

FAQ

FOCUSED AND QUICK

Issue 141
February 12, 2019

ESTIMATES OF EXCHANGE RATE PASSTHROUGH FOR THAILAND

Nuwat Nookhwun

บทความนี้เป็นทรัพย์สินของธนาคารแห่งประเทศไทย
การกล่าว คัด หรืออ้างอิง ข้อมูลบางส่วนตามสมควรในบทความนี้
จะต้องกระทำโดยถูกต้อง และอ้างอิงถึงผู้เขียนและธนาคารแห่งประเทศไทย โดยชัดเจน

ข้อคิดเห็นที่ปรากฏในบทความนี้เป็นความเห็นของผู้เขียน
ซึ่งไม่จำเป็นต้องสอดคล้องกับความเห็นของธนาคารแห่งประเทศไทย



Source: <https://www.xconomy.com/raleigh-durham/2016/02/18/north-carolina-equity-investments-double-topping-1b-in-2015/>

“Exchange rates affect prices in a heterogeneous and non-linear way. The precision of ERPT estimates is hence important to the accuracy of inflation forecast and the formulation of monetary policy decisions”

In a small and open economy with a flexible exchange rate regime, an exchange rate becomes an important macroeconomic variable given its wide-ranging effects on the economy. This article focuses on its effects on prices of goods and services, also known as exchange rate passthrough (ERPT), for Thailand. The results show the low ERPT, where the passthrough mainly operates on retail oil prices. The passthrough to core inflation is, on average, insignificant. However, impact asymmetry is found, where exchange rates significantly affect core consumer prices only when the domestic currency depreciates. Compared to other countries, the ERPT estimates for Thailand are relatively low and comparable to those of advanced economies. This may be explained by the low import content of Thai goods and services as well as the low-inflation environment, which makes Thai inflation less susceptible to exchange rate shocks.

Introduction

In a small and open economy with a flexible exchange rate regime, an exchange rate becomes an important macroeconomic variable given its wide-ranging effects on the economy. In the case of Thailand alone, given a high degree of trade openness, the impact on price competitiveness and export income is always under the spotlight. This article, however, deviates from the trade impact above to focus on its effects on prices of goods and services, also known as exchange rate passthrough (ERPT). Movements in the exchange rate, which are intended to help absorb the impact of external shocks on the economy, may themselves affect production costs and hence domestic consumer prices. The exchange rate, therefore, inevitably matters for households' costs of living and the country's overall price stability.

The aim of this article is hence to estimate the size of ERPT for Thailand. To do so, rather than relying on aggregate price data as in the literature, I make use of disaggregate data, which allows us to trace the channels that the passthrough operates on and, more importantly, to obtain more precise ERPT estimates. The latter is based upon the fact that aggregate prices are influenced by a number of factors, ranging from common to sector-specific factors, which make it difficult to identify ERPT in the macro estimation. Apart from this, I am also interested in potential asymmetry and non-linearity in the ERPT estimates.

1. How does the ERPT work?

A key, direct channel of how exchange rates affect domestic prices is through their impact on import prices of either raw materials, intermediate goods or final goods. That is, when

domestic currency depreciates, costs of imports measured in terms of domestic currency rise. Producers, then, pass such higher costs onto product prices charged to their customers. In contrast, consumer prices decline as domestic currency appreciates. **Additionally, movements in the exchange rates may affect consumer prices through the demand channel.** A currency appreciation, which erodes the country's price competitiveness and lowers net exports, may contribute to a decline in household income and hence generate deflationary pressures. However, like the impact of other demand shocks (e.g. monetary policy shocks) on prices, it could take some time for the effects to pass onto prices through this channel.

Past literature have found diverse passthrough estimates across countries and time, suggesting that a wide range of factors matters for the size of ERPT. To name a few, these include the extent of import content in the production of domestic goods. The larger the import content, the higher the passthrough to prices. In this regard, the existence of transportation and marketing costs, taxes as well as local inputs in domestic good production may cushion the impact of exchange rates on prices. The second of these is the degree of substitution between local and foreign brands. For products that are highly substitutable, producers may find it difficult to pass on higher costs to prices, implying lower ERPT. Third, the impact depends on the currency in which imports are invoiced. Exchange rate changes matter when imports are priced in terms of foreign currency, rather than being priced to market (PTM). Fourth, some studies suggest that monetary policy regime is an important factor determining the size of ERPT. In particular, Taylor (2000) proposes that a low-inflation

environment leads to a low ERPT, as inflation becomes less persistent. The proposition is confirmed by empirical results from Choudri and Hakura (2006)¹. Apart from these, the availability of exchange rate risk hedging instruments could lessen or delay the exchange rate effects, since exchange rates are predetermined by contracts.

2. What does the recent literature say about ERPT?

Key findings found in the recent literature are that **the ERPT to consumer prices, particularly in emerging markets, has declined from the past** (Jasova et al, 2016), which is possibly due to declining inflation rates globally. However, **the ERPT for emerging markets is still higher than that of advanced countries** (Ca'Zorzi et al, 2007). Potential explanations include the fact that emerging economies often price their imports in foreign currencies, inflation rates that are relatively higher, as well as the limited availability of hedging instruments (Caselli and Roitman, 2016)². Moreover, the higher share of commodities in their consumer price index (CPI) baskets³ may also raise the ERPT for emerging markets.

A few articles also investigate the asymmetry and non-linearity in the ERPT estimates, as price adjustments are likely to be state-dependent. In particular, Caselli and Roitman (2016) find that **a large depreciation of the currency yields the strongest ERPT**, implying the existence of menu costs and the fact that firms more eagerly adjust prices in response to increases, rather than decreases, in import costs. Last, Forbes et al (2015, 2017) propose that **the extent of ERPT may depend on the source of shocks**, where they found that shocks affecting exchange rates are crucial in explaining time-varying ERPT for each

¹ Mishkin and Schmidt-Hebbel (2007) also find that the passthrough is lower for inflation targeters.

² However, Ca'Zorzi et al (2007) find that emerging markets with low inflation have low ERPT to consumer prices, comparable to advanced countries.

³ CPI basket is the fixed basket of goods and services that are used as a reference for the collection of price data.

country. In particular, exchange rate movements triggered by global and monetary policy shocks yield higher passthrough estimates than those from domestic demand shocks. For example, if a given exchange rate appreciation was driven by a positive shock to domestic demand, a firm would be more likely to increase its mark-up than to reduce prices.

This casts a question of where Thailand's ERPT stands compared to other economies. **A handful of papers estimated the ERPT for Thailand, where a limited passthrough to consumer prices is commonly found.** Ito and Sato (2007), employing a vector autoregression (VAR) approach, found the estimate to be small and statistically insignificant. They found that CPI rises by 0.05 percent following a 1-percent depreciation in the nominal effective exchange rate⁴. Meanwhile, Mihaljek and Klau (2008) relied on a single-equation approach and obtained the significant ERPT estimate of 0.04. The latest article by Forbes et al (2017) found a larger estimate of 0.12-0.14, though its standard errors are large and may render the estimate insignificant (see table 2 in their paper). Nevertheless, all the above papers made use of the aggregate price index in their ERPT estimation. **This article complements by employing disaggregate data**, which allow us (1) to indicate types of goods and services that the passthrough mainly operates on and (2) to obtain more precise ERPT estimates since aggregate prices are influenced by a number of factors, both common and sector-specific, thereby making it difficult to precisely identify the exchange rate effects in the macro-data regression.

3. ERPT estimates using aggregate data

Despite having an interest in the bottom-up approach, I first obtain baseline estimates using aggregate data. For simplicity, a single-equation approach as in Mihaljek and Klau (2008) is

⁴ Nominal effective exchange rate or NEER is the weighted-average of nominal bilateral exchange rates of the baht against key trading partners and competitors' currency.

employed, where I include exchange rates, the output gap, oil prices and farm prices as explanatory variables. All the variables, except the output gap, are transformed into percentage changes given the non-stationary feature of the data. Quarterly data from the post-Asian-crisis period (2001-2017) are used as policy regime shifts after the crisis likely affect structural parameters. Furthermore, sharp exchange rate movements during the crisis could become outliers in the estimation. As for a proxy of consumer prices, I use headline CPI, but purposely eliminate the effects of government measures⁵ from the index as they induce large and one-off shifts in consumer prices that could bias regression estimates. Regarding exchange rates, both the bilateral Thai baht against US dollar and a nominal effective exchange rate are examined. The former suits the fact that most Thailand's international trade transactions are priced in US dollar, whereas the latter reflects the fact that Thailand trades with a large number of countries.⁶

The results using aggregate data, shown in table 1, suggest insignificant exchange rate passthrough for Thailand. The ERPT estimate is found to be at 0.024 (a 1-percent strengthening of the baht results in a 0.024-percent decline in consumer prices), but is not statistically significant. The estimate using NEER is found to be larger, but remains insignificant. Our result, therefore, differs from that of Mihaljek and Klau (2008) which found significant ERPT. However, these authors include pre-crisis data into the observations, which could make their estimation subject to outliers.

4. ERPT estimates using disaggregate data

In this section, I employ disaggregate data to identify precisely the exchange rate effects. **My focus is hence to estimate the degree of ERPT for three main components within the CPI**

⁵ These, for example, include taxes on cigarettes and alcohol, transportation and education subsidies, and etc.

⁶ The description and sources of all the variables used are described in the Appendix.

Table 1: Estimates of Exchange Rate Passthrough for Thailand

Variables	Headline Inflation		Core Inflation		Energy Inflation		Retail Oil Inflation		Fresh Food Inflation	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constant	0.19***	0.20***	0.05	0.04	0.69**	0.72**	0.55	0.60	0.93***	0.92***
Lagged dependent variables	0.49***	0.49***	0.64***	0.66***						
Exchange rate										
- %Δ in THBUSD (t)	0.024		0.015		0.15		0.42**		0.07	
- %Δ in NEER (t)		-0.04		-0.013		-0.15		-0.37*		-0.05
%Δ in Dubai oil prices	0.02***	0.02***	0.016***	0.015***	0.28***	0.27***	0.49***	0.46***		
%Δ in farm prices	0.04***	0.04***	0.032**	0.03**					0.29***	0.28***
Output gap	-0.00	0.00	0.01	0.01						
Adjusted R-squared	0.75	0.75	0.65	0.64	0.76	0.76	0.80	0.79	0.52	0.51
Number of Observations	68	68	68	68	68	68	68	68	68	68

Note: (1) *, **, *** indicate the significant level at 90%, 95% and 99%, respectively

(2) The sample covers period 2001Q1-2017Q4, unless otherwise stated.

(3) The dependent variable is quarter-on-quarter percentage changes in prices, excluding the impact from government measures.

Source: BOT

basket, including (1) energy, (2) fresh food and (3) the core component, whose changes in prices are so-called core inflation. Given disaggregate estimates, the size of ERPT in aggregate can then be computed as the average of those estimates, weighted by their corresponding share in the CPI basket.

a) ERPT to energy prices

First, on the exchange rate effects on energy prices⁷, I expect to find a significant, large effect, since energy consumed is mostly imported from abroad. The fifth and sixth rows of table 1 show the ERPT estimates for energy prices, where only Dubai crude oil prices are included as a controlled variable. The results show that **exchange rate changes do not significantly affect energy prices**. One potential explanation may be that energy prices also comprise electricity charges, on top of retail oil prices. Despite the fact that natural

gases used in the electricity production are partially imported, electricity charges do not adjust instantaneously in response to exchange rate shocks since they are pre-determined several quarters ahead, taking into account expected electricity demand and production costs. **If focusing on the impact on retail oil prices, I find the passthrough to be large and statistically significant.** In particular, 1-percent weakening of the Thai baht against the US dollar results in a 0.42-percent rise in retail oil prices over the same quarter. Given that the share of retail oil in the CPI basket is around 7.55 percent, such an increase in retail oil prices could contribute to a 0.032-percent rise in headline CPI. The ERPT estimate using NEER is slightly lower, but is weakly significant. The finding suggests that oil imports are likely invoiced in US dollar terms.

I proceed by examining the effects on retail oil prices further into items within the retail oil component, including benzene⁹⁵, diesel,

⁷ Energy prices include retail oil prices, electricity charges and prices of liquid petroleum gases (lpg).

Table 2: Exchange Rate Passthrough to Retail Oil Prices

Variables	%Δ in retail oil prices					
	Benzynes95	Gasohol91	Gasohol95	Diesel	E20	E85
Constant	-0.07	-0.13	-0.11	-0.03	-0.03	-0.01
Exchange rate						
- %Δ in THBUSD (t)	0.30**	0.45***	0.43***	0.39***	0.52***	0.37**
- %Δ in THBUSD (t-1)	0.34***	0.11	0.08	0.33***	0.08	0.17
%Δ in Singapore ULG95 price (t)	0.28***	0.35***	0.33***		0.41***	0.26***
%Δ in Singapore ULG95 price (t-1)	0.17***	0.16***	0.14***		0.10***	0.02
%Δ in Singapore HSD price (t)				0.35***		
%Δ in Singapore HSD price (t-1)				0.23***		
The ratio of changes in taxes and oil funds contribution to retail prices (t)	0.65***	0.94***	0.98***	0.57***	0.92***	0.46*
(t-1)	0.19***	0.23**	0.10	0.21***	-0.02	
Adjusted R-squared	0.84	0.84	0.85	0.78	0.89	0.62
Number of Observations	189	96	96	189	61	61

Note: (1) *,**,*** indicate the significant level at 90%, 95% and 99%, respectively

(2) The sample covers period 2002M4-2017M12 for Benzynes95, and 2010Q1-2017Q4 for Gasohol91 and Gasohol95.

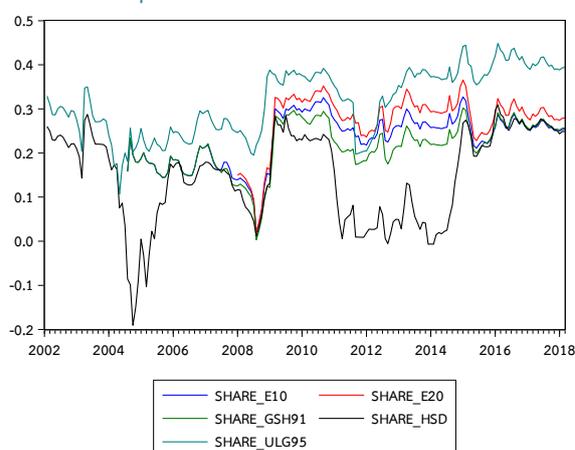
For Diesel, we use the sample from 2005Q1-2017Q4 excluding the period where its prices are strictly targeted by the government.

Source: BOT

gasohol91, gasohol95, E20 and E85. The aim is to investigate heterogeneity in the ERPT across products within the same category. To account for US-dollar costs of oil imports, I use Singapore oil prices instead of Dubai prices, since the former comprise prices of different types of oil (HSD and ULG95) that better represent actual costs of domestic oil production. Moreover, I include changes in taxes and oil fund contribution (as a percentage of retail prices) as an explanatory variable to account for their role in influencing retail oil prices.⁸ Given data availability, I rely on monthly data, but the lagged value of each explanatory variable must be included in the regression to fully capture the immediate passthrough to retail oil prices.

The results in table 2 confirm the heterogeneity in ERPT estimates across different retail oil types. If the baht depreciates by 1 percent

Figure 1: the share of taxes and oil fund contribution in the retail oil price structure



against the US dollar, retail oil prices can be expected to increase by around 0.52-0.72 percent over two-month periods. In particular, the size of ERPT is largest for diesel prices. This may be explained by the low taxes and contribution to the oil fund in the diesel price structure (see figure 1),

⁸ However, whether taxes and oil fund contribution should be included as one of the explanatory variables is debatable. In reality, they sometimes systematically respond to changes in oil import costs with

an aim to limit movements in retail oil prices. In such a case, they should not be included; otherwise, the passthrough would be overestimated.

rendering the retail prices relatively sensitive to changes in exchange rates.

b) ERPT to fresh food prices

For fresh food price estimation, only farm prices are introduced as a controlled variable. The results, shown in table 1, suggest that the ERPT estimates, despite being large, are not statistically significant. This may be due to the fact that most fresh food, such as rice, vegetables and fruits and eggs, is domestically produced. Another potential explanation is that, even though certain staple products, such as wheat, corn and soybean, are imported to feed animals, their import costs do not appear to have material effects on meat prices, which are instead largely driven by domestic demand and supply conditions.

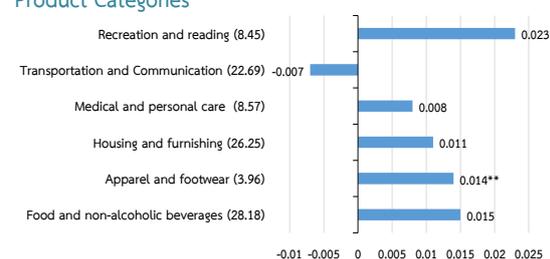
c) ERPT to core inflation

The exchange rate effects on prices of core consumer products are of interest given their large share in the CPI basket (72.56 percent). Like headline CPI, we exclude the impact of government measures from the core CPI index. The same set of explanatory variables as in the headline CPI regression is chosen, but we replace growth of Dubai oil and farm prices with growth of retail oil and fresh food prices, to better represent supply-side shocks. The results suggest that **the ERPT to core CPI is small and not statistically significant. Nevertheless, this does not imply that core inflation is insulated from exchange rate movements, since changes in retail oil prices significantly affect core CPI.** Therefore, changes in the exchange rate, which matter for retail oil prices, can have an indirect, despite being small, effect on prices of goods and services in the core CPI basket.

I next disaggregate core CPI into seven components, in accordance with the Ministry of Commerce's classification.⁹ Again, this is to examine

heterogeneity in the ERPT estimates across sub-components within the core CPI basket. Common explanatory variables presenting in all regressions consist of the output gap and growth of non-farm average labor earnings. Moreover, additional controlled variables are separately included for each regression to account for idiosyncratic shocks. The results (shown in figure 2) point to some heterogeneity in the ERPT. That is, **only apparel and footwear prices are significantly affected by exchange rate changes.** Nevertheless, given the small share of apparel and footwear in the core CPI basket (3.96 percent), the significant effects on their prices should not have any material impact on overall core CPI. **Moreover, all the ERPT estimates are commonly found to be small, in line with the estimate from core CPI regression.** The low and insignificant passthrough to core CPI is, therefore, confirmed.

Figure 2: Exchange Rate Passthrough to Core Inflation by Product Categories



Note: (1) *,**,*** indicate the significant level at 90%, 95% and 99%, respectively
 (2) Ministry to Commerce classified the CPI basket into 7 categories. We examine passthrough to prices of each category, except tobacco and alcoholic drinks.
 (3) The dependent variable is percentage changes in the price index for each category.
 (4) The sample covers period 2001Q1-2017Q4.
 (5) The figures in () indicate the category share in the core CPI basket
 Source: BOT

Any asymmetry and non-linearity in the ERPT to core inflation?

I hypothesize, as in the literature, that currency appreciation may have a smaller effect on prices, as firms tend to be more reluctant to cut their product prices to benefit from lower production costs. Furthermore, due to the existence of price adjustment costs or contracts, firms may find it optimal to adjust prices only when changes

⁹ These include (1) food and non-alcoholic beverage (2) apparel and footwear (3) housing and furnishing (4) medical and personal care (5)

transportation and communication (6) recreation and reading and (7) tobacco and alcoholic beverages.

in costs are sufficiently large. The results in table 3 show that there is some evidence of ERPT asymmetry. **We find an insignificant effect from currency appreciation, whereas the depreciation significantly results in an increase in core CPI.** In particular, following 1-percent weakening of the baht, core CPI is estimated to rise by 0.044 percent (or 0.032-percent increase in headline CPI). The result suggests the possibility that a linear model could fail to identify the ERPT to consumer prices. On the contrary, I do not find any difference

Table 3: Asymmetry and Non-linearity of Exchange Rate Passthrough

Variables	Baseline	ERPT Asymmetry	ERPT Non-linearity
Constant	0.05	0.00	0.07*
Lagged dependent variables	0.64***	0.61***	0.59***
%Δ in THBUSD (t)	0.015		
- Appreciation		-0.021	
- Depreciation		0.044**	
- Small E/R changes			0.030
- Large E/R changes			0.012
%Δ in Dubai oil price	0.02***	0.01***	0.01***
%Δ in farm price	0.03**	0.02	0.02*
Output gap	0.01	0.01	0.01
Adjusted R-squared	0.65	0.70	0.68
Number of Observations	68	68	68

Note: (1) *,**,*** indicate the significant level at 90%, 95% and 99%, respectively

(2) The sample covers period 2001Q1-2017Q4.

(3) The dependent variable is quarter-on-quarter percentage changes in core CPI, excluding the impact from government measures.

Source: BOT

between the impact of small and large exchange rate changes.

d) Summary

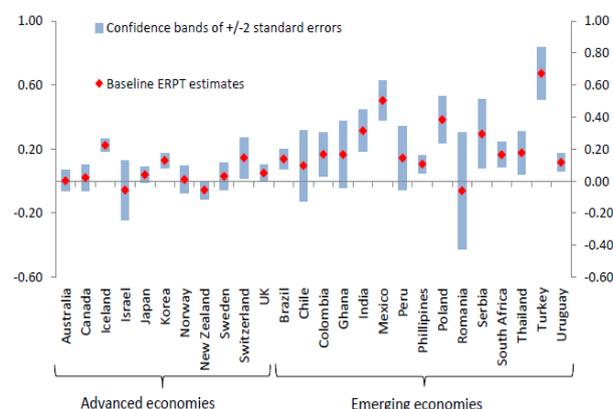
Given all disaggregate estimates from table 1 and 3, it is possible to obtain aggregate ERPT to headline CPI. I find that following a 1-percent change in the baht, headline CPI on average alters by 0.032 percent. The effects are merely channeled through energy prices. However, the ERPT can be larger in the case of baht depreciation. In particular, a 1-percent depreciation of the baht leads to 0.06-percent rise in headline CPI.

Compared to estimates of other countries, the ERPT estimates for Thailand are

relatively low and are comparable to those of advanced economies (figure 3). This may reflect the fact that production of Thai goods and services, except for oil, does not contain high import content. Considering the 2011 input-output (I/O) table, compiled by NESDB, the import content of goods and services in the CPI basket averaged at around 17 percent. As expected, the import content was highest for goods and services in the transportation and communication component, which helps explain why the ERPT mainly operates through retail oil prices. However, I could not find any significant ERPT for medical and personal care items whose import content is also relatively high. Huge competition in this sector may explain such muted passthrough.

Apart from the import content consideration, the low inflation environment could

Figure 3: ERPT Estimates across Countries



Source: Forbes et al (2017)

be another contributing factor to low ERPT. After the adoption of the inflation targeting framework, Thailand's inflation declined, with its expectations being well anchored. This could lead to less persistent inflation, making prices less susceptible to exchange rate shocks.

5. Conclusion and policy implications

The results above show the low ERPT in the case of Thailand, where the passthrough mainly operates on retail oil prices. Impact asymmetry is also found for the passthrough to core CPI, which is

By Nuwat Nookhwun

significant only when the baht depreciates. However, despite the low ERPT, movements of exchange rate can be large and hence result in evident changes in consumer prices. This can be seen in the movements of retail oil prices in recent years. Although Dubai crude oil prices significantly rose, the baht appreciation helped lessen their impact on retail oil prices, and hence reduced costs of living and overall inflationary pressures to some extent.

The findings point to at least three implications on monetary policy. First, since exchange rates affect prices in a heterogeneous and non-linear way, the precision of ERPT estimates remains important to the accuracy of inflation forecast and the formulation of monetary policy decisions. Second, the low ERPT implies that monetary policy transmission does not operate much on the exchange rate channel. However, this requires further investigation, since Forbes et al (2015) suggest that exchange rate movements caused by monetary policy shocks can have larger effects on prices than other shocks. Third, the low ERPT makes the shock-absorbing benefit of exchange rate flexibility limited. For example, when the economy overheats, the resulting exchange rate appreciation may not help reduce inflationary pressure much. Nevertheless, the low passthrough ensures that any non-fundamental shocks causing large exchange rate movements are less likely to threaten price stability.

References:

- Caselli, F. G., & Roitman, A. (2016). Non-Linear Exchange Rate Pass-Through in Emerging Markets (No. 16/1). International Monetary Fund.
- Choudhri, E. U., & Hakura, D. S. (2006). Exchange rate pass-through to domestic prices: does the inflationary environment matter? *Journal of International Money and Finance*, 25(4), 614-639.
- Forbes, K., Hjortsoe, I., & Nenova, T. (2015). The shocks matter: improving our estimates of exchange rate pass-through (No. 43). Monetary Policy Committee Unit, Bank of England.
- Forbes, K., Hjortsoe, I., & Nenova, T. (2017). Shocks versus structure: explaining differences in exchange rate pass-through across countries and time (No. 50). Monetary Policy Committee Unit, Bank of England.
- Jašová, M., Moessner, R., & Takáts, E. (2016). Exchange rate pass-through: What has changed since the crisis? (No. 583). Bank for International Settlements.
- Mihaljek, D., & Klau, M. (2001). A note on the pass-through from exchange rate and foreign price changes to inflation in selected emerging market economies. *BIS papers*, 8, 69-81.
- Mihaljek, D., & Klau, M. (2008). Exchange rate pass-through in emerging market economies: what has changed and why?. *BIS Papers*, 35, 103-130.
- Mishkin, F. S., & Schmidt-Hebbel, K. (2007). Does inflation targeting make a difference? (No. w12876). National Bureau of Economic Research.
- Ito, T., & Sato, K. (2007). Exchange rate pass-through and domestic inflation: A comparison between East Asia and Latin American countries. *Research institute of Economy, Trade and Industry, RIETI Discussion Papers*, 7040.
- Taylor, J. B. (2000). Low inflation, pass-through, and the pricing power of firms. *European economic review*, 44(7), 1389-1408.

This article greatly benefits from earlier studies by Pajaree Prasitsak. I would also like to thank Sukpinnarat Vongsinsirikul, Paiboon Pongpaichet, Tananthorn Mahapornprajuck Warinthip Worasak and the FAQ editorial team for their helpful comments.

Contact author:

Nuwat Nookhwun
Senior Economist
Monetary Policy Department
NuwatN@bot.or.th