements, as was the case with the CPI and CPIHOUSE indices. Another interesting point is that inflation expectations and monetary policy also moved in the same direction, as was the case for CPI and CPIHOUSE.

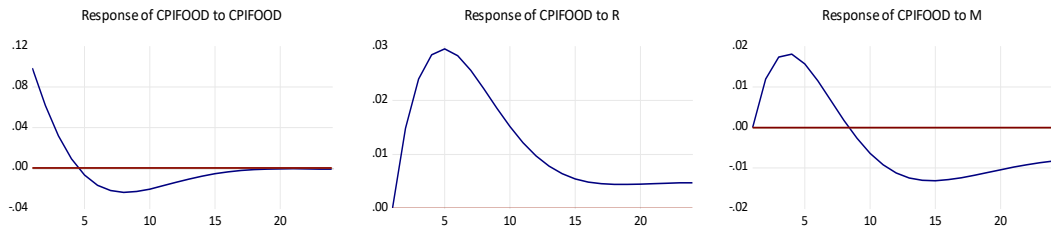


Figure 26. Impulse Response Function of CPIFOOD to Foreign Currency Shocks (R), Money Supply (M) and Inflation Expectations (the lags of CPIFOOD) over the Period 2011:1-2018:4

Source: Research finding.

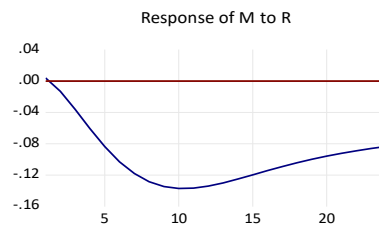


Figure 27. Impulse Response Function of the Monetary Policy Instrument of Money Supply (M) to Foreign Currency Shocks (R) over the Period 2011:1-2018:4

Source: Research finding.

Based on the variance decomposition of the CPIFOOD index in Figure 28, it can be seen that the foreign currency shock has the highest share after inflationa epectations, and the money supply has the lowest share in its fluctuations. The share of the foreign currency shock and inflation expectations remained constant (roughly close to the Geneva political agreement) after seven quarters since the shock.

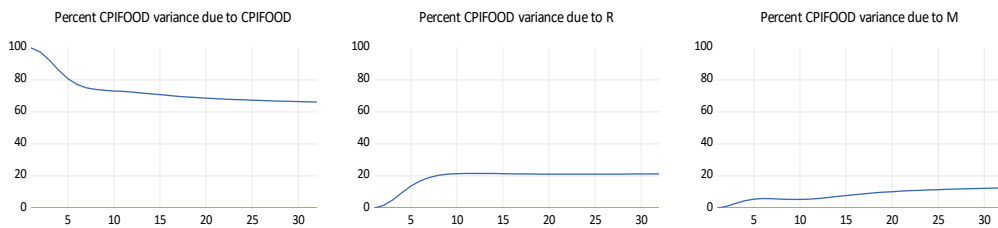


Figure 28. Variance Decomposition of CPIFOOD on Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of CPIFOOD) over the Period 2011:1-2018:4

Source: Research finding.

4.2.4 Health Care Price Index (CPIHEALTH)

Figure 29 shows that the response of the CPIHEALTH index to the foreign currency shock increased, then weakened over the medium-term, and returned to the starting point in about quarter 20 (almost just before the JCPOA agreement). This response bears a marked resemblance to the responses of the CPI, CPIFOOD,

and CPIHOUSE indices. Figure 30, on the other hand, shows that monetary policy responds contractionarily to the foreign currency shock and mitigates the inflationary effects of the shock. For this reason, the CPIHEALTH response to the money supply is decreasing after 3quarters since the shock. The CPIHEALTH index positively responds to inflation expectations, turned into the negative range coincided with Geneva political agreement, and returned to the starting point in about quarter20 (just before the JCPOA agreement).

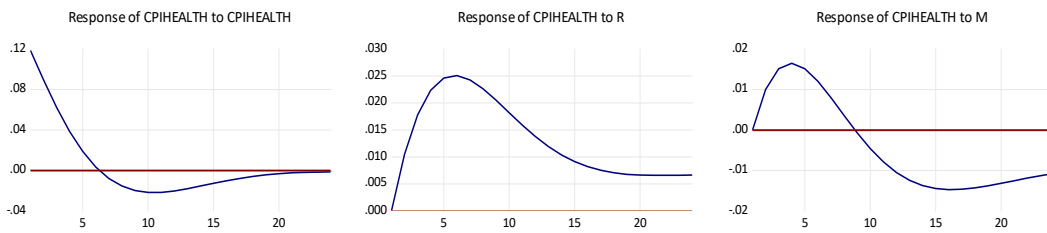


Figure 29. Impulse Response Function of the CPIHEALTH to Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of the CPIHEALTH) over the Period 2011:1-2018:4

Source: Research finding.

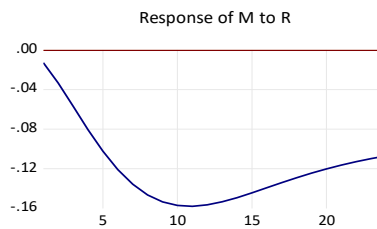


Figure 30. Impulse Response Function of the Monetary Policy Instrument Money Supply (M) to Foreign Currency Shocks (R) over the Period 2011:1-2018:4

Source: Research finding.

Regarding Figure 31, the variance decomposition of the CPIFOOD index shows that the share of foreign currency shock was the highest after inflation expectations, and has remained constant after 9quarters since the shock (nearly coincided with Geneva political agreement). The share of inflation expectations is considerably sharp after the shock occurred. The money supply also has a very small share in the fluctuations of the CPIHEALTH.

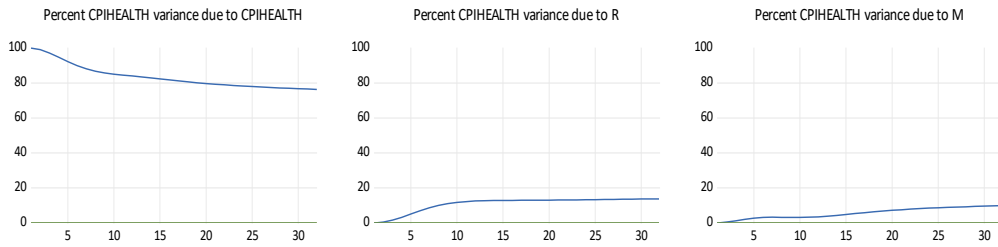


Figure 31. Variance Decomposition of the CPIHEALTH on Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of the CPIHEALTH) over the Period 2011:1-2018:4

Source: Research finding.

4.2.5 Producer Price Index (PRODUCER)

Figure 32 shows that the response of the PRODUCER index to the foreign currency shock increased and then weakened after seven quarters since the shock (just before the Geneva political agreement) and returned to the starting point in quarter 16 (just before the JCPOA agreement). Such a response also occurred for CPI, CPIHOUSE, CPIHEALTH, and CPIFOOD. In short, the inflationary impact of the foreign currency shock on all commodity groups was influenced by the political agreements. On the other hand, regarding Figure 33, the response of monetary policy to the foreign currency shock was contractionary and moderated the inflationary effects of the shock.

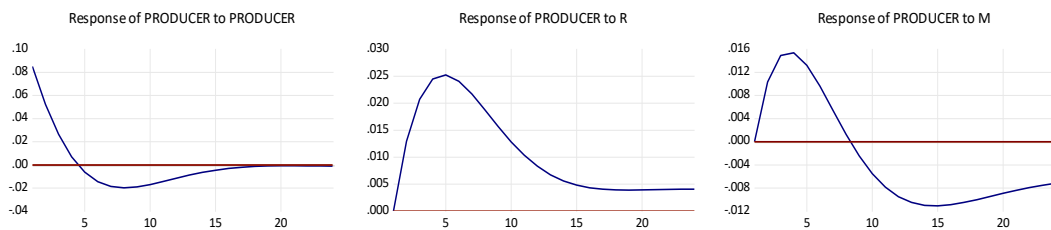


Figure 32. Impulse Response Function of PRODUCER to Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of PRODUCER) over the Period 2011:1-2018:4

Source: Research finding.

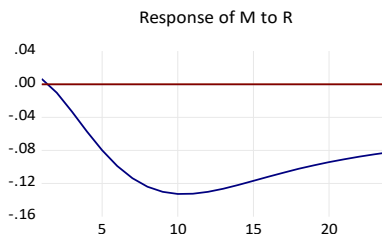


Figure 33. Impulse Response Function of the Monetary Policy Instrument Money Supply (M) to Foreign Currency Shocks (R) over the Period 2011:1-2018:4

Source: Research finding.

In Figure 34, the variance decomposition of the PRODUCER index shows that the inflation expectations share is the highest and the monetary policy share is the lowest. The share of foreign currency shock remained constant after the Geneva policy agreement in quarter 10 until the JCPOA agreement in quarter 30.

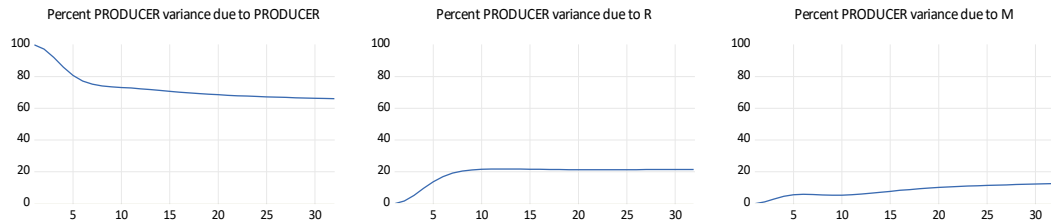


Figure 34. Variance Decomposition of PRODUCER on Foreign Currency Shocks (R), Money Supply (M), and Inflation Expectations (the lags of PRODUCER) over the Period 2011:1-2018:4

Source: Research finding.

4.3 The Vector Error Correction Models

In the following, by using vector error correction models and extracting adjustment coefficients for the deviation from a long-term equilibrium in short-term periods, it is important to examine whether or not these adjustments have been significant after foreign currency shocks of the policy of exchange rate unification and international economic sanctions? In addition, the degree of adjustments in which periods shows a higher percentage? The periods after the exchange rate unification policy or after international sanctions? Based on the impulse response functions that were investigated, the effects of foreign currency shock of the exchange rate unification policy showed more persistency, and its effects continued in the medium and long term. Whereas regarding the foreign currency shock of international sanctions, it showed significant adjustments, in a way that its effects were moderated in the medium term, and almost neutralized in the long term.

Table 5. The Results of Vector Error Correction Estimates for 2001:1-2010:4

Equation	ecm (-1)	Std. Error	t-Statistic	Prob
CPI	108975/- 0	048809/0	232683/- 2	0277/0
CPIFOOD	209303/- 0	099318/0	107394/- 2	0375/0
CPIHOUSE	181296/- 0	040892/0	433558/- 4	0000/0
CPIHEALTH	015750/- 0	046988/0	335192/0	7381/0
CPISERVICE	161760/- 0	041284/0	918190/- 3	0002/0
PRODUCER	342434/- 0	134982/0	536890/- 2	0128/0

Source: Research finding.

Note: Coefficient ecm (-1) shows the adjustments of the deviation from a long-term equilibrium.

For the time period of 2001:1-2010:4, when foreign currency shock came after the exchange rate unification policy, the short-term adjustment coefficients show that adjustments to the effects of the shocks have been significant. However, the amount of these adjustments is not remarkable, and shows a low percentage. It confirms the results of the impulse response functions regarding the sustainability of the effects in the medium and long term. There is an exception for the healthcare price index response. A probable explanation for the non-significance of the adjustment coefficient of the healthcare price index, as the response of this group also showed, is the continuous reaction to the shock, and the lack of adjustment of its effects in the short, medium, and long term.

After international economic sanctions in 2011:1-2018:4, the adjustment coefficients show that the adjustment of the deviation from a long-term equilibrium has been significant for all indices. In addition, the percentage of adjustments also shows a considerable percentage, unlike the shock of the exchange rate unification policy. In such a way that the adjustments related to food, housing, services, and producers are 48%, 58%, 47%, and 47%, respectively. As the impulse response functions of the shock of international sanctions also showed that the effects of these shocks were moderated in the medium term, and neutralized in the long term. In fact, with the removal of the political factor of international sanctions after the Geneva and JCPOA agreements, the effects of foreign currency shock were accompanied by considerably adjustments.

Table 6. The Results of Vector Error Correction Estimates for 2011:1-2018:4

Equation	ecm (-1)	Std. Error	t-Statistic	Prob
CPI	370774/- 0	160931/0	303927/- 2	0238/0
CPIFOOD	483401/- 0	147301/0	281728/- 3	0015/0
CPIHOUSE	585400/- 0	140026/0	180647/- 4	0001/0
CPIHEALTH	212491/- 0	197978/0	873306/- 2	0286/0
CPISERVICE	479169/- 0	154086/0	109755/- 3	0026/0
PRODUCER	470854/- 0	139002/0	387402/-3	0011/0

Source: Research finding.

Note: Coefficient ecm (-1) shows the adjustments of deviation from a long-term equilibrium.

4.4 Serial Correlation, the Stability of Models and R-Squared

The possibility of serial correlation in the estimated models has been investigated by using Breusch-Godfrey LM tests. The results show that the null hypothesis_ that there is no serial correlation between disturbance components_ has not been confirmed. Therefore, there is no serial correlation in any of the models. The stability of the models has also been assessed by using unit root circles. If no root lies outside the unit circle, the VAR model satisfies the stability condition. The findings show that all the roots are located in the unit circle. Thus, the stability of the models has been confirmed. The Adjusted R-squared values of all models for 2001:1-2010:4 and 2011:1-2018:4 show that there is a strong relationships between the variables and the response variable.

5. Discussion

The results show some significant differences and similarities in how foreign currency shocks with domestic and external sources affect the prices of different groups of goods (all goods and services, housing, healthcare, food, and producer prices). Domestic-source foreign currency shocks had a short-term inflationary effect and continued to have an impact in the medium- and long-term (except for the producer price index, which showed only a long-term effect and was neutral in the short- and medium-term). In contrast, foreign currency shocks originating from outside had only a short-term inflationary effect. Their effects were weakened in the medium term and fully neutralized in the long term. The weakening of the medium-term inflationary impact of the foreign currency shock from an external source occurred almost simultaneously with the Geneva political agreement and the neutralization of its long-term impact with the JCPOA agreement. Thus, the weakening of the political factor in the source of the shock played a significant role in adjusting its inflationary effects. As noted above, the inflationary impact of the domestic-source foreign exchange shock due to structural reforms (the exchange rate unification policy) persisted in the medium- and long-term, showing the persistence of the impact of the domestic-source shock on the occurrence of the domestic source.

After the foreign currency shock, monetary policy was expansionary and amplified the inflationary effects of the shock (except for the producer price index, where monetary policy mitigated the inflationary effects). Moreover, inflation expectations moved in the opposite direction to monetary policy, showing a lack of confidence in monetary policy. In contrast, following a foreign currency shock that came from the outside, monetary policy was contractionary and mitigated the inflationary impact of the shock. Moreover, the evolution of inflation expectations has been in line with monetary policy, indicating confidence in the central bank's monetary policy. Hence, the monetary policy of the Central Bank of Iran has not been able to control the side effects of structural reform, although it has planned and implemented a good policy to unify the exchange rate. In contrast, after a foreign currency shock resulting from international economic sanctions, the Central Bank of Iran was able to sufficiently control the inflationary effects of the shock by creating confidence in its policies, which in turn was accompanied by inflation expectations. For this reason, the inflation rate in the Iranian economy declined between 2013 and 2016.

A notable similarity is that the prices of all groups of goods were affected by the inflationary impact of the foreign currency shocks, regardless of whether they originated from domestic or external sources. The only differences were in the persistence and severity of the inflationary effects of the shocks. This issue shows a considerable dependence of consumption, production, and services sectors on

imported inputs, intermediate goods, and final consumption goods, which causes the weakness and vulnerability of these real sectors of the economy to exchange rate fluctuations. The structural weakness that has been an unresolved issue in the Iranian economy for decades.

This result is significantly confirmed by both aspects of theoretical background and Iran's Statistical Center and Customs. As pointed out in section 2, the volume of tradable goods in the consumer's basket of goods and domestically produced goods can potentially influence the degree of the effects of exchange rate shocks on domestic prices. Firms that have the large share of imported inputs and intermediate goods in their production process are likely to be more affected by exchange rate fluctuations and factor them into their goods prices. In summary, the dependence degree of both supply and demand sectors of an economy on imports is an important factor in transition of inflationary effects of exchange rate fluctuations to domestic prices. On the other hand, based on Iran's Statistical Center and Customs, as pointed out in data description, the sectors of housing, food, services, and healthcare showing a noticeable share in the price index of households' consumption basket, are considerably dependent on the imported input, intermediate and final goods. More details, on average about 80% of imports are allocated to intermediate and capital goods, and only 20% to final consumer goods. It shows the significant dependence of various sectors of Iran's economy on imported inputs. In addition, the share of imported inputs in the food, healthcare, housing, services, and production sectors is significantly high. Because foods are highly dependent on imported agricultural inputs, and other mentioned sectors on specific inputs of their own sectors_ healthcare on the imported input to produce drugs, housing on the imported building materials, and the same as the sectors of services and production_. Therefore, the sectors mentioned above, have enough potential to be affected by exchange rate shocks. As a result, the theoretical background and the statistics confirm the obtained results.

Some studies reached the same conclusions regarding some parts of the present study. Şen et al. (2020) concluded that the inflation rate and the increase in the exchange rate are related to the dependence on imported inputs. Kurtović et al. (2018) found that the inflationary impact of exchange rate fluctuations is only a short-term effect for some economies, but has a long-term effect in some other economies. Sadeghi and Tayebi (2018) emphasized the transition of the inflationary impact of an increase in the foreign exchange rate on domestic prices after international economic sanctions. Civcir & Akçağlayan (2010) showed that an increase in the exchange rate had a positive effect on domestic prices in Turkey and that the central bank and its monetary policy instrument, the interest rate, responded significantly in some periods but not in other periods. In addition, being differently affected the various sectors of an economy by foreign currency shocks

is confirmed by Osbat et al. (2021). Ha et al. (2020) found out that the degree of exchange rate pass-through is affected by the source of foreign currency shocks (domestically or globally), economies' structures, and the response of monetary policy.

6. Conclusion and Policy Recommendation

This study assesses the inflationary effects of foreign currency shocks and then the monetary policy response using the VAR methods. In this regard, first, the response of the price indices of different groups of goods to foreign currency shocks with domestic source after the application of the exchange rate unification policy in 2001:1-2010:4 and to foreign currency shocks with external source after the international economic sanctions in 2011:1- 2018:4 were evaluated separately using the impulse response functions. Second, the contribution of foreign currency shocks, inflation expectations, and monetary policy to the fluctuations of all commodity groups were analyzed and compared separately. Third, the response of the price indices of the various goods groups to monetary policy and then the response of monetary policy to foreign currency shocks were examined.

The results show that the foreign currency shocks of domestic source had medium- and long-term inflationary effects in addition to short-term effects (with the exception of the producer price index, which showed only a long-term effect). In contrast, the foreign currency shocks with an external source had only a short-term inflationary effect. In this regard, the adjustment speed of the deviation from a long-term equilibrium was considerably greater after the foreign currency shock of international economic sanctions than the policy of exchange rate unification. One notable similarity is that the prices of all commodity groups were affected by the inflationary effects of the foreign currency shocks, regardless of whether they were domestically or externally sourced. Another point is that monetary policy was expansionary and amplified the inflationary effects of the domestic-source shock (except for the producer price index, where monetary policy weakened the inflationary effects) and contractionary and weakened after the external-source shock. Furthermore, monetary policy was accompanied by inflationary expectations after the external-source shock, while this was not the case after the domestic-source shock. In other words, confidence in monetary policy was sufficient after the external source shock.

In light of the results, it is recommended to gradually reduce the heavy dependence of the real sectors of the economy on exchange rate fluctuations by taking the opportunity to rely on domestic capacity. To this end, the manufacturing sector must be strengthened and its dependence on imported inputs and intermediate goods reduced in the long-term. This policy will not only reduce the impact of exchange rate fluctuations on the manufacturing sector, but also make

the services and consumption sectors more resilient to foreign exchange shocks by meeting the needs of domestic consumers in various sectors of the economy, such as services, housing, food, and health care. One of the positive outcomes in the long-run will be a reduction in foreign exchange outflows from the country as imports of inputs, intermediate goods, and final consumer goods decline. This is because a strong domestic manufacturing sector can affect consumer preferences to turn to domestic goods. In addition, strengthening the manufacturing sector can earn more foreign exchange, which leads to an increase in exports. This policy and the achievement of its goals will strengthen the value of the national currency in the long-run, leading to less exchange rate fluctuations.

As the results regarding the persistence of the inflationary effects of foreign currency shocks of domestic source resulting from structural reforms have shown, if similar reform policies are to be pursued, policymakers should take their side effects into account in advance in order to reduce the intensity and persistence of their impact on the economy. In this regard, there is a need for comprehensive planning so that the negative side effects of structural reforms do not affect the performance of the different sectors of the economy in the medium- and long-term. This is because, as the results show, the shocks that come from the outside, unlike the shocks that come from the inside and are due to the structural reforms, usually have a political factor and not an economic one. Therefore, when political tensions diminish, their effects will not last. The third policy recommendation is that the central bank should accompany economic agents' inflation expectations with its monetary policy in order to achieve its objectives by creating sufficient confidence in the goals of its monetary.

References

- Ahn, J., & Park, C. G. (2014). Exchange Rate Pass-through to Domestic Producer Prices: Evidence from Korean Firm-Level Pricing Survey. *Economics Letters*, 125(1), 138-142.
- Aisen, A., Manguinhane, E., & Simione, F. F. (2021). An Empirical Assessment of the Exchange Rate Pass-Through in Mozambique. *International Monetary Fund Working Papers*, 21(132), 1-34.
- Antonio J. G., & Luis A. H. (2022). Inflation, Oil Prices and Exchange Rates; The Euro's Dampening Effect. *Journal of Policy Modeling*, 44(1), 130-146.
- Antwi, S., Issah, M., Patience, A., & Antwi, S. (2020). The Effect of Macroeconomic Variables on Exchange Rate: Evidence from Ghana. *Cogent Economics & Finance*, 8(1), 1-20.
- Betts, C., & Devereux, M. B. (2000). Exchange Rate Dynamics in a Model of Pricing-to-Market. *Journal of international Economics*, 50(1), 215-244.

- Buyandelger, O. E. (2015). Exchange Rate Pass-Through Effect and Monetary Policy in Mongolia: Small Open Economy DSGE Model. *Procedia Economics and Finance*, 26, 1185-1192.
- Caporale, G. M., Carcel, H., & Gil-Alana, L. (2017). Central Bank Policy Rates: Are they Cointegrated? *International Economics*, 152, 116-123.
- Choudhri, E. U., & Hakura, D. S. (2015). The Exchange Rate Pass-Through to Import and Export Prices: the Role of Nominal Rigidities and Currency Choice. *Journal of International Money and Finance*, 51, 1-25.
- Civcir, I., & Akçağlayan, A. (2010). Inflation Targeting and the Exchange Rate: Does it Matter in Turkey? *Journal of Policy Modeling*, 32(3), 339-354.
- Comunale, M., & Simola, H. (2018). The Pass-Through to Consumer Prices in CIS Economies: the Role of Exchange Rates, Goods and Other Common Factors. *Research in International Business and Finance*, 44, 186-217.
- Cuitiño, F., Medina, J. P., & Zacheo, L. (2022). Conditional Exchange Rate Pass-Through and Monetary Policy Credibility: Insights from Uruguay and Chile. *Economic Modelling*, 114, 105926.
- De Mendonça, H. F., & Tiberto, B. P. (2017). Effect of Credibility and Exchange Rate Pass-Through on Inflation: An Assessment for Developing Countries. *International Review of Economics & Finance*, 50, 196-244.
- Delgado, N. A. B., Delgado, E. B., & Saucedo, E. (2018). The Relationship Between Oil Prices, the Stock Market and the Exchange Rate: Evidence from Mexico. *The North American Journal of Economics and Finance*, 45, 266-275.
- Devereux, M. B., & Yetman, J. (2014). Globalization, Pass-Through and the Optimal Policy Response to Exchange Rates. *Journal of International Money and Finance*, 49, 104-128.
- El Alaoui, A. O., Jusoh, H. B., Yussof, S. A., & Hanifa, M. H. (2019). Evaluation of Monetary Policy: Evidence of the Role of Money from Malaysia. *The Quarterly Review of Economics and Finance*, 74, 119-128.
- Elnagger, A., & Richter, C. (2022). Exchange Rate Pass-Through, Inflation and Monetary Policy in Egypt. *Applied Economics Quarterly*, 1, 1-36.
- Forbes, K., Hjortsoe, I., & Nenova, T. (2018). The Shocks Matter: Improving our Estimates of Exchange Rate Pass-Through. *Journal of International Economics*, 114, 255-275.
- Ghartey, E. E. (2019). Asymmetries in Exchange Rate Pass-Through and Monetary Policy Principle: Some Caribbean Empirical Evidence. *The North American Journal of Economics and Finance*, 47, 325-335.

- Güney, P. Ö. (2016). Does the Central Bank Directly Respond to Output and Inflation Uncertainties in Turkey? *Central Bank Review*, 16(2), 53-57.
- Ha, J., Stocker, M. M., & Yilmazkuday, H. (2020). Inflation and Exchange Rate Pass-Through. *Journal of International Money and Finance*, 105, 102187.
- Helmy, O., Fayed, M., & Hussien, K. (2018). Exchange Rate Pass-Through to Inflation in Egypt: A Structural VAR Approach. *Review of Economics and Political Science*, 3(2), 2-19.
- Ji, J. (2022). Exchange Rate Pass-Through to Domestic Inflation in a Pricing Model Incorporating Distribution Chain Structure. *Journal of Applied Economics*, 25(1), 432-453.
- Jiménez-Rodríguez, R., & Morales-Zumaquero, A. (2016). A New Look at Exchange Rate Pass-Through in the G-7 Countries. *Journal of Policy Modeling*, 38(5), 985-1000.
- Kramarz, F., Martin, J., & Mejean, I. (2020). Volatility in the Small and in the Large: the Lack of Diversification in International Trade. *Journal of International Economics*, 122, 1-19.
- Kurtović, S., Siljković, B., Denić, N., Petković, D., Mladenović, S. S., Mladenović, I., & Milovancevic, M. (2018). Exchange Rate Pass-Through and Southeast European Economies. *Physica A: Statistical Mechanics and its Applications*, 503, 400-409.
- López-Villavicencio, A., & Mignon, V. (2017). Exchange Rate Pass-Through in Emerging Countries: Do the Inflation Environment, Monetary Policy Regime and Central Bank Behavior Matter? *Journal of International Money and Finance*, 79, 20-38.
- Lueangwilai, K. (2012). Monetary Policy Rules and Exchange Rate Uncertainty: A Structural Investigation in Thailand. *Procedia Economics and Finance*, 2, 325-334.
- Mohanty, M. S., & Klau, M. (2005). Monetary Policy Rules in Emerging Market Economies: Issues and Evidence. In *Monetary policy and macroeconomic stabilization in Latin America* (205-245). Berlin: Springer.
- Nasir, M. A., Huynh, T. L. D., & Vo, X. V. (2020). Exchange Rate Pass-Through & Management of Inflation Expectations in a Small Open Inflation Targeting Economy. *International Review of Economics & Finance*, 69, 178-188.
- Osbat, C., Sun, Y., & Wagner, M. (2021). Sectoral Exchange Rate Pass-Through in the Euro Area. *European Central Bank Working Paper Series*, 2634, 1-41.
- Popescu, I. V. (2014). Analysis of the Behavior of Central Banks in Setting Interest Rates, the Case of Central and Eastern European Countries. *Procedia Economics and Finance*, 15, 1113-1121.
- Sadeghi, A., & Tayebi, S. K. (2018). Effects of International Sanctions and Other Determinants on Iran's Inflation Rate (1981-2014). *Iranian Journal of Economic Research*, 23(74), 33-57.

Sasaki, Y., Yoshida, Y., & Otsubo, P. K. (2022). Exchange Rate Pass-Through to Japanese Prices: Import Prices, Producer Prices, and the Core CPI. *Journal of International Money and Finance*, 123, 1-50.

Şen, H., Kaya, A., Kaptan, S., & Cömert, M. (2020). Interest Rates, Inflation, and Exchange Rates in Fragile Emes: a Fresh Look at the Long-Run Interrelationships. *The Journal of International Trade & Economic Development*, 29(3), 289-318.

Senay, O., & Sutherland, A. (2019). Optimal Monetary Policy, Exchange Rate Misalignments and Incomplete Financial Markets. *Journal of International Economics*, 117, 196-208.

Shahmoradi, A., & Sarem, M. (2013). Optimal Monetary Policy and Inflation Targeting. *Journal of Economic Research*, 48(2), 25-42.

Shi, K., & Xu, J. (2010). Intermediate Goods Trade and Exchange Rate Pass-Through. *Journal of Macroeconomics*, 32(2), 571-583.

Shin, J., & Park, Y. (2005). Analysis on the Dynamic Relationship among Product Attributes: VAR Model Approach. *The Journal of High Technology Management Research*, 16(2), 225-239.

Shin, Y., & Schmidt, P. (1992). The KPSS Stationarity Test as a Unit Root Test. *Economics Letters*, 38(4), 387-392.

Stock, J. H., & Watson, M. W. (2003). *Introduction to Econometrics*. New York: Pearson.

Tayebi, S. K., & Sadeghi, A. (2017). The Impacts of International Sanctions and Other Factors Affecting Exchange Rate in Iran. *Journal of Economic Research*, 52(3), 641-661.

Walsh, E. C. (2010). *Monetary and Theory Policy* (3rd Ed.). Cambridge, MA: The MIT Press.

Woodford, M. (2001). The Taylor' Rule and Optimal Monetary Policy. *American Economic Review*, 91(2), 232-237.

Yanamandra, V. (2015). Exchange Rate Changes and Inflation in India: What is the Extent of Exchange Rate Pass-Through to Imports? *Economic Analysis and Policy*, 47, 57-68.

Yazdani, M. (2018). Monetary Policies, Exchange Rate Pass-Through and Prices in Asian Economies: a Long and Short-Run Analysis. *Iranian Economic Review*, 22(4), 1034-1064.

This article is an open-access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license.



Cite this article: Sadeghi, A., Marzban, H., Samadi, A. H., Azarbaiejani, K., & Rostamzadeh, P. (2024). Inflationary Effects of the Foreign Currency Shocks with Different Sources: The Response of Monetary Policy in a Developing Economy. *Iranian Economic Review*, 28(3), 695-729.