Exchange rate pass-through into inflation in Vietnam: evidence from VAR model

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Abstract

Purpose – The purpose of this paper is to examine and analyze the exchange rate pass-through into inflation (ERPT) in Vietnam.

Design/methodology/approach – The paper examines and analyzes the ERPT in Vietnam by applying vector autoregression model over the period 2008–2018.

Findings – The key finding of the research is that from the impulse response results, the transmission of exchange rate shocks to inflation is significant in Vietnam, and this is incomplete exchange rate pass-through. Moreover, the evidence from variance decompositions argues that exchange rate is an important factor to explain the fluctuation of inflation.

Originality/value – In overall, the depreciation or appreciation of exchange rate in Vietnam will considerably impact inflation.

Keywords Vietnam, Vector autoregression, Exchange rate pass-through into inflation

Paper type Research paper

1. Introduction

After being a member of World Trade Organisation (WTO) in 2007, Vietnam has been deeply integrated into the global economy. Therefore, the exchange rate that represents the relationship between Vietnam and the world plays an important role, as well as affects many macroeconomic factors including inflation. Now, quantitative studies on the exchange rate pass-through into inflation (ERPT) are scarce in Vietnam, especially during the post-WTO period. Hence, in this study, the author estimates and analyses the impact of exchange rate on inflation quantitatively in Vietnam over that time to contribute to existing literature.

Goldberg and Knetter (1997) defined exchange rate pass-through as "the percentage change in local currency import prices resulting from a one percent change in the exchange rate between the exporting and importing countries" (p. 1248). However, this definition also extends to producer prices and consumer prices. According to the authors, there are two types of exchange rate pass-through: incomplete exchange rate pass-through if exchange rate pass-through is less than 1 (exchange rate changes by 1 percent and price levels change by less than 1 percent) and complete exchange rate pass-through if exchange rate pass-through is equal or greater than 1 (exchange rate changes by 1 percent and price levels change by 1 percent or greater than 1 percent).

There are some research studies on ERPT in different countries. Dornbursch (1987) studied the US market in the 1980s and proved that in the imperfectly competitive market,

ERPT is not complete and opposite to the ratio between the number of domestic enterprises and the number of foreign enterprises. In other words, the increase in competitive pressure faced by the domestic firms leads to a decrease in ERPT. Meanwhile, Taylor (2000) studied the US market from the 1960s to the 1990s to conclude that ERPT is proportional to the inflation level. To be more exact in the lasting inflation, enterprises are aware that inflation fluctuations are not temporary, so they adjust their product prices.

McCarthy (2000) compared countries such as the USA, Belgium, Germany, France, the Netherlands, the UK, Japan, Sweden and Switzerland over the period 1976–1998 to confirm that ERPT in the emerging countries is greater than ERPT in the developed countries. Moreover, Campa and Goldberg (2005) used data series from 1975 to 2003 for 23 countries in Organization for Economic Co-operation and Development (OECD) to find the following: ERPT is small in the short term; ERPT is significant in the countries where the exchange rate is unstable; and important factor affecting ERPT is not macroeconomicvariables, it is the change of imported goods. Besides, Lian (2006) also studied the impact of the exchange rate pass-through on three price indices (producer prices, import prices and consumer prices) over the period 1980–2007 of 09 OECD countries. The result shows that the exchange rate pass-through is less than 1, both in the short and long term. In particular, the exchange rate pass-through into the import prices is the largest, and the exchange rate pass-through into the consumer prices is the smallest. At the same time, the authors also concluded that the exchange rate pass-through is always more considerable in small countries characterized by large scale of imported goods, rigid exchange rate regime, inconsistent monetary policy and high inflation.

In Vietnam, there are some research studies on ERPT. Specifically, Vo (2009) found that the exchange rate pass-through is complete after five to seven months since the exchange rate fluctuates, then it gradually decreases; the exchange rate pass-through into consumer prices is greater than the exchange rate pass-through into import prices. Furthermore, Nguyen *et al.* (2009) also evaluated the exchange rate pass-through. Their results point out that inflation in the period 2005–2009 changes by 0.07 percent after two months when exchange rate changes by 1 percent, and this effect completely disappeares in the third month.

In general, there are two main approaches to investigate exchange rate pass-through, namely micro-approach used in studies such as Dornbursch (1987), Krugman (1986) and Feinberg (1986), and macro-approach used in studies such as Taylor (2000), McCarthy (2000) and Ito and Sato (2006). Researchers such as Olivei (2002), Otani *et al.* (2005), Campa and Goldberg (2005) and Campa *et al.* (2005) used ordinary least square (OLS) to measure ERPT, whereas other researchers used vector autoregression model (VAR) to measure ERPT, for instance McCarthy (2000), Leigh and Rossi (2002), Hahn (2003), Belaish (2003), Faruqee (2006) and Ito and Sato (2006). According to McCarthy (2000), VAR model is better than OLS model due to following reasons: VAR model improves limitation of OLS regarding non-stationary issues, and it identifies the comtemporanous impacts among variables, so variables affect each other, instead of unique direction impact in OLS model. This paper follows the macro-approach and uses VAR to evaluate ERPT in Vietnam, during post-WTO period from 2008 to 2018.

Based on monthly data from 2008M1 to 2018M5, the paper contributes to existing studies by threefold aspects. First, the paper sets up VAR model with one exogenous variable (world price of oil) and five endogenous variables (output gap, consumer price index, broad money, lending interest rate and real effective exchange rate (REER)) to evaluate ERPT. Second, for the key variable in the model (i.e. exchange rate), the paper calculates the REER and uses this exchange rate ratio in order to examine the pass-through level. The reason is that the nominal exchange rate is fixed for a long time and makes little sense to Vietnam economy. Third, the paper focuses on the post-WTO period of Vietnam,

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which is now scarce to study ERPT. The results from impulse responses and pass-through coefficients represent that ERPT in Vietnam is incomplete. In addition, the variance decomposition analysis of inflation suggests that the REER is an important factor to explain the fluctuation of inflation. In general, it is likely to say that the REER significantly affects inflation in Vietnam. It means that the exchange rate policy (i.e. appreciation or depreciation) plays an important role in influencing macroeconomic factors like inflation in Vietnam.

The rest of this paper is organized as follows: Section 2 mentions that VAR model is used to identify the exchange rate shocks; Section 3 explains the results of model; Section 4 provides robutsness; and Section 5 presents conclusion and future study.

2. Methodology and data

2.1 Methodology

McCarthy (2000) and Hahn (2003) argued that exchange rate and price level are key variables to estimate exchange rate pass-through; oil price and output capture impacts of real side in economy; money aggregate and interest rate capture impacts of money market side, allowing monetary policy to influence exchange rate pass-through. All variables are needed in the model of ERPT. Based on arguments of McCarthy (2000) and Hahn (2003), as well as adjusted to Vietnam economy, the paper conducts the VAR model as follows:

$$Y_t = AY_{t-1} + e_t,$$

where Y_t comprises one exogenous variable (world price of oil) and five endogenous variables (IP – output gap, CPI – consumer price index, M2 – broad money, IR – lending interest rate and REER – REER) at time t; Y_{t-1} comprises one exogenous variable (world price of oil) and five endogenous variables (IP, CPI, M2, IR and REER) at time $t-1$; A is coefficient matrices; and e_t is error terms at time t.

Structural shock is identified by Cholesky decomposition, specifically ordering variables. Thus, variables will respond contemporaneously to variables' shocks that are placed ahead, and they will not be affected contemporaneously by variables' shocks that are placed behind. According to Bernanke and Mihov (1998), the non-policy variables such as oil price, output and price level are placed first, followed by the policy variables such as money aggregate, interest rate and exchange rate. Therefore, the recursive restriction is imposed as follows:

$$\begin{bmatrix} eOIL \\ eIP \\ eCPI \\ eM2 \\ eIR \\ eREER \end{bmatrix} = \begin{bmatrix} z11 & 0 & 0 & 0 & 0 & 0 \\ z21 & z22 & 0 & 0 & 0 & 0 \\ z31 & z32 & z33 & 0 & 0 & 0 \\ z41 & z42 & z43 & z44 & 0 & 0 \\ z51 & z52 & z53 & z54 & z55 & 0 \\ z61 & z62 & z63 & z64 & z65 & z66 \end{bmatrix} \begin{bmatrix} uOIL \\ uIP \\ uCPI \\ uM2 \\ uIR \\ uREER \end{bmatrix}.$$

Hence, the exogenous variable – oil price – is placed first. Oil price shocks could then impact contemporaneously all other endogenous variables, but oil price does not respond to other variables' shocks. The next variables that describe the macro-domestic market are output and price level. Output is only affected by oil price's shocks contemporaneously and does not respond to price level, money aggregate, interest rate and exchange rate shocks contemporaneously. However, price level is affected by oil price and output shocks contemporaneously and does not respond to money aggregate, interest rate and exchange rate shocks contemporaneously. Following macro-domestic market is monetary market, which includes money aggregate and interest rate. Broad money variable mentions money demand function where real money demand depends on the opportunity cost of holding

money and real income. Besides, interest rate variable reflects the monetary policy rule in which the Central Bank will set up a suitable interest rate, after observing the current domestic currency velocity in the economy. So broad money is affected by oil price, output and price level shocks contemporanously and does not respond to interest rate and exchange rate shocks contemporanously. However, interest rate is affected by oil price, output, price level and money aggregate shocks contemporanously and does not respond to exchange rate shocks contemporanously. As a forward-looking asset price, the exchange rate is ordered last to respond to all variables' shocks in the system contemporaneously.

2.2 Data

The model comprises one exogenous and five endogenous variables; all variables are derived from M1:2018 to M5:2018, and they need to be seasonally adjusted (except financial variables).

Oil price: in the paper, oil price is UK Brent oil price, and it is extracted from Federal Reserve Bank. Oil price will definitely impact the import price and consumer price; changes in world price of oil make a considerable influence on the inflation rate in Vietnam.

Industrial output: following the aforenamed studies, monthly industrial production is used as proxy for output, since there are no monthly statistic data on Gross Domestic Product. Industrial production data are derived from Vietnam General Statistics Office (GSO). Hodrick–Prescott filter is used to estimate potential output, based on real industrial production. The difference between the actual output and the potential output is output gap. This variable does not need to adjust seasonality, as seasonal effects have been eliminated by Hodrick–Prescott technique. Industrial output gap is used in the model to represent aggregate demand pressure. If other factors are held constant, when real output is more than potential output (positive output gap), this implies that the demand increases, so inflation starts increasing and vice versa when real output is less than potential output (negative output gap). This implies that with the decrease of the demand, there is a decrease in inflation.

Consumer price index: this indicator is taken from GSO in order to measure the inflation. In Vietnam economy, inflation is characterized by seasonality: inflation increases from December and starts falling in February due to New Year festival and Lunar New Year festival.

Monetary variables: according to Milton Friedman (1963), inflation is considered as a monetary phenomenon. This is a policy variable that plays an important role in macroeconomic stability including inflation, but this can be the main cause of high inflation as well as other instabilities of macroeconomics. The paper uses the broad money supply M2 and lending interest rates to represent the demand and supply on the monetary market. The data are extracted from International Financial Statistics (IFS) and State Bank of Vietnam (SBV).

Exchange rate: SBV publishes official exchange rate, namely average interbank exchange rate (from 2008 to 2015) or central exchange rate (from 2016 onwards); however, this nominal exchange rate seems as anchor. Sometimes it is fixed for a long period, and it does not reflect the movement of macroeconomics factors. Hence, the paper calculates and uses the REER, instead of the nominal exchange rate, to evaluate ERPT in Vietnam. REER reflects the value of domestic currency VND; this ratio accounts to inflation and exchange rate movements of the largest trading partner countries with Vietnam (USA, EU, China, Japan, Korea, Thailand and Singapore). The data to calculate REER are derived from GSO, SBV and IFS:

$$\text{REER}_j = \prod_{i=1}^{N} \left(\frac{d_j e_{i,j}}{d_i} \right)^{W_i},$$

where $N = 7$ foreign countries including USA, EU, China, Japan, Korea, Thailand and Singapore; $e_{i,j}$ is the exchange rate between Vietnam and each foreign country; W_j is trade weight of each foreign country; d_j is Vietnam's CPI; and d_i is each foreign country's CPI.

Therefore, if REER > 100, domestic currency appreciates; if REER < 100, domestic currency depreciates; and if REER = 100, domestic currency does not change.
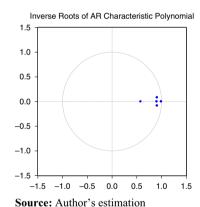
3. Empirical results
3.1 Unit root test
The augmented Dickey–Fuller (ADF) unit root test is used to examine variable stationarity. When analyzing time-series data, stationarity absolutely needs to be checked and to be satisfied. If variables are non-stationary, it leads to spurious regression and unreliable results. The ADF results show that variables such as broad money M2 and output gap IP are stationary, whereas others are non-stationary, which makes the system to be non-stationary.

According to Sims *et al.* (1990) and Fujiwara (2003), even if macro variables are non-stationary, the VAR could make the system stationary due to detrending, differencing or cointergrating techniques. Following these authors, VAR should be investigated in levels instead of differencing because differencing throws away important information. Thus, the paper takes the natural logarithm of variables, except output gap IP (treated in Hodrick–Prescott filter) and lending interest rate IR. The results show that the natural logarithm of variables – denoted LOG(Y) – makes the system stationary (Figure 1).

3.2 Lag length criteria
Determining lag length in VAR model is one of the most important requirements. Table I shows the lag length criteria for VAR analysis.

Inverse Roots of AR Characteristic Polynomial

Roots of Characteristic Polynomial
Endogenous variables: IP LCPI LM2 IR LREER
Exogenous variables: C LOIL
Lag specification: 1 1
Date: 10 June 2018 Time: 13:07

Root	Modulus
0.992375	0.992375
0.908434 − 0.082988i	0.912217
0.908434 + 0.082988i	0.912217
0.900816	0.900816
0.576236	0.576236

No root lies outside the unit circle
VAR satisfies the stability condition

Figure 1.
Stationary

Source: Author's estimation

Lag	LogL	LR	FPE	AIC	SC	HQ
0	−278.1205	na	9.48e–05	4.925136	5.161219	5.020983
1	639.2593	1,724.988	2.25e–11	−10.32922	−9.502927*	−9.993754
2	678.4208	70.28991	1.77e–11*	−10.57130	−9.154796	−9.996214*
3	700.4518	37.65985	1.88e–11	−10.52054	−8.513836	−9.705845
4	715.3053	24.12110	2.26e–11	−10.34710	−7.750184	−9.292784
5	746.3144	47.70622	2.08e–11	−10.44982	−7.262694	−9.155885
6	773.8191	39.96410	2.05e–11	−10.49263	−6.715302	−8.959083
7	804.5918	42.08237*	1.93e–11	−10.59131	−6.223773	−8.818145
8	830.5531	33.28368	2.01e–11	−10.60774*	−5.649997	−8.594960

Table I.
Lag length criteria

Source: Author's estimation

According to criteria AIC, SC and HQ, lag length should be 1, 2 or 8. As the number of observations is limited over the period M1:2008–M5:2018, the lag length is as small as possible. The reason is that if the lag length is increased, the degree of freedom is decreased, which might then affect the quality of the estimation. This is a reason why the paper chooses one lag length for the model.

3.3 Chow test
The SBV changed the exchange rate policy at the end of 2015 and implemented it in the beginning of 2016. Hence, there would have been a structural break to the official/nominal exchange rate. In other words, it is necessary to apply a nonlinear model such as threshold vector autoregression instead of a linear model such as vector autoregression. Nevertheless, the paper uses the REER over full period 2008–2018 instead of the nominal exchange rate. This could help the model avoid structural break issues, as the REER takes not only the nominal exchange rate of Vietnam but also various factors such as inflation and exchange rate movements of the largest trading partner countries with Vietnam. The REER reflects the "true" value of exchange rate of Vietnam over full period 2008–2018, and it may not be affected by changes of the exchange rate policy in 2016. In order to test whether there appears the structural break, the paper uses Chow test. Table II provides results.

The empirical results implies that it cannot reject the null hypothesis that there is no break at specified breakpoint (in January 2016 – the beginning time to implement new exchange rate policy). It means that there is no structural break for the model. Therefore, the paper could use VAR model to investigate the exchange rate pass-through.

3.4 Impulse response test and pass-through coefficients
Figure 2 illustrates the impact of REER changes on inflation. Because the REER is behind the consumer price index in the Cholesky triangle matrix, the shocks from REER to inflation only occur in the next period. As expected, inflation decreases after the REER increases (domestic currency appreciates). The interval confidence (red lines) mentions that result is significant over 15 months. So if REER increases, then inflation decreases from 2nd month onward and reaches maximum at 12th month.

To measure ERPT, many studies, for example McCarthy (2000), Leigh and Rossi (2002), Ito and Sato (2006) and Lian (2006), used a standardized approach in which the standard deviation of the exchange rate would be standardized to 1 percent increase in shock. At the same time, when calculating ERPT, it is necessary to consider the response of exchange rate due to its own shock in subsequent periods.

Applying the formula of Leigh and Rossi (2002) to measure the pass-through coefficient (PT):
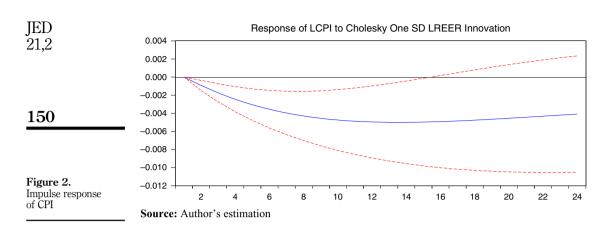
$$PT_{t,\,t+i} = P_{t,\,t+i}/E_{t,\,t+i},$$

Chow Breakpoint Test: 2016M01
Null Hypothesis: No breaks at specified breakpoints
Varying repressors: All equation variables
Equation sample: 2008M01 2018M05

F-statistic	0.823642	Prob. F(6, 113)	0.5539
Log likelihood ratio	5.350489	Prob. χ^2(6)	0.4997
Wald statistic	4.941852	Prob. χ^2(6)	0.5513
Source: Author's estimation			

Table II.
Chow test

Response of LCPI to Cholesky One SD LREER Innovation

Figure 2.
Impulse response
of CPI

Source: Author's estimation

where $P_{t,\ t+i}$ is price level change in period i in response to initial exchange rate shock and $E_{t,\ t+i}$ is the accumulated exchange rate change in response to its own shocks.

So, the pass-through coefficients are provided in Table III.

As shown in Table III, the real effective ERPT is incomplete pass-through (less than 1 percent). Specifically, after the first three months, the pass-through coefficient is −0.05, which means that 1 percent increase of the REER (i.e. appreciation) will cause the consumer price to decrease by 0.05 percent. After the first six months, the pass-through coefficient is −0.13, which means that 1 percent increase of the REER (i.e. appreciation) will cause consumer prices to decrease by 0.13 percent. After 12 months, the pass-through coefficient is −0.22, which means that 1 percent increase of the REER (i.e. appreciation) will cause consumer prices to decrease by 0.22 percent. After 15 months, the pass-through coefficient is −0.24, which means that 1 percent increase of the REER (i.e. appreciation) will cause consumer prices to decrease by 0.24 percent. Thus, it can be said that the REER shocks have a signinficant impact on consumer prices. Moreover, this is incomplete ERPT.

3.5 Variance decomposition
The paper uses Cholesky variance over a 15-month period because the impulse response of consumer price level to REER is significant over the period of 15 months, as mentioned above. According to Taylor (2000), in order to reinforce the result of ERPT, it is necessary to analyze variance decomposition of inflation, apart from the impulse response. To be more exact, if the real effective ERPT is high, this implies a strong transmission from REER fluctuations to consumer price. However, if the REER slightly affects the variance of the inflation, the REER is not an important factor to determine the fluctuations of

Month	CPI	Month	CPI
1	0.000000000	9	−0.182170388
2	−0.027774431	10	−0.196289103
3	−0.054789344	11	−0.208356451
4	−0.080579939	12	−0.218345799
5	−0.104765170	13	−0.226361291
6	−0.127124090	14	−0.232546249
7	−0.147550111	15	−0.237006336
8	−0.165902347		

Table III.
Pass-through
coefficients

Source: Author's estimation

consumer price. Thus, it can be observed that analysis of the variance of inflation is very essential (Table IV).

The results in LCPI variance table show that LREER is a great factor to determine the variance of LCPI among macroeconomic factors. It means that Vietnam has a relatively significant transmission effect from the REER to inflation. Three months after the REER shocks, LREER explains nearly 5 percent of LCPI variance or 5 percent of the inflation influctuation is explained by REER. Six months after the REER shocks, LREER explains nearly 22 percent of LCPI variance or 22 percent of the inflation influctuation is explained by REER. In total, 12 months after the REER shocks, LREER explains nearly 43 percent of LCPI variance or 43 percent of the inflation influctuation is explained by REER. Fifteen months after the REER shocks, LREER explains nearly 47 percent of LCPI variance or 47 percent of the inflation influctuation is explained by REER. In the other words, it confirms the significant role of the domestic currency appreciation/depreciation in inflation.

4. Discussion and policy implication

The paper applies VAR approach to investigate the ERPT over the period 2008–2018. From the paper's results, it can be observed that the impact level of ERPT over the post-WTO period is incomplete and less than that of ERPT over the ante-WTO period, as seen in Vo (2009) and Nguyen *et al.* (2009). Although the impact level of ERPT tends toward reducing, it is still significant based on impulse response of inflation to REER and variance decomposition of inflation results. In other words, it is likely that the REER significantly affects inflation. The paper's results could be explained by some reasons, which are given below.

First, in Vietnam, importers and their counterparts tend to adopt mark-up price, so the increase/decrease in the exchange rate is almost transferred into the import price and then consumer price. Goujon's (2006) view is consistent with empirical studies by Ghei and Pritchett (1999) and Feinberg (2000). These studies show that for small and developing countries, exchange rate pass-through into import price and consumer price is higher than the large and developed countries.

Second, in Vietnam, the inflation expectation makes the exchange rate and inflation relationship to be more sensitive. When an appreciation/depreciation policy is implemented, the people's psychology about the appreciation/depreciation is stimulated, and the effect goes

Period	SE	IP	LCPI	LM2	IR	LREER
1	8.720252	2.258229	97.74177	0.000000	0.000000	0.000000
2	10.34189	6.280352	91.15513	0.815911	0.002289	1.746313
3	11.00465	9.413639	82.44019	2.631441	0.023976	5.490750
4	11.34807	11.15179	73.02065	5.189604	0.077518	10.56043
5	11.56740	11.67044	63.78853	8.168619	0.159597	16.21282
6	11.73156	11.34866	55.28299	11.27675	0.257246	21.83436
7	11.86637	10.54909	47.77428	14.30056	0.356050	27.02002
8	11.98184	9.542362	41.33725	17.11213	0.444978	31.56328
9	12.08209	8.501954	35.92417	19.65265	0.517676	35.40355
10	12.16904	7.525351	31.42469	21.90951	0.571804	38.56865
11	12.24390	6.658938	27.70675	23.89639	0.607752	41.13018
12	12.30766	5.918144	24.64024	25.63940	0.627460	43.17476
13	12.36134	5.301285	22.10830	27.16858	0.633566	44.78826
14	12.40600	4.798218	20.01123	28.51338	0.628865	46.04831
15	12.44270	4.395363	18.26645	29.70051	0.616015	47.02166

Source: Author's estimation

Table IV.
Variance
decomposition of LCPI

straight to the consumer price index instead of passing through the production channel. Nguyen (2011) argued that in order to reduce negative effects from people's psychology, the Government should pay attention to control inflation even if inflation is at low level. Exaggerated expectation of inflation reduces the effectiveness of macroeconomic policies.

Third, Vietnam is considered as a high dollarization country. Some commodities such as real estate or fixed assets are usually quoted in US dollar. When the domestic currency depreciates, these commodities tend to increase and indirectly increase inflation and vice versa. Another point is that in Vietnam, money supply (M2) includes foreign currency deposit. If foreign currency appreciates, money supply will increase and vice versa. In the context of holding other macroeconomic factors constant, this will create impacts on price level in Vietnam.

Fourth, Vietnam's economy is highly dependent on imports for the domestic consumption and the production. Thus, Vietnam is heavily affected by the inflation import. If domestic currency value increases/decreases, it causes the price of imported goods in the local currency to decrease/increase, hence contributing directly to influence the price level of the country.

Finally, in Vietnam, domestic savings are not enough to meet the demand for investments, so Vietnam's economy is still growing due to foreign capital inflows. The appreciation/depreciation of the domestic currency will decrease/increase capital cost, which implies a decrease/increase in production costs, thus decreasing/increasing inflation.

To sum up, paper's results related to impulse responses and variance decompositions indicate that the inflation is significantly affected by REER shocks. Therefore, the exchange rate policy could strongly influence macroeconomic factor, especially inflation. If the exchange rate has to absorb negative shocks, it thus might influence inflation negatively. During the post-WTO period, ERPT in Vietnam tends toward reducing its impact level. This maybe due to the efficiency of SBV management on the exchange rate policy whereby SBV permits the exchange rate to be more flexible. This then enhances the development of the derivatives market, hedging the exchange rate risks for credit institutions and enterprises. As a result, firms usually use derivative instruments and take fluctuations of the exchange rate occurring in their products. Therefore, negative effects from the exchange rate changes could be reduced. It means that the exchange rate mechanism implemented by SBV is efficient, and the SBV needs to continue the exchange rate to be more flexible in line with the development of economy.

5. Robustness of results

To test the robustness, the paper now changes variable for the baseline model. Instead of using REER the paper uses nominal effective exchange rate, NEER. In this model, one lag is used to estimate the impulse response of consumer price level to nominal effective exchange rate in recursive zero contemporaneous restrictions. Following the result of impulse response of inflation to nominal effective exchange rate, inflation decreases after the nominal effective exchange rate increases (domestic currency appreciates). The interval confidence mentions that result is significant over 15-month period. So if nominal effective exchange rate increases, inflation decreases from the second month onward as nominal effective exchange rate is behind consumer price index in Cholesky triangle.

Calculating the pass-through coefficient shows that the nominal effective ERPT is incomplete and its absolute value is less than that of baseline model. Specifically, after the first 3 months, the pass-through coefficient is −0.04, which means that 1 percent increase of the NEER (i.e. appreciation), will cause the consumer price to decrease by 0.04 percent. After the first six months, the pass-through coefficient is −0.09, which means that 1 percent increase of the NEER (i.e. appreciation) will cause consumer prices to decrease by 0.09 percent. After 12 months, the pass-through coefficient is −0.15, it means that 1 percent

increase of the NEER (i.e. appreciation) will cause consumer prices to decrease by 0.15 percent. After 15 months, the pass-through coefficient is −0.17, it means that 1 percent increase of the NEER (i.e. appreciation) will cause consumer prices to decrease by 0.17 percent.

The results of LCPI variance analysis show that LNEER is great factor to determine the variance of LCPI among macroeconomic factors. However, its absolute value is less than that of baseline model. Three months after the shocks, nearly 3 percent of the inflation variance is determined by nominal effective exchange rate. Six months after the shocks, nearly 13 percent of the inflation variance is determined by nominal effective exchange rate. Twelve months after the shocks, nearly 34 percent the inflation variance is determined by nominal effective exchange rate. Fifteen months after the shocks, nearly 40 percent the inflation variance is determined by nominal effective exchange rate.

6. Conclusion

The paper measures the ERPT on the basis of VAR. The empirical results point out that ERPT is incomplete (less than 1 percent); specifically, the pass-through coefficient is −0.05 after 3 months; −0.13 after 6 months; −0.22 after 12 months; and −0.24 after 15 months. It means that 1 percent increase in the REER (i.e. appreciation) will decrease CPI by 0.05 percent over the next 3 months; by 0.13 percent after 6 months; by 0.22 percent after 12 months; and by 0.24 percent after 15 months. In addition, the variance analysis suggests that the REER may explain about 5 percent of the change in inflation after 3 months; 22 percent after 6 months; 43 percent after 12 months; and 47 percent after 15 months. This evidence argues that the REER significantly affects inflation in Vietnam.

Future work: because of the data limitation, this paper has not yet investigated and compared ERPT in two different periods, which reflects two different exchange rate regimes: from 2008 to 2015 and from 2016 onward:

(1) From 2008 to 2015, SBV applied the exchange rate mechanism through the average interbank exchange rate tool and the exchange rate band. Specifically, the average exchange rate in the interbank market in the previous day was the index basis for determining the next day's exchange rate. SBV regulated the trading band in each period, and it directly intervened in the interbank foreign exchange market to monitor the daily exchange rate.

(2) From 2016 onward, SBV has applied the exchange rate mechanism through the central exchange rate tool and the exchange rate band. The central exchange rate is determined by domestic and foreign factors, such as the average exchange rate in the interbank foreign currency market; exchange rates in the international market of some largest trading partner countries's currencies; and balance on macroeconomic and monetary policy.

So in the future, research studies could investigate and compare ERPT in two different exchange rate regimes. By doing this work, they could find the exchange rate regime, 2008–2015 exchange rate regime or 2016 onward exchange rate regime, that affects inflation more significantly.

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