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EXCHANGE RATE PASS-THROUGH AND INFLATION: POLICY INSIGHTS FOR VIETNAM BASED ON COMPARATIVE ANALYSES ACROSS ASIA

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ABSTRACT

This paper studies the effect of exchange rate pass-through (ERPT) on domestic inflation in Vietnam by comparing with other Asian economies. Specifically, pass-through mechanisms are examined for every single price as well as a distribution chain from import price index (IMP), producer price index (PPI) to consumer price index (CPI). The empirical results show that exchange rate shocks positively influence the price changes in Vietnam as well as in other Asian countries. According to Cholesky decomposition, the exchange rate plays a limited role in regulating CPI movements. Besides, world commodity prices are found to have a significant impact on domestic inflation across the sample-countries. Our findings reveal profound implications for monetary policy management and price stability.

Keywords: exchange rate pass-through, economic growth, financial development, developing economies, Asia

INTRODUCTION

In today's global trade context, alongside traditional interest rate channels, the pass-through of exchange rate movements on inflation has been of particular interest to central banks in emerging market economies. Due to the close link with interest rate fluctuations, the exchange rate is deemed among the key monetary transmission channels in this economic group (Ghosh & Rajan, 2007; Ha et al., 2020; Ito & Sato, 2008; Sek & Kapsalyamova, 2008; Vo et al., 2021). Unlike other mechanisms (e.g., interest rates, asset prices and domestic credit), variations in the exchange rate could have either an instant direct impact via the composition of the consumption bundle, or an indirect contractionary impact via the traditional expansionary competitiveness, financial cost of capital and balance sheet destabilization effects, on domestic price indices (Carranza et al., 2009; Dang et al., 2020a). Such procedures are referred to as the ERPT.

The ERPT research has greatly assisted countries in keeping their inflation low and stable. Especially in transitional economies, it contributed to enhancing the monetary policy effectiveness, notably in bringing down inflation from the double digits during the early stage of the economic reforms to a range of 3 - 5% in recent years (Ghosh, 2013). Empirical studies in Asia posit that the extent of ERPT to domestic inflation can have both short-run and long-run effects, yet in opposite directions conditional on the research period and country characteristics (Nguyen & Vo, 2021; Vo et al., 2021). For instance, Webber (1999) offers evidence of partial, long-run pass-through to IMP in most of the Asian-Pacific research sample, using a single equation technique. Studying five Asian countries including Indonesia, Thailand,

Malaysia, Singapore and South Korea in the post-Asian currency crisis, Ito and Sato (2008) conclude that: (i) the pass-through of exchange rate shocks tends to be the largest on IMP, then on PPI, and the smallest on CPI; and (ii) the entire period of 1994 - 2006 witnesses a larger extent of the pass-through to the three prices than the sub-period starting in 1997. Meanwhile, Hara et al. (2015) acknowledge a surge in the ERPT in Japan since the late 2000s with the support of a time-varying parameter estimation and a decomposition technique.

The ERPT mechanism has received considerable attention of academics and policymakers in Asian emerging economies in general and Vietnam in particular, where the strategy of devaluating domestic currency for export advantages has been a priority. Such a strategy would promote exports and national economic growth, yet it also causes domestic inflation and macro instability. Particularly in Vietnam, according to Dang et al. (2020b) and Pham (2015), the exchange rate is regarded as a key monetary policy tool to facilitate the transition to inflation targeting. However, contrary to the growing presence of ERPT-related research in Asian emerging markets, there has been scant evidence for Vietnam. Prior to the 2009 financial crisis, most studies concentrate on exploring either the determinants of exchange rate movements or the choice of exchange rate policy (Nguyen & Nguyen, 2009; Nguyen et al., 2010). Yet, entering the post-crisis era, the ERPT has been discussed in in-depth research on monetary policy (e.g. Pham, 2013; Pham, 2015; Vo et al., 2020). These studies, with the support of advanced time-series techniques (e.g. structural vector autoregression (SVAR) model), focus only on the pass-through to CPI instead of a complete price series (including IMP, PPI and CPI) as postulated by Laflèche (1997). Another drawback is that the previous works failed to place their findings on Vietnam in comparison with other developing countries in the region (e.g. Asia or the Asia-Pacific) to obtain a robust conclusion. Besides, research data not fully updated on a monthly/quarterly basis up until 2020 might cause the provided policy implications obsolete (Pham et al., 2021). Therefore, contemporary research on the ERPT for Vietnam needs to fill the gaps as indicated.

Vietnam provides a perfect institutional context for the ERPT study as the conduct of monetary policy in this country has been moving towards inflation targeting (Dang et al., 2020b). This requires a thorough understanding of the ERPT to domestic inflation to support the exchange rate management and stabilization (Pham, 2015; Pham, 2019). Through several transmission channels, exchange rate variations could exert an influence on both IMP and CPI. Adjustments in the exchange rates may as well alter the inflation expectations, thus redirecting the current inflation of the economy. For these reasons, exchange rate policy has been considered among the most effective tools for the State Bank of Vietnam (SBV) to achieve the inflation target. Aside from that, in-depth studies of the ERPT would also benefit the SBV in determining the scale and timing of the exchange rate adjustments, thereby reinforcing the objective of inflation control and macroeconomic stabilization.

To gain a complete picture of the ERPT in Vietnam, we include other Asian emerging economies, namely China, Malaysia and Thailand in our analyses. The main reasons for choosing these countries are as follows: (i) In the post-crisis period, drastic actions were taken to reconstruct the conduct of monetary policy. Accordingly, most countries have switched to more flexible exchange rate regimes in fostering international investment and trade. In our sample, China, Malaysia and Vietnam have pursued managed floating regimes while Thailand is among the few following inflation targeting. Despite their formal declarations, according to the International Monetary Fund (IMF) (2020), Ito and Sato (2008), Jiang and Kim (2013), and Rajan (2012), all the four could be re-classified as "managed floaters", which correspond with the adoption of a de facto fixed regime; (ii) Vietnam has long been regarding China, Malaysia

and Thailand as major partners with both trade and investment relationship growing substantially in recent years (Pham et al., 2019); (iii) The exchange rates of the three economies have been appreciating against USD in recent times (due to their dependence on the Western partners, notably the US), which has been accompanied by rising inflation, particularly in China.

This study seeks to address the following research questions: (i) To what extent have exchange rate variations affected domestic prices separately and in a price series over time?; (ii) To what extent did the pass-through to inflation depend on the underlying shocks triggering exchange rate movements?; (iii) Is there any difference in the degree of the ERPT to domestic price variables between Vietnam and other Asian countries with similar exchange rate regimes?; (iv) Did world commodity price fluctuations matter for the CPI of the sampled countries?

To shed light on such issues, we first adopt a reduced-form vector autoregressive (RVAR) approach to examine the pass-through effects for the case of Vietnam, on every single price variable as well as on a set of prices along the pricing chain from IMP, PPI to CPI. Second, the impact of global and domestic shocks on the price indices could be clarified through impulse response analysis. Third, to investigate the impact of exchange rate changes on the price series among the sampled countries, a seven-variable SVAR model is employed. The research results are subsequently analyzed using impulse response functions. Finally, a variance decomposition analysis is performed to identify what percentage of the CPI fluctuations could be explained by world commodity price.

The novelties of this paper are as follows. To the best of our knowledge, this is the first to explore the pass-through effects on every single price as well as a complete pricing chain towards CPI for the case of Vietnam. As discussed above, the majority of the extant studies on the ERPT in Vietnam consider CPI-based inflation rather than extending the model of pricing along a distribution chain as per the grounded theory. Second, our paper provides new insight into Vietnam's ERPT through empirical comparisons with other emerging Asian countries under similar exchange rate regimes. This might help the Vietnamese government design an appropriate strategy for not only exchange rates but other external interventions. Third, unlike earlier works that used a single approach along or limited time spans of data, our work is carried out based on up-to-date monthly data (lasting for 13 years) and advanced techniques for elucidating the ERPT in Vietnam. Specifically, an RVAR model is adopted to investigate the ERPT to domestic prices in Vietnam, whereas an SVAR model is used to grasp the contagion effects of an exchange rate shock on CPI along the pricing series. Finally, our work reveals an important conclusion that has not previously been reached based on the empirical examination of the ERPT to price series, that the theoretical unity of price dynamics with exchange rate fluctuations seems only justified by the dollarization feature of the Vietnamese economy, rather than the standard functioning of the ERPT in Vietnam.

BACKGROUND AND LITERATURE REVIEW

ERPT and Inflation

The magnitude of ERPT to domestic prices is defined as the percentage change in local-currency IMP caused by a 1% change in an exchange rate between the exporting and importing nations. As ERPT takes the value of 1, this pass-through effect is considered complete, implying the existence of the law of one price and purchasing power parity theory (Goldberg

& Knetter, 1996; Yanamandra, 2015). In light of the extant ERPT literature, it is clear that the degree of ERPT varies significantly across nations, thus, ascertaining correctly how exchange rate changes affect domestic prices is deemed an undeniable duty for the emerging-market central banks to fulfill the objectives of bringing down both inflation and trade deficits.

Theoretically, exchange rate movement could affect domestic prices through either direct, indirect or foreign direct investment (FDI) flow channels (Dobrynskaya & Levando, 2005; Laflèche, 1997). Direct channels reflect the impact of exchange rates on domestic inflation through IMP. Figure 1 illustrates the pass-through from a depreciation of the domestic currency to consumer prices. Specifically, in case of a domestic currency depreciation, the prices of domestic goods and imported inputs become more expensive, resulting in a rise in consumer prices. Meanwhile, through indirect channels, following the depreciation of the local currency, the prices of exported goods become more competitive, boosting foreign demand for domestically produced goods. Increased demand for labour, wages and aggregate demand would, in turn, lead to higher price levels. However, this effect only exists in the long term due to the stickiness of the prices. Besides, as proven empirically, higher degrees of dollarization of the economy may amplify this indirect transmission effect (Carranza et al., 2009). For instance, in some Latin American and Asian economies, despite not being traded internationally, luxury goods such as real estate and automobiles are customarily quoted in USD (Berg & Borensztein, 2001). Specifically, the depreciation of the home currency could lead to a rise in the local currency prices of these items, thus raising the money supply. As a result, domestic inflation occurs. Lastly, the FDI flows channel works through the influence of exchange rate changes on the FDI decisions (Jiang & Kim, 2013).

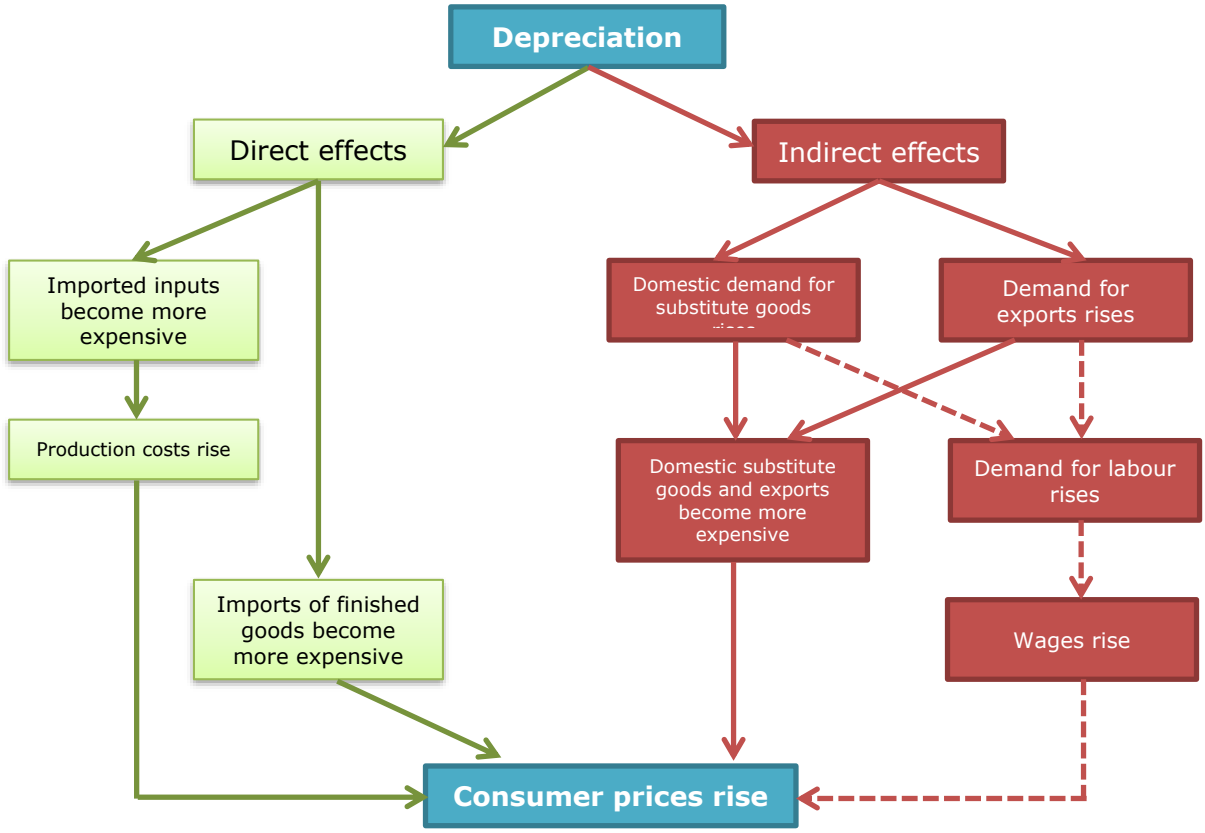

Figure 1. Pass-through from a depreciation of the domestic currency to consumer prices
Source: Laflèche (1997)

Review of the Extant Literature

There has been a growing body of literature on the relationship between the exchange rate regimes and the evolution of domestic prices in developed and developing economies. These works concentrate on three main directions:

(1) In the first direction, academics edeavour to prove the presence of the ERPT into IMP with varying degrees across economies. For instance, using data from 71 advanced and developing economies covering the period between 1979 and 2000, Goldfajn and Werlang (2000) find that developed economies tend to experience a lower pass-through than developing economies, however, both groups witnessed a sharp decline in ERPT over time. Barhoumi (2005), studying a pass-through mechanism on a sample of 24 developing countries, reveals evidence of cross-country differences of the ERPT caused by heterogeneity on exchange rate regimes and trade distortions. The empirical results of ERPT for typical countries in ASEAN are also inconclusive. ERPT estimates for Thailand appear low in comparison to advanced economies, according to Nookhwun (2019). The low import content of Thai commodities and low inflation context, which makes Thai inflation less susceptible to exchange rate shocks, may both contribute to this explanation. Meanwhile, as manifested by Vo et al. (2020), Vietnam's high ERPT magnitude compared to other ASEAN members may be the result of the macroeconomic and financial environments, as well as the country's economic integration into the world market.

(2) Researches associated with the second direction are inclined to explore the ERPT to a chain of domestic prices, namely, import, producer and consumer prices, using McCarthy's (2007) approach. The merit of this methodology is that, by developing three separate equations that employ import, producer and consumer prices as dependent variables; oil price shocks, demand shocks (the output gap) and exchange rate shocks as explanatory variables, it is possible to justify the effect of exchange rate shocks on domestic price indices simultaneously in a vector autoregression (VAR) model. Based on a panel dataset of nine advanced economies, McCarthy (2007) points out a gradual pass-through of exchange rate shocks to multiple domestic prices, where timings and magnitudes of response, ranked in descending order, are IMP, PPI and CPI. The studies of Ca'Zorzi et al. (2007), Ito and Sato (2008), Sek and Kapsalyamova (2008), Nguyen and Vo (2021) found consistent results when analyzing the inflationary effects of exchange rate changes across different economies, though with different degrees and speed rates. Relevant to the case of Vietnam, Vo et al. (2021), adopting an SVAR model on a sample data of the ASEAN-5 to analyze a distribution chain model, suggest that exchange rate shocks have an instant effect on PPI in all the sampled countries.

(3) Studies under the third direction discuss the possibility that the ERPT could be non-linear or symmetric. Bussiere (2013), examining the ERPT into import and export prices on a sample of the G7 economies, insists that non-linearities and asymmetries really matter and could not be ignored in assessing the ERPT. Meanwhile, Kilic (2015) found a nonlinear pass-through to IMP in six advanced economies. The same results were reached in Baharumshah et al.'s (2017) work using a sample of six Asian countries. Kassi et al. (2019) suggested an asymmetry of the pass-through to the CPI across developing Asian countries over the short- and long-term. Most recently, Pham et al. (2020) conducted comparative analysis of the ERPT between inflation targeting and non-inflation targeting economies of ASEAN-5 and found evidence of the asymmetric effects of exchange rate shocks in Singapore, Philippines and Indonesia. By and large, the empirical literature has rapidly emerged to enrich the characteristics of the ERPT over time.

To our best knowledge, VAR models, including RVAR, recursive VAR and SVAR, are the most commonly used approaches in the ERPT research. In an RVAR model, each variable is regressed by its own lags and those of all other variables. The problem behind this is the error terms or residuals might be correlated among equations and includes a stochastically contemporaneous effect among variables. Thus, RVAR model could not be utilized to interpret an economically causal relationship among variables. The recursive VAR model contributes to the problem of correlated error terms by ordering all influential variables to eliminate the correlation of the error term with the preceding equation. Specifically, the first equation explores the first-order variable as a dependent variable and its own lags as explanatory variables; the second equation includes the second-order variable as the dependent variable and its own lag as well as the present value of the first-order variable. This raises an issue on how to determine the order of the variables included. To settle this, an SVAR model could be chosen. According to Stock and Watson (2001), the "identifying assumption" might be the most stringent in a VAR model. The assumption requires economic theory to support the ranking of variables in order of influence. Therefore, the SVAR model is broadly applied to analyze the causal relationship among endogenous variables. The merits of SVAR urge researchers to use it for identifying complex relationships among endogenous variables in their models.

Overview of the Pass-Through in Vietnam

As depicted in Figure 2, there was a persistent tendency for the positive pass-through effects of exchange rate changes on CPI and PPI. However, for each period segment characterized by distinct circumstances and conditions, the link between this transmission channel and the inflation target requires in-depth analysis.

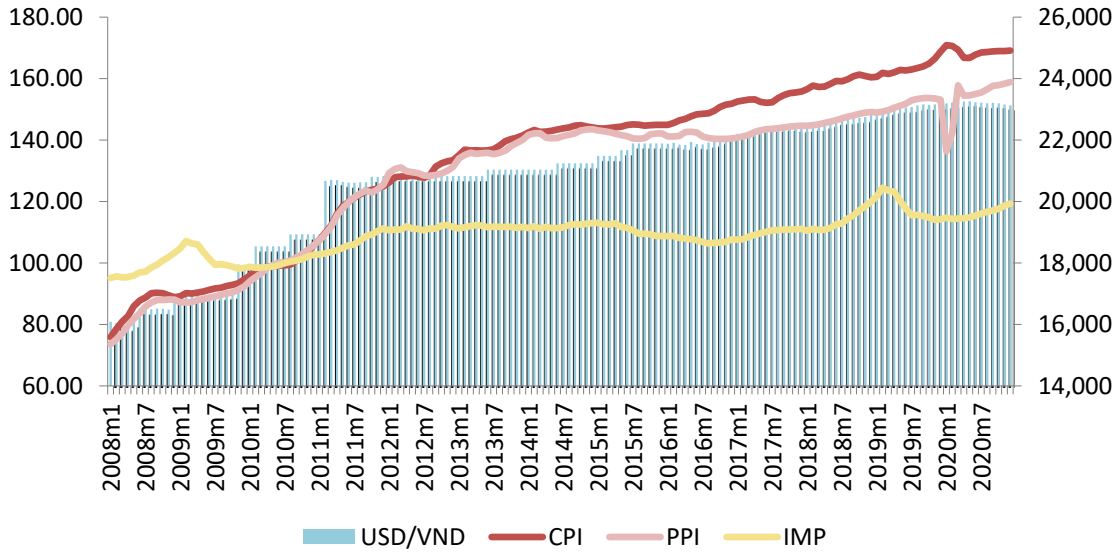

Figure 2. Vietnam's price indices and nominal exchange rate vis-à-vis USD
Notes: Index, 2010 = 100 (left axis); USD/VND exchange rate (right axis)
Sources: CEIC Global Database, International Financial Statistics (IFS) and SBV

Prior to the 2007-2008 global financial crisis, Vietnam's economy experienced a period of impressive growth under stable macroeconomic conditions, viz. inflation below double-digit, USD/VND exchange rate fluctuations below 2%, and trade deficits below 5 billion USD (Dang et al., 2020b; Le & Finch, 2022). Nevertheless, such a steady state was no longer maintained

since the beginning of 2008. Trade deficits started to exceed 10 billion USD, causing the current account deficits to rise above 9% in the gross domestic product (GDP). The forex market concurrently revealed the inability to absorb the excessive amount of foreign currency inflows into the economy, in which exchange rate stress became a major concern as it showed the external value of the VND had been distorted in the market. Commercial banks' exchange rates used to have differentials of over 2,000 VND per USD compared to the rates on the free market. The VND depreciated nominally against the USD, yet its real exchange rate continued to rise against most of the trading partner currencies due to high inflation.

Table 1
Vietnam's macroeconomic indicators (annual percentage change)

Year	GDP	CPI	M2	Domestic credit	USD/VND
2008	6.31	19.9	20.31	25.43	5.36
2009	5.32	6.50	29	37.53	5.68
2010	6.78	11.8	33.3	31.20	5.52
2011	5.90	18.10	12.4	14.40	10.01
2012	5.25	6.81	17.0	5.50	0.03
2013	5.42	6.04	18.5	12.51	0.98
2014	5.89	1.84	15.65	14.16	1.00
2015	6.68	0.63	16.23	17.26	3.03
2016	6.21	4.74	18.38	18.25	1.23
2017	6.81	3.53	14.50	18.17	1.20
2018	7.08	3.54	12.41	13.89	1.71
2019	7.02	2.79	14.78	13.65	1.26
2020	2.91	3.23	14.53	12.17	-0.28

Source: Authors' calculations based on data from the General Statistics Office of Vietnam (GSO) and SBV

Together with difficulties in achieving the final objectives of the monetary policy, Vietnam has seen strong volatility of exchange rate and inflation since 2008. This trend adversely affected the stability and growth of the economy as Vietnam had to import up to 70% of input materials for the production of consumer and export goods. Basically, between 2008 and 2013, both inflation and exchange rates in Vietnam varied considerably without any rules.

Theoretically, when the exchange rate is kept stable, the exchange rate risk to import and export enterprises would be mitigated, and thus, the foreign currency loan fluctuations would not become a burden for all sectors of the economy. In 2011, the Vietnamese government passed Resolution No. 11/NQ-CP with the aim of stabilizing the macro economy, reducing the trade deficits and containing inflation through synchronously coordinated macro policies such as fiscal and monetary tightening and capital priorities for manufacturing and exports. Yet in reality, CPI inflation in 2011 reached an all-time high of 18.10%. As of early 2012, the SBV signaled that the VND/USD exchange rate would fluctuate by no more than 3% in the whole year. Instantly, commercial banks sold USD to the SBV for VND as at that time, interest rates in VND were greater than those in USD. Subsequently, the SBV directed commercial banks to reduce VND deposit rates, commercial banks had to borrow VND on the interbank market to avoid exchange rate risk at the end of the year as demand for foreign currency increased. By the end of 2012, the exchange rate was stable.

From 2014 until the present time, as SBV started to tighten monetary policy setting through control of money supply and interest rates to dampen inflation shocks, Vietnam's inflation and bilateral exchange rates remained relatively stable, contributing significantly to macroeconomic stability and economic growth (Dang & Pham, 2020). In accomplishing the mission to control inflation assigned by the government, for the period until 2020, the SBV is expected to make changes to exchange rate policy so that the exchange rate movements better

reflect the market supply and demand and the announced interbank exchange rates closely follow the market spot rate.

An increase in the exchange rate would, to a certain extent, affect the interest rate and inflation, thus putting pressure on the interest rate in the market. The greater the difference in interest rates between VND and USD, the more favorable the VND. If the exchange rate increases sharply, depositors would tend to withdraw VND and convert them to USD bank deposits. Therefore, commercial banks need to consider raising interest rates in VND to retain customers. Once the input interest rates rise, the output interest rates also increase accordingly. This could affect the production investment sector when having loans. Nevertheless, in recent years, the SBV has repeatedly affirmed that the USD/VND exchange rate will fluctuate no more than 2% per year, regardless of the "room" so far is no longer available and the SBV is willing to sell foreign currency to intervene the market if necessary. With the SBV's commitment to stabilize exchange rates, the trade deficits in the past few years have not significantly affected the market interest rates.

To summarize, the exchange rate variations explicitly correlate with the inflation in Vietnam, to a greater of lesser degree depending on the stage of economic development. The maintenance of the less volatile nominal exchange rate is deemed a great effort of the SBV to stabilize the currency market, VND value and support production activities. However, Vietnam's inflation in recent years seems to be still high and unstable. Facing this situation, the SBV's exchange rate policy has been adjusted to be more flexible. As a result, the belief in VND of local and foreign invested enterprises has been strengthened, and simultaneously, exchange rate stabilization also effectively supports sectors in the medium and long-term business planning.

METHODOLOGY

Econometric Models

First, an RVAR approach is adopted to analyze the pass-through effects of exchange rate variations on the domestic prices for Vietnam. The general RVAR specification is written as follows.

$$Y_t = c + \sum_{i=1}^{p} \theta_i Y_{t-i} + \varepsilon_t \qquad (1)$$

where: Y_t is the vector of endogenous variables; θ_i denotes the coefficient matrices; ε_t is the composite of contemporaneous structural disturbances and c is the intercept.

Following McCarthy (2007), we set up a five-variable RVAR encompassing the bilateral exchange rate (ER), the domestic price (P) and other three macro variables, viz. world commodity price (WCP) as the supply shocks, the output gap (YGAP) as the demand shocks and the broad money (M2) as the monetary policy shocks – in which, exchange rate and domestic price variables are the main focus of attention.

Structural shocks in the RVAR model could be identified by setting out endogenous variables in the most appropriate order and applying Cholesky decomposition for a variance-covariance matrix of the reduced-form residuals (ε_t). The following order of variables in the RVAR model is selected: (i) world commodity price is ordered first since it could influence all other variables

contemporaneously, yet unlikely to be influenced by any other shocks (Ca'Zorzi et al., 2007; Ito & Sato, 2008); (ii) the output gap is placed second since it is likely to be affected by the variations in world commodity price while output gap (demand) shocks could have contemporaneous impact on the other variables (except world commodity prices); (iii) placed third in the ordering would be the monetary variable since in the case of Vietnam, monetary policy has a noticeable impact on the exchange rate through State Bank's adjustments to the average interbank exchange rate and trading bands, meanwhile, monetary policy might also be affected by changes in demand or supply; (iv) the exchange rate is placed fourth, indicating that it might respond contemporaneously to changes in supply, demand and monetary policy, yet unable to respond to the price variations; (v) the domestic price is placed last in order to examine how this variable reacts to the supply, demand and monetary policy shocks.

Accordingly, the Y_t vector of five endogenous variables takes the following form:

$$Y_t = \{WCP_t, YGAP_t, M2_t, ER_t, IMP_t, PPI_t, CPI_t\} \qquad (2)$$

From McCarthy's (2007) original model, we make the following adjustments. Instead of oil prices as in previous studies, we employ WCP to represent supply shocks since this indicator tends to better reflect the price changes of major commodities in the international market (including oil prices). Apart from CPI, we also consider the other two alternatives, viz. PPI and IMP. Accordingly, each price indicator is in turn incorporated in a five-variable RVAR model and placed at the bottom so that the ERPT to domestic prices could be justified, and simultaneously the degree and timing of the pass-through effects could be compared among the three prices. IMP is expected to have a quicker and larger response to the exchange rate shock than the other price indices, since non-tradable components such as distribution costs, rents and profits appear higher in PPI than IMP, and even higher in consumer prices than PPI. Second, to observe the contagion of the exchange rate shock spreading to the CPI over time, we examine the pass-through effects on a set of prices along a pricing series, from the IMP, PPI to CPI by using an SVAR model. In reality, this approach has been broadly used in prior studies (e.g. Hajek & Horvath, 2016; Ito & Sato, 2008; Jiang & Kim, 2013) to comprehend the shock transmission along the distribution chain. The structural shocks are identified using the Cholesky decomposition, in which the variance covariance matrix of the reduced form residuals is at a lower triangular matrix. There are $k*(k-1)/2$ restrictions as zero[1] imposed on the lower triangular matrix to identify the structural shocks, where the identified structural shocks from the variables at an early stage do not simultaneously affect those ordered later. The association between the RVAR residuals (μ_t) and the structural shocks (ε_t) is established as follows:

[1] The zero restrictions applied to Eq. (3) are similar to Hahn (2003), Ito and Sato (2008), and McCarthy (2007).

$$\begin{pmatrix} \mu_t^{WCP} \\ \mu_t^{YGAP} \\ \mu_t^{M2} \\ \mu_t^{NEER} \\ \mu_t^{IMP} \\ \mu_t^{PPI} \\ \mu_t^{CPI} \end{pmatrix} = \begin{pmatrix} \Phi_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ \Phi_{21} & \Phi_{22} & 0 & 0 & 0 & 0 & 0 \\ \Phi_{31} & \Phi_{32} & \Phi_{33} & 0 & 0 & 0 & 0 \\ \Phi_{41} & \Phi_{42} & \Phi_{43} & \Phi_{44} & 0 & 0 & 0 \\ \Phi_{51} & \Phi_{52} & \Phi_{53} & \Phi_{54} & \Phi_{55} & 0 & 0 \\ \Phi_{61} & \Phi_{62} & \Phi_{63} & \Phi_{64} & \Phi_{65} & \Phi_{66} & 0 \\ \Phi_{71} & \Phi_{72} & \Phi_{73} & \Phi_{74} & \Phi_{75} & \Phi_{76} & \Phi_{77} \end{pmatrix} \begin{pmatrix} \varepsilon_t^{WCP} \\ \varepsilon_t^{YGAP} \\ \varepsilon_t^{M2} \\ \varepsilon_t^{NEER} \\ \varepsilon_t^{IMP} \\ \varepsilon_t^{PPI} \\ \varepsilon_t^{CPI} \end{pmatrix} \quad (3)$$

In the array of Eq.(3), the above variable is set to affect the below one. In other words, the first variable has an impact on all other variables but it does not receive any influence in return. The second variable is affected by the first variable and affects the remainder. This rule is applied to all variables.

Data

The study utilizes up-to-date monthly data in four countries covering ten years from 2008M1 to 2020M12. All the data, except the output gap, are in the logarithmic form and seasonally adjusted using the Census X13 method. Details about each series are as follows:

World commodity price (WCP): Represents the supply shock to the economy. This variable is proved to have a direct impact on the IMP, and thus the CPI.

Output gap (YGAP): Is the difference between actual output and the maximum potential output of an economy. An excess of actual output over potential output implies that the economy is growing over its long-run capacity or, in other words, over its full employment capacity – hence, the output gap is often seen as an indicator of excess demand in the economy. This series could be generated by applying the Hodrick-Prescott (HP) filter to the natural log of the industrial production index with a monthly smoothing parameter set at 14,400.

Money supply (M2): A proxy for the monetary policy shock. In most Asian developing countries, since the interest rates are sometimes not a truly effective instrument, the central bank tends to make use of broad money as a key target of monetary policy.

Bilateral exchange rate (ER): Indicates the exchange rate of the domestic currency vis-à-vis USD. ER is chosen as a proxy for the exchange rate of Vietnam due to the following reasons: (i) According to Vietnam Customs' statistics, during the study period, over 80% of the total export and import value by Vietnamese enterprises are in USD; (ii) The bilateral USD/VND exchange rate is also kept under severe control and management by the SBV on a daily basis.

Nominal effective exchange rate (NEER): For comparative analyses across four countries, using NEER as the proxy for the exchange rate seems more appropriate than bilateral exchange rates due to two reasons: (i) NEER is a broader measure than other bilateral exchange rates; (ii) There is more variation in the NEER than in the bilateral exchange rate since a country's currency was virtually pegged to the USD during most of the sample period.

Price variables (P): Including IMP, PPI and CPI.

Table 2
Description of variables

Variable	Definition and measurement	Sources
WCP	World commodity price index (2010 = 100)	IMF
YGAP	Output gap, being the difference between the economy's actual output and potential output, is derived by applying HP filter to the natural log of the industrial production index (2010 = 100).	IFS (Vietnam, Malaysia), FRED (China), BOT (Thailand)
M2	Broad money	IFS (Vietnam, China, Malaysia), BOT (Thailand)
ER	Bilateral exchange rate against USD. An increase in the exchange rate implies a depreciation of the concerned country's currency.	IFS
NEER	Nominal effective exchange rate vis-à-vis 120 trading partners (2010 = 100). An increase in NEER indicates depreciation of the concerned country's currency.	Bruegel
IMP	Import price index (2010 = 100)	CEIC (Vietnam, Malaysia), FRED (China), BOT (Thailand)
PPI	Producer price index (2010 = 100)	CEIC (Vietnam), FRED (China), IFS (Malaysia), BOT (Thailand)
CPI	Consumer price index (2010 = 100)	IFS

Notes: BOT: Bank of Thailand; CEIC: CEIC Global Database; FRED: Federal Reserve Bank of St. Louis; IFS: International Financial Statistics; IMF: International Monetary Fund Database

Testing for stationarity

Assessment of the time series properties of variables is supported by Dickey-Fuller with GLS detrending (DF-GLS) and Phillips-Perron (PP) tests. Unit root test results (Table 3) imply all the series, other than YGAP, are non-stationary in levels, yet their first differences appear stationary at the 1% significance level. In other words, all the variables are integrated of order one - I(1). Hence, variables in first differences (except YGAP) could be included in the VAR estimation.

Table 3
Result of unit root tests

	Dickey-Fuller GLS (DF-GLS)		Phillips - Perron (PP)	
	Level	First difference	Level	First difference
WCP	–2.17**	–4.92**	–1.97	–6.83***
Vietnam				
YGAP	–4.42***	–13.49***	–7.84***	–27.19***
M2	–2.14	–8.96***	–2.03	–11.60***
NEER	–0.49	–8.07***	–2.04	–8.02***
IMP	0.01	–4.46***	–1.91	–7.06***
PPI	1.35	–1.97*	–3.83**	–10.75***
CPI	1.38	–1.76*	–4.03**	–5.66***
China				
YGAP	–8.66***	–9.78***	–9.29***	–70.47***

	Dickey-Fuller GLS (DF-GLS)		Phillips - Perron (PP)	
	Level	First difference	Level	First difference
M2	0.41	–1.89*	–4.75***	–12.42***
NEER	–0.34	–7.48***	–2.00	–7.76***
IMP	–1.87	–3.79***	–1.06	–6.86***
PPI	–1.68	–4.07***	–2.06	–4.06***
CPI	2.29	–10.46***	–0.64	–11.61***
Malaysia				
YGAP	–11.10***	–11.66***	–12.46***	–64.42***
M2	4.09***	–10.92***	–0.42	–11.52***
NEER	–0.29	–8.18***	–0.73	–9.85***
IMP	–1.84**	–2.39**	–2.72*	–8.62***
PPI	–1.26	–3.02***	–2.4	–10.33***
CPI	1.28	–7.94***	–1.68	–7.91***
Thailand				
YGAP	–4.65***	–15.00***	–7.42***	–24.63***
M2	2.22***	–7.02***	–1.59	–8.91***
NEER	–0.29	–7.08***	–0.67	–8.25***
IMP	–2.79*	–7.18***	–1.82*	–6.77***
PPI	–1.03	–5.86***	–2.54	–7.19***
CPI	0.38	–6.12***	–2.30	–7.87***

Notes: ***, **, * denote significance at the 1%, 5%, and 10% level, respectively.
Source: Authors' calculations

RESULTS AND DISCUSSION

ERPT to Domestic Prices in Vietnam

The lag order of the five-variable RVAR models is selected based on the Likelihood Ratio (LR) test with reference to the Akaike and Schwarz Information Criteria (AIC and SIC). From the RVAR estimation results, exchange rate shocks are identified based on Cholesky decompositions under the recursive assumption. Accordingly, evaluation of the ERPT to price indices could be undertaken in five steps as follows: (i) estimating the RVAR models with any lag; (ii) selecting the optimal lag lengths; (iii) re-estimating the RVAR models with the selected optimal lag lengths; (iv) conducting the diagnosis and stability tests on the estimated results; and (v) quantifying the exchange rate shocks (in terms of degree and timing) to the price indices.

The five-variable RVAR model is estimated in which the Y_t vector is specified as in Eq.(2) with every different price variable, namely, IMP, PPI and CPI, and simultaneously, measure the response of each price index to the exchange rate shocks. As suggested by Ito and Sato (2008), the ERPT magnitude could be determined by normalizing the exchange rate shocks to shocks of a 1% change in the exchange rate. A 1% shock is identified by dividing the cumulative response of the price change to the exchange rate shock after i month (indicated as $P_{t,t+i}$) by the corresponding impulse response of the exchange rate change (indicated as $E_{t,t+i}$). Specifically:

$$PT_{t,t+i} = \frac{P_{t,t+i}}{E_{t,t+i}}$$

Estimated results from Figure 3 show that price indices reacted to exchange rate shock yet at varying magnitudes. IMP began to rise as there emerged an exchange rate shock in the second month. Specifically, in response to a 1% increase in the exchange rate, IMP rose 0.13% after

two months and reached the highest level of 0.37% after 6 months. This finding insists the ERPT to IMP does exist in Vietnam, as a 1% change in the exchange rate would be transferred to IMP in VND with an increase of 0.37% after 6 months.

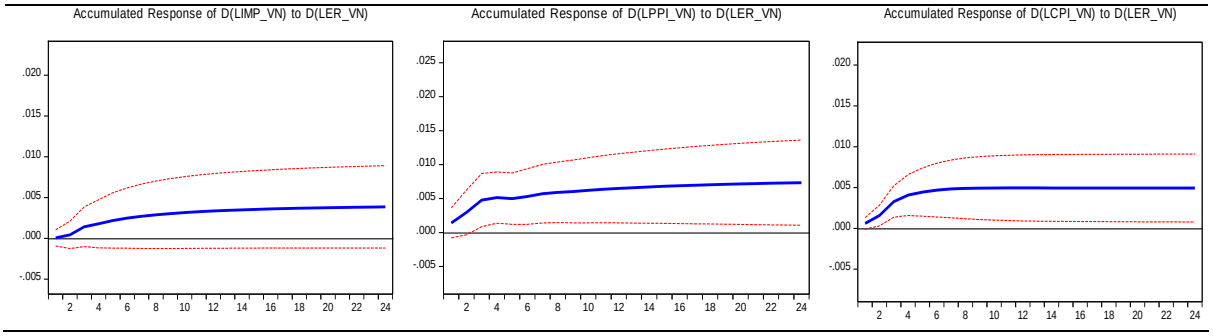

Figure 3. Responses of Vietnam's price indices to the exchange rate shocks
Source: Authors' calculations

The response of PPI tends to be stronger than that of IMP when there was a 1% increase in the exchange rate. PPI began to increase in the third month and reached the highest level, increasing 0.81% after 12 months. Thus, the exchange rate shocks have spread to PPI through IMP. However, as there remain other inputs used for production and unaffected by the exchange rate, the response of PPI seems stronger than that of IMP. Likewise, a long-run equilibrium of the PPI was established following 12 months with an increase of 0.81% compared to the period before the exchange rate shocks. CPI reacted more weakly than PPI to a 1% exchange rate shock, achieving the highest increase of 0.69% after one year. Thus, it is evident that in Vietnam, exchange rate shocks have an impact on the CPI, yet with minimal degrees.

Table 4
Responses of Vietnam price indices to a 1% exchange rate shock (%)

	IMP	PPI	CPI
After 3 months	0.13	0.17	0.20
After 6 months	0.24	0.64	0.59
After 12 months	0.37	0.81	0.69
After 24 months	0.37	0.81	0.69

Source: Authors' calculations

To sum up, the reaction of price indices to a 1% exchange rate shock in Vietnam has exposed some distinct characteristics: (i) ERPT to IMP reached a relatively high level after 12 months; (ii) the reaction magnitudes of the price indices decline along the pricing chain: PPI shows the largest response, followed by IMP and CPI; (3) the evolution of price indices follows the same direction: rising rapidly during the early months of the shock - mirroring the price stickiness (since import contracts are usually concluded from 3 to 6 months prior to the actual delivery date), then dropping gradually to set a new equilibrium. This proves that importers of final consumer goods or capital goods might relocate the sources of imports, searching and switching to cheaper items.

Variance Decomposition

Although the reaction measurements suggest that the exchange rate shocks have an impact on price indices, such results seem not fully reflect the role of the exchange rate in price fluctuations during the ten-year span. Therefore, the present study continues to carry out

variance decomposition of price variables over 24 months to explore the cause of price evolution. Using a five-variable RVAR model with the Y_t vectors as in Eq.(2) for each price variable, in turn, we establish that the exchange rate is not an important source of the IMP and PPI volatility.

As illustrated in Table 5, the exchange rate could explain only 3% of these prices' movements. Yet, it could explain up to 12% of the CPI changes after one year. This implies that the impact of the exchange rate shock on prices in Vietnam seems rather modest. This may bring some policy implications which could boost exports while not having much influence on the domestic inflation. Additionally, Table 5 shows that Vietnam's CPI is profoundly affected by the WCP. Specifically, WCP could explain 35% of the CPI fluctuations after one year. This might be due to the high degree of openness, trade deficits and dependence on imported input materials of the Vietnamese economy during the recent time.

Table 5
Variance decomposition of IMP, PPI and CPI in Vietnam

Period	WCP	YGAP	M2	ER	P
(1) Variance decomposition of IMP					
1	0.807	0.339	0.348	0.001	98.504
6	1.356	0.492	0.713	2.716	93.768
12	4.087	0.532	0.701	3.104	90.317
24	4.087	0.532	0.701	3.104	90.317
(2) Variance decomposition of PPI					
1	0.227	8.405	0.041	0.464	89.991
6	4.163	10.200	1.187	3.173	74.117
12	4.692	10.191	1.228	3.295	73.324
24	4.692	10.191	1.228	3.295	73.324
(3) Variance decomposition of CPI					
1	8.639	0.045	0.639	2.190	84.069
6	35.199	0.423	3.227	11.535	42.779
12	35.192	0.536	3.262	11.683	42.250
24	35.192	0.536	3.262	11.683	42.250

Source: Authors' calculations

Comparative Analyses of the ERPT to Price Series Across Asian Emerging Economies

In this study, a seven-variable SVAR model (see Eq.(3)) is employed to gauge the impact of 1% exchange rate shocks on the price series in the four Asian countries including Vietnam, China, Malaysia and Thailand. As turned out from the diagnostic test results: (i) the residuals of the SVAR model are normally distributed; (ii) serial correlation does not exist; and (iii) the model achieves general stability[1].

Estimation results from the seven-variable SVAR indicate that all the three price indices of Vietnam reacted positively to the NEER shock (see Figure 4 for response pattern and the Appendix for detailed results). Specifically: (i) IMP reacted rapidly to the exchange rate shock with an increase of 0.17% after 6 months and then 0.42% after 12 months; (ii) PPI began to rise sharply in the third month and hit a new balance of 1% after 9 months; (iii) From the third

[1] The diagnostic test results will be provided upon request.

month of the NEER shocks, CPI started to increase, reaching a new balance of 0.75% after 12 months. Our results are in line with the previous study conducted by Vo et al. (2021) in ASEAN economies, viz. Indonesia, Malaysia, the Philippines and Thailand. As proved, these countries witness a positive response of the PPI and CPI to the exchange rate shock in the first quarter, followed by a declining trend in the second quarter before dissipating during the last two quarters.

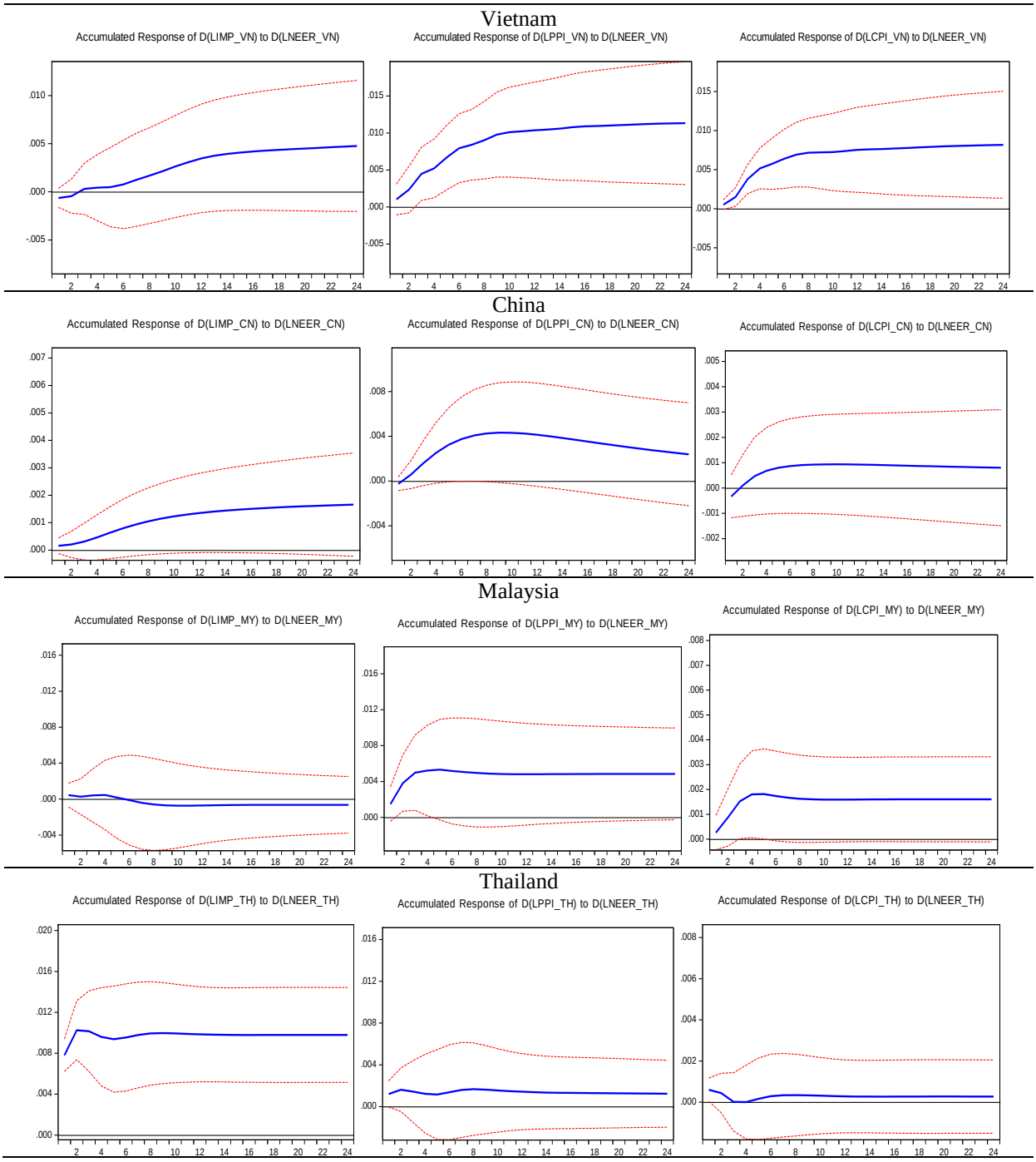

Figure 4. Responses of price indices to the exchange rate (NEER) shocks
Source: Authors' calculations

The reaction of China's price indices to the exchange rate shocks seems weaker than that of Vietnam. In response to a 1% NEER shock, the IMP tends to increase by merely 0.14% after 12 months. Meanwhile, the PPI started to rise in the third month and reached a new steady-state level of 0.43% after 6 months. Lastly, the CPI showed a modest increase and reached a new equilibrium of 0.09% after 6 months of the NEER shocks. Malaysia's IMP shows no reaction to the exchange rate shock, while the PPI reacted significantly and in the same direction to the exchange rate shock (i.e., increasing by 0.60% after 3 months). Likewise, the CPI recorded a slight increase of 0.26% after 4 months.

In contrast to Malaysia, Thailand's IMP reacts relatively fast and significantly to the exchange rate shock. Accordingly, the IMP rose by 1.09% in the second month of the NEER shock. This is also the largest increase of this price candidate compared to other countries in the sample. Meanwhile, the PPI reacted slightly to the exchange rate shock with an increase of just 0.20% after 3 months. Finally, the CPI increased by 0.12% as soon as a NEER shock was present, then fell to a mere 0.07% after 3 months. Our estimates for Thailand, therefore, present further evidence of the low level of ERPT in Thailand. Since the adoption of the inflation targeting framework in 2000, Thailand's inflation has been in decline with its expectations being well anchored. As explained by Nookhwun (2019), this could lead to less persistent inflation, making the prices less susceptible to exchange rate shocks. It is also clear from Figure 4 that the IMP of the studied countries all reacted in the same direction to the exchange rate shock, except for Malaysia. This could be rationalized by considering the openness of each economy to different degrees.

These above findings support the viewpoint expressed by Ito and Sato (2008), McCarthy (2007), and Nguyen and Vo (2021). They suggest that in Asia-Pacific region (with the exception of Australia), the degree of ERPT to the price series tends to follow the distribution chain, in which the pass-through is larger to IMP than to PPI and CPI. Studies by McCarthy (2007) for industrialized nations and Ito and Sato (2008) for the East Asian region also provide similar evidence.

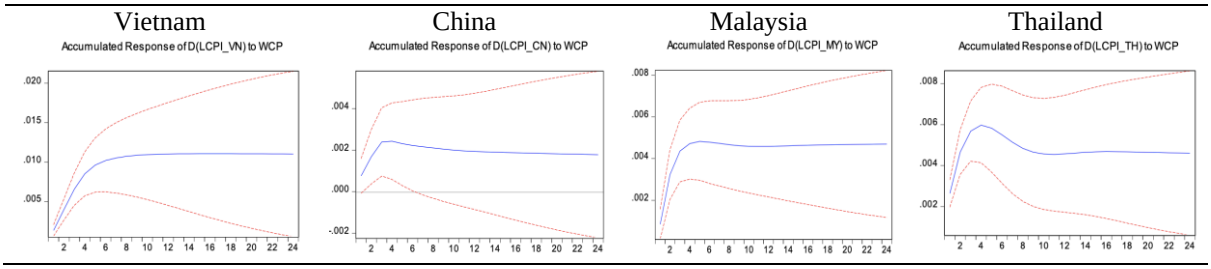

Figure 5. Responses of CPI to world commodity price shocks
Source: Authors' calculations

Figure 5 describes how the CPI responds to the shocks of WCP through the impulse response functions. Of the four countries, Vietnam experiences the largest response, which turns positive in the second month and reaches its peak of 1.2% after 6 months. Meanwhile, the weakest response of CPI could be witnessed in China, with a rise of just 0.22% after 3 months. The CPI in Thailand and Malaysia responded positively and significantly to the WCP shocks after 2 months, before gradually declining to a sustainable growth rate of 0.5% after 6 months. Despite having similar exchange rate regimes, Vietnam's CPI appears more sensitive to global market

fluctuations due to its high degree of openness (208.25%). Conversely, with a modest level of openness (34.5%), China's CPI reacted fairly weakly to the world price shocks[1].

Table 6
Variance decomposition of CPI

Period	WCP	YGAP	M2	NEER	IMP	PPI	CPI
	Vietnam						
1	13.9	5.6	1.9	3.0	4.1	5.1	66.1
6	49.5	7.0	0.9	6.1	1.7	3.3	31.2
12	49.6	7.3	0.9	6.2	1.7	3.4	30.7
24	49.6	7.3	0.9	6.2	1.8	3.4	30.7
	China						
1	2.2	0.2	0.2	0.0	0.0	0.5	96.7
6	5.3	1.3	3.0	1.1	0.4	1.8	86.9
12	5.3	1.3	3.1	1.1	0.4	1.8	86.9
24	5.3	1.3	3.1	1.1	0.4	1.8	86.9
	Malaysia						
1	4.9	3.7	1.4	3.3	0.4	0.7	85.3
6	18.2	6.7	1.7	6.1	6.3	1.1	59.7
12	18.2	6.7	1.7	6.1	6.3	1.1	59.6
24	18.2	6.7	1.7	6.1	6.3	1.1	59.6
	Thailand						
1	29.1	0.0	4.3	2.4	0.3	13.1	50.5
6	37.3	4.4	9.4	2.1	4.9	9.1	32.6
12	37.6	4.5	9.4	2.0	5.0	9.0	32.2
24	37.6	4.5	9.4	2.0	5.0	9.0	32.2

Source: Authors' calculations

The variance decomposition results from Table 6 stress that the CPI of Vietnam and Thailand is strongly driven by the WCP. Specifically, the WCP shock explains nearly 50% of the CPI changes in Vietnam, and just over 37% in Thailand. It is worth noting that the CPI of Thailand, as analyzed previously, is not significantly affected by the exchange rate shock. This might be due to the fact that the import content of goods and services in the CPI basket averaged at around 17%. As expected, the import content was highest for goods and services in the transportation and communication component, which helps explain why the ERPT in Thailand mainly operates through oil prices (an important share of WCP) (Nookhwun, 2019).

Concerning China, the CPI is not considerably affected by the WCP shock. This could be explained by China's fixed exchange rate policy and its major domestic commodity market which could accommodate the domestic demand. Besides, the moderate increase in the CPI under the exchange rate shock proves effective and flexible management of the exchange rate policy from the People's Bank of China (PBOC). Compared with the research results of China's ERPT during the pre-crisis, this transmission mechanism has changed drastically, from a negative to a positive direction.

[1] Trade openness is measured as the ratio of total trade to GDP. Analytical statistics of the sampled countries are extracted in 2020 from World Bank Data.

Our results suggest that WCP has a marked impact on the CPI of the sampled countries (except China), which is different from the findings of Vo et al. (2021). They contend that the CPI of the developing countries in ASEAN is significantly impacted by output gaps and monetary policy shocks. Differences in the study period and choice of exogenous shock variables (oil price instead of WCP) are the main cause for the difference in conclusions.

CONCLUSION AND POLICY IMPLICATIONS

In this paper, the pass-through mechanisms of the exchange rate movements to a price series, from IMP, PPI to CPI in Vietnam were examined. Our findings show that the exchange rate shocks have a positive impact on price variations in Vietnam. IMP has the largest response to the exchange rate shocks, followed by PPI and CPI. In addition, the contagion effects of exchange rates during each stage of development were acknowledged from the estimated results of the pass-through to the pricing chain under the RVAR model.

To gain a broader insight into the ERPT of Vietnam, we studied the ERPT in four Asian countries. The SVAR results confirm the CPI of all sampled countries reacts in the same direction with the NEER shock, yet with varying degrees. The variance decomposition analysis dictates that the magnitude of the pass-through appears marginal in China, yet relatively high in Vietnam and Malaysia. Clearly, under the same exchange rate shock, the magnitude of CPI response in each country largely depends on their openness of the economy, the balance of trade, and notably monetary policy objectives.

Another noteworthy finding is that WCP turns out to be the main contributing factor to the domestic inflation in the four economies surveyed. As for developing economies with a high degree of openness and a managed floating regime, the central banks are recommended to account for the WCP shocks (especially the oil price) in policy formulation since the complexity of WCP may threaten a country's price stability. It should be further noted that monetary easing, as shown in our empirical results, seems to have a limited impact on the domestic inflation of the countries studied, with the exception of Thailand.

As shown in our variance decomposition results for Vietnam, the exchange rates have played a minor part in explaining the fluctuations of CPI. Hence, on the condition that the aggregate demand and monetary policy were under strict control, devaluation of domestic currency might not necessarily cause inflation. From the research findings, several far-reaching policy implications for the SBV could be drawn out:

First, the SBV may consider the devaluation of VND to promote exports in the current situation. Aside from that, a more flexible regime with a broadened band might also enable the SBV to have timely responses to external shocks while mitigating risks due to the impact of exchange rate volatility on inflation.

Second, the SBV should continue to implement strict measures to control and fight against dollarization, and step by step abolish foreign currency transactions within the territory of Vietnam. It is because a highly dollarized economy becomes more exposed to the exchange rate risks, otherwise, currency devaluation would also affect debt assets and liabilities in the local currency. By and large, such issues could lead to inefficiency in the conduct of monetary policy.

Lastly, in pursuit of the inflation targeting policy framework in the long run, the SBV has to recognize exchange rates as a policy tool rather than an operational target. As such, rather than recurrent intervention to stabilize the exchange rates, exchange rate management needs directing towards the attainment of the targeted inflation. Nevertheless, at times, direct interventions seem still necessary, particularly when the exchange rate fluctuations are forecasted to have adverse effects on the inflation targets.

On top of that, it is recommended from the research results that trading companies plan ahead based on commodity prices forecasts. Specifically, exporters could stockpile domestic goods in advance of price hike, whereas importers could hedge exchange rate risk by entering into USD forward contracts.

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APPENDIX

Estimation results from the seven-variable SVAR (N = 152)

Variable	**ΔIMP**	**ΔPPI**	**ΔCPI**	**ΔIMP**	**ΔPPI**	**ΔCPI**
		Vietnam			China	
WCP_{t-1}	-0.01	-0.01	0.01***	0.01***	0.01***	0.01*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
WCP_{t-2}	-0.01	-0.01	-0.01***	-0.01	-0.01***	-0.01**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
WCP_{t-3}	0.01	0.01	0.01*	-0.01*	0.01	0.01*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$YGAP_{t-1}$	-0.01	0.01	-0.01	0.01	0.02**	-0.01
	(0.013)	(0.029)	(0.009)	(0.004)	(0.007)	(0.010)
$YGAP_{t-2}$	0.02*	-0.05*	0.01	0.01*	-0.01	0.01
	(0.013)	(0.030)	(0.010)	(0.003)	(0.007)	(0.010)
$YGAP_{t-3}$	-0.02*	0.01	0.01	0.01	-0.01	-0.01
	(0.012)	(0.027)	(0.009)	(0.003)	(0.007)	(0.010)
$\Delta M2_{t-1}$	0.01	-0.08	0.04*	0.01	-0.01	0.11***
	(0.039)	(0.089)	(0.028)	(0.015)	(0.030)	(0.043)
$\Delta M2_{t-2}$	-0.02	0.05	0.01	-0.01	0.02	-0.06*
	(0.039)	(0.089)	(0.029)	(0.015)	(0.030)	(0.043)
$\Delta M2_{t-3}$	-0.01	-0.02	-0.04*	0.01	0.03	-0.09**
	(0.037)	(0.085)	(0.027)	(0.015)	(0.030)	(0.044)
$\Delta NEER_{t-1}$	0.03	0.10	0.04	-0.01	0.01**	0.04
	(0.042)	(0.097)	(0.031)	(0.013)	(0.026)	(0.037)
$\Delta NEER_{t-2}$	0.05	0.13*	0.11***	0.01	-0.03	-0.01
	(0.043)	(0.098)	(0.031)	(0.014)	(0.027)	(0.039)
$\Delta NEER_{t-3}$	-0.06*	0.08	-0.05*	-0.02	0.04*	0.03
	(0.043)	(0.098)	(0.031)	(0.013)	(0.025)	(0.036)
Constant	-0.01	-0.01	-0.01	-0.01	0.01**	0.01
	(0.003)	(0.006)	(0.002)	(0.001)	(0.002)	(0.003)
R-squared	0.452	0.294	0.674	0.497	0.781	0.235
		Malaysia			Thailand	
WCP_{t-1}	0.01***	0.01**	0.01***	0.01*	0.01*	0.01***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
WCP_{t-2}	-0.01**	-0.01	-0.01**	-0.01	-0.01	-0.01
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
WCP_{t-3}	-0.01	-0.01	-0. 01*	0.01	-0.01	-0.01
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$YGAP_{t-1}$	0.02	-0.13***	0.01	0.03**	0.01	0.01**
	(0.030)	(0.045)	(0.014)	(0.015)	(0.012)	(0.006)
$YGAP_{t-2}$	-0.09***	0.05	-0.02*	-0.02*	-0.02**	-0.01**
	(0.030)	(0.045)	(0.013)	(0.015)	(0.012)	(0.006)
$YGAP_{t-3}$	-0.03	0.02	0.02*	-0.01	0.01	-0.01
	(0.031)	(0.047)	(0.014)	(0.015)	(0.012)	(0.006)
$\Delta M2_{t-1}$	-0.03	-0.07	0.01	-0.14	-0.06	-0.09*
	(0.121)	(0.182)	(0.055)	(0.148)	(0.119)	(0.056)
$\Delta M2_{t-2}$	-0.01	0.08	-0.07*	0.03	0.21**	0.09**
	(0.119)	(0.179)	(0.054)	(0.140)	(0.113)	(0.053)
$\Delta M2_{t-3}$	-0.04	-0.01	-0.14***	0.02	-0.01	0.07*
	(0.122)	(0.183)	(0.055)	(0.138)	(0.112)	(0.053)
$\Delta NEER_{t-1}$	-0.02	0.20**	0.05*	0.01	-0.12*	-0.07**
	(0.070)	(0.105)	(0.031)	(0.114)	(0.092)	(0.044)
$\Delta NEER_{t-2}$	-0.01	0.01	0.01	-0.03	0.01	0.06*
	(0.072)	(0.108)	(0.032)	(0.119)	(0.096)	(0.045)
$\Delta NEER_{t-3}$	0.05	0.06	0.08***	0.18*	0.17**	0.03
	(0.068)	(0.103)	(0.031)	(0.109)	(0.088)	(0.041)
Constant	0.01	0.01	-0.01*	-0.01*	0.01	-0.01
	(0.004)	(0.006)	(0.002)	(0.005)	(0.004)	(0.002)
R-squared	0.492	0.215	0.480	0.445	0.474	0.447

Notes: Standard errors in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% level. IMP, PPI, CPI denotes the test on the basis of the import price, producer price and consumer price index, respectively. Δ reflects the first difference of the variables.

Source: Authors' calculations