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ARTICLES IN THIS ISSUE

BOOK REVIEW

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The Philippine Review of Economics

A joint publication of the UP School of Economics (UPSE)
and the Philippine Economic Society (PES)

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The impact of Philippine monetary policy on domestic prices and output: evaluating the country's transmission channels

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This paper examines the price and output effects of Philippine monetary policy through its transmission channels from 1996 to 2019 using Structural Vector Autoregression (SVAR) models. Recursive and non-recursive identification strategies are implemented to build a model that represents the small open economy of the Philippines, which is affected by exogenous shocks in oil prices and US interest rates. Impulse response functions are then compared between recursive and non-recursive models to select results that demonstrate consistency with macroeconomic theory and overall statistical significance. The Local Projections method is then applied as a means of verifying the accuracy of the preferred model's results. Findings show that a contractionary shock to Philippine monetary policy has weak short-term effects on domestic output and prices. These results contribute to the literature by characterizing the strength of transmission channels 17 years after inflation targeting was adopted as a primary component of Philippine monetary policy.

JEL classification: C01, E52
Keywords: Philippine monetary policy, structural vector autoregression, Local Projections method

1. Introduction

In 2002, the Philippine Central Bank or Bangko Sentral ng Pilipinas (BSP) adopted inflation targeting (IT) as the principal mechanism of its monetary policy. The adoption of IT allowed the central bank to set and publicly announce explicit inflation rate targets for the medium-term. Guinigundo [2016] states the IT approach fosters a well-anchored expectations channel to help the central bank achieve price stability while reducing the volatilities of output and interest rates. The public announcement of inflation targets generally ensures a stable price level of goods and services which protects the purchasing power of economic agents and indirectly encourages economic growth in the country. IT has placed the BSP in a better position to focus on price stability as its primary objective which has facilitated roughly 20 years of sustained economic growth

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in the country. However, it has its limitations and it does not completely shield economies from inflationary periods that are caused by supply-side constraints or exogenous shocks. The Philippines most recently, in 2018, experienced such an episode partly due to the rising international fuel costs, as inflation rates soared to a ten-year high, or roughly two percentage points above the announced target.

Both the national government and the central bank deemed the inflationary episode as transitory. The Department of Finance (DOF) attributed inflation rise to external transitory pressures from the United States (US) increasing its interest rates, rising international oil prices, and the adjustment period from the implementation of the Tax Reform for Acceleration and Inclusion [Department of Finance 2018]. Alternatively, in response to these rising prices, the BSP raised interest rates by a cumulative 175 basis points from 3.00 percent in January 2018 to 4.75 percent in December 2018.[1]

During these instances, the appropriate responses to supply shock inflationary pressures are not changes in policy rates, but rather non-monetary policy programs such as targeted in-kind or cash-transfers.[2] The exception is when it becomes apparent that there are lingering demand effects from persistent supply-side inflation. The central bank may then decide to revise interest rates to alter the inflation expectations of consumers and producers.

In the last two decades, the Department of Economic Research – Bangko Sentral ng Pilipinas [2019] noted that most of the inflationary episodes were caused by supply-side constraints such as oil shocks, or structural impediments affecting food importation, and typhoons impacting the domestic agriculture. Bernanke and Mishkin [1997] allude that these short-run deviations from inflation targets are to be expected and even occasionally accommodated by the central bank. However, it is worth noting that these increased price volatilities negatively impact economic growth and delay monetary policy transmission. Therefore, viable transmission channels are essential to minimize the (demand driven) price fluctuations in the short run and reduce the tradeoff between inflation and output.

In the case of supply shocks, similar to those encountered by the Philippines, Arestis, Caporale, and Cipollini [2002] implied that mistimed policy rate adjustments contribute to a destabilization in the output gap because monetary policy is now inducing an opposite variation on output and demand. Guinigundo [2016] states that inflation volatility has been on a clear downward trend since 2002 due to IT's well-anchored inflation expectations in the country, but this approach does not prevent persistent inflationary episodes because the Philippines is still susceptible to oil price shocks or agricultural impediments.

It is to this end that this paper investigates the impact of monetary policy on the Philippine economy. Its primary objective is to characterize price and output effects of interest rate adjustments in the country through its monetary

[1] Monetary policy decisions were taken from Bangko Sentral ng Pilipinas [2018].
[2] An example of non-monetary policy programs is the Pantawid Pasada Program.

policy transmission channels. The methodology of this study involves building a Structural Vector Autoregression (SVAR) model of a small open economy like the Philippines to analyze the effect of BSP's monetary policy, in the form of its policy rates, on consumer prices and output (through industrial production). Such a framework allows this study to achieve its objectives by answering two research questions: (1) the impact of monetary policy on domestic commodity prices and output, and (2) the strength of monetary policy transmission channels and their pass-through effects on the Philippine economy.

Existing literature on the impact of Philippines monetary policy on output and prices is limited. There are only a handful of studies, but none of these specifically highlight the impact of policy rates on the production output or real gross domestic product (GDP) and prices. Therefore, this paper seeks to contribute to the literature in two ways: first, by providing fresh analysis that reflects monetary policy decisions after the adoption of inflation targeting; and second, by using SVAR models, which, if properly identified, tend to provide more realistic estimates and simulations of shocks to policy variables.

The outline of the succeeding sections of this paper are as follows. Section 2 provides a literature review of theoretical and empirical studies associated with this topic. Section 3 presents the data and preparatory tests needed for time-series analysis. Section 4 then covers the methodology, while Section 5 provides a discussion of primary results and robustness tests. Finally, Section 6 presents a summary of findings, limitations of the paper, and future areas for research.

2. Literature review

There exists a clear heterogeneity in the effects of monetary policy on macroeconomic indicators like prices, output, and employment. Additionally, Mishra, Montiel, and Spilimbergo [2012], and Mishra and Montiel [2013] outlines the differences, and their reasons, in monetary policy effects between low-income and high-income economies. There are changes in government laws, the development of banking and financial systems, and the presence of imperfect competition levels that ultimately affect the strength of transmission channels. These factors make it important to regularly update the empirical literature to see if the impact of interest rates on output and prices still conform with conventional economic theory, holding all else constant, over multiple time periods.

In the case of the Philippines, the issue of heterogeneity is especially essential because empirical studies on the price and output effects of monetary policy are limited. There are only a few readily available papers like Guinigundo [2008], Tuano-Amador, Glindro and Claveria [2009], and Glindro et al. [2016] that extensively discuss the impact of monetary policy for the period following the adoption of inflation targeting.

2.1. Philippine monetary policy transmission channels and their effects on domestic prices and output

Guinigundo's [2008] research is one of the few papers that characterizes interest rate, credit, exchange rate, asset price, and expectation channels in the Philippines under an inflation targeting framework. While the analysis is empirical, it also provides (1) a clear description of monetary policy transmission channels' responses and the (2) implementation lag before pass-through effects on the country's interest, exchange rate, and credit channels become evident. Guinigundo's analysis may be summarized into four points.

First, the BSP's monetary board makes changes to the Philippine policy interest rate (channel) through the bank's overnight policy rate (PR) rate. Empirically, these adjustments are said to directly affect Treasury Bill rates within three months. Second, the dominance of banking in the financial system through both in-person and digital mediums have created a strong interdependence between the credit and asset price channels. This structure forced the central bank to adopt more macroprudential policies geared towards monitoring risky transactions, which have potentially weakened the pass-through effects of both channels over time. Third, as part of its inflation targeting framework, the BSP commits to a flexible exchange rate regime by allowing market forces to influence the exchange rate even if this has a direct, but not severe, impact on actual inflation and inflation expectations. There is an estimated exchange rate pass-through of about a year before effects are fully realized. Finally, the Philippines is characterized to regularly experience supply-side shocks in the form of rising oil and food prices. These volatile price movements, along with a significant expectations channel, have required the BSP to conduct regular public announcements on its policy decisions for consumers and firms so that it remains a credible source of information for stable inflation expectations.

Apart from adjustments in the PR rate, Glindro et al. [2016] lists the BSP's primary instruments for open market operations (OMO) as the reserve requirement, the rediscount rate on short-term loans extended to financial institutions against collateral from banking clients, the purchase or sale of the central bank's government securities, and the acceptance of special deposit accounts. Chie [2013] further classifies these measures into direct and indirect instruments. Direct instruments allow the BSP to control the percentage of bank deposits and deposit substitute liabilities that banks keep on premises while indirect instruments generally entail adjustments in short-term policy interest rates or the buying and selling of government securities from these financial institutions.

In the context of this study, two conclusions can be made from the characterization of Philippine monetary policy transmission channels. First, despite more financial alternatives (electronic accounts and e-wallets) and macroprudential policies, the credit channel likely remains the most potent channel of Philippine monetary policy. Guinigundo's [2008] analysis holds true

in the status quo as the Philippine economy is heavily reliant on credit: because banks comprise 80 percent of the country's total assets, which also creates some interconnectedness between both credit and asset channels.

In terms of pass-through effects from the credit channel on prices and output, these should be relatively noticeable in the short-term. While more alternatives to bank loans have emerged, majority of Filipinos still make use of banks. As of 2019, the BSP [2019] reported that bank accounts still have a marginally higher penetration rate of 12.2 percent versus microfinancing at 12.1 percent and e-money accounts at 8.0 percent. Moreover, historically low bank rates and high credit claims have also provided the liquidity needed for domestic consumption and investments decisions (i.e., small-scale entrepreneurial decisions and lending capacity) in the economy. Much of the literature such as Glindro et al. [2016], Bayangos [2010], and Tuano-Amador, Glindro and Claveria, [2009] supports this claim as they found significant but relatively weak pass-through effects on the credit channel. As described by Anzuini, Lombardi and Pagano [2012] and Frankel [2006], lower banking rates, for example, decrease the opportunity cost for firms who hold unsold commodities and unpaid loans. They especially incentivize borrowing and spending decisions in consumption-driven economies like the Philippines.

Second, the impact of BSP policy rate adjustments on the country's flexible exchange-rate regime is expected to impact prices in the short- and medium-term. Tuano-Amador, Glindro and Claveria [2009] state that due to well-anchored inflation expectations from the IT regime and a cyclical inflow of foreign exchange, the pass-through effects of the Philippine exchange rate channel have decreased noticeably after 2002. Their analysis suggests that the pass-through effects of the exchange rate channel is more consistent with economic theory or the Uncovered Interest Rate Parity Condition (following adjustments in monetary policy). Intuitively, this condition means a hike in Philippine policy rates likely makes domestic assets more attractive relative to foreign assets. Higher policy rates then encourage an inflow of foreign exchange which leads to an appreciation of the peso relative to foreign currencies. Ultimately, an appreciating peso makes the country's exports more expensive which will likely decrease an economy's output.

2.2. Empirical Philippine monetary policy studies

2.2.1. Price and output effects of Philippine monetary policy

This section covers the various empirical methodologies used to analyze Philippine monetary policy transmission mechanisms. While there is a relatively large variation of models tackled in this discussion, the result of each study provides a baseline expectation of monetary policy transmission channels in the Philippines.

Literature dedicated specifically to the domestic price and output effects of Philippine monetary policy is limited, and most papers have not used data that

is recent as of this writing. Most of the studies that are readily available from independent and central bank researchers use Autoregressive Distributed Lag (ARDL) models, VAR models, Structural Equations Modeling (SEM), and input-output (I-O) methodologies, but only a few utilize SVAR models with extensive identification strategies. Moreover, the current empirical literature does not directly address the effects of monetary policy adjustments on (1) prices and output or (2) the relative strength of transmission channels following policy rate adjustments.

The consensus in the literature is that the Philippines's interest and credit channels are relatively stronger in comparison to other channels.

Vargas' [2021] VAR analysis uses quarterly data from 1985 to 2007 and supports the relative strength of the country's credit channel. The results show that this channel had the strongest effect on real GDP in comparison to the real exchange rate and lending rate channels. However, forecast error variance decomposition (FEVD) found that each of the channels were still relatively weak sources of the variance changes for real GDP and consumer prices. In terms of the study's output effects, the model found expansionary monetary policy strongly increased output after two quarters while having a weaker long-run effect on domestic prices in the country.

Research from the BSP is generally consistent with work highlighting the relative strength of the country's credit channel, but monetary policy's price and output effects are less clear. Tuano-Amador, Glindro and Claveria [2009] implemented a SEM to support the claim that the BSP's policy rate changes affect the credit of the private sector through its OMO, but their paper did not enumerate the impact of BSP policy changes on the country's output and prices.

Guinigundo [2008] from the BSP also supports the relative strength of the country's credit channel but considers its possible weakening over time. Decreased penetration from bank lending channels due to increased financial market liberalization in the early 1990s, a stricter prudential regulatory framework, and more efficient risk-based and punitive measures against erring banks are few reasons for a potentially weaker credit channel in the Philippines. However, empirically, his analysis only makes use of a simple ARDL model, which fails to account for identification problems or seasonality and stationarity in the data.

Other studies describe the strength of interest and exchange rate channels. Dakila Jr. and Paraso [2005] used a Vector Error Correction Model (VECM) to examine the short- and long-run effects of Philippine monetary policy, primarily through the interest rate channel, on GDP and capital formation. Instead of BSP's policy rates, the paper uses 91-day Treasury Bill rates from quarterly data in 1987 to 2003, since these two variables are closely correlated. Their findings present the same conventional relationship between interest rates, GDP, and capital formation, but deviate slightly from the Philippine literature when they argue that contractionary monetary policy is felt only six quarters following the shock.

Glindro et al. [2016] implemented a Bayesian VAR model to analyze the country's monetary policy transmission channels from 1999 to mid-2015. This

approach was complemented with an ARDL model to examine the inflation persistence and pass-through of PHP/USD exchange rates. In comparison to exchange rates, policy rate shocks have stronger effects on the one-day Treasury Bill rate and the average bank lending rate because they are fully absorbed after a one percentage point increase over the course of a year. These findings are consistent with those of Guinigundo [2015] who used a two-step Engle Granger Error Correction Model to conclude that policy rate changes have a significant, but a relatively weaker impact on bank credit when price changes and economic growth are considered in the equations due to well-anchored inflation expectations. Alternatively, Guinigundo's [2008] I-O analysis indicates that impact of policy rate hikes on the exchange rate is felt immediately after the first month with a gradual increase up to a year after the shock.

2.3. Cross country studies on the impact of monetary policy on prices and output

Research that measures the price and output effects of monetary policy and its transmission channels have been conducted for Asia-Pacific economies like Vietnam, Singapore, Malaysia, Thailand, and Australia. The literature presents two points of contention when discussing the effects of monetary policy in a small open economy. First, many empirical papers consider the trade-offs between utilizing a VAR or SVAR model. Second, the type of identification strategy implemented contributes heavily to the accuracy of the results.

VARs are used for modelling small open economies because they impose relatively few theoretical assumptions on the statistical analysis. Phan [2014] argues that VAR models are empirically convenient for monetary policy studies because they are less dependent on economic theory and treat all macroeconomic variables as endogenous variables in a matrix of reduced form equations. However, Cooley and LeRoy [1985], Evans and Kuttner [1998], Bagliano and Favero [1998], were further cited in Phan's [2014] study to claim that (1) this flexibility makes VAR's IRF mere linear combinations of structural shocks that produce misleading results which are disconnected from economic theory, and (2) VARs have poor forecast performance, particularly in long samples due to parameter instability. The benefit of a SVAR model is that it allows the consideration of the structural dynamics that are specific to the Philippine economy through an identification scheme that imposes various restrictions.

2.3.1. SVAR studies on monetary policy

The contributions from Bernanke [1986] and Sims [1980] present the importance of the theory-based approach in SVAR models of the monetary policy of small open economies. They argue that discounting macroeconomic theory leads to (1) potential correlations that exist between variables like money and

output as well as (2) missing the true underlying structural shocks present in system of the model.

There are several identification strategies used in the SVAR monetary policy literature. This review mainly covers studies that made use of recursive and non-recursive identification methods. Along with this, studies also impose a combination of short-run and long-run restrictions on endogenous variables that were developed by Shapiro and Watson [1988], King and Watson [1992], and Blanchard and Quah [1988].

Much of the empirical literature of monetary policy effects is based on the SVAR model developed by Kim and Roubini [2000] on non-US G-7 countries. Their model utilizes a non-recursive identification strategy and imposes contemporaneous restrictions. Variables are also segregated into either domestic or foreign blocs in their paper. This classification aids researchers in selecting appropriate variables that potentially avoid economic puzzles. The former bloc consists of monetary transmission channels like interest, exchange, credit, and asset price channels along with an economy's money supply. Domestic output is captured either through industrial output or GDP. Policy variables are those considered to be the central bank's main component of implementing monetary policy or adjusting interest rates.

Two variables then account for the influence of the international market which in turn helps ensure the accuracy of IRFs. Oil prices and the US Federal Funds Rate represent exogenous changes to monetary policy because these two factors often contribute to unexpected domestic policy rate adjustments. Grilli and Roubini [1995] argue that the inclusion of the Federal Funds Rate is necessary because this controls the reaction of a small open economy's domestic monetary policy to US monetary policy changes. Generally, models may classify US Federal Reserve rates, and oil prices as two exogenous variables in the 'foreign bloc' of the SVAR model that do not respond contemporaneously to domestic monetary policy channels from small open economies.[3]

In Kim and Roubini's [2000] paper, results from a contractionary shock to monetary policy are consistent with conventional macroeconomic theory for a majority of the industrialized countries in their SVAR model: (1) an initial increase in interest or policy rates in the short-run along with a fall in money supply, (2) a decrease in price level and output, and (3) an appreciation of the exchange rate followed by its depreciation or mean-reversion.

Modifications of Kim and Roubini's model have been applied to much of the succeeding literature. Raghavan, Silvapulle, and Athanasopoulos [2012] apply a similar strategy in the post Asian financial crisis period for Malaysia, a slightly similar Southeast Asian economy to the Philippines. They apply both recursive and non-recursive identification schemes to an initial seven-by-seven

[3] In the SVAR monetary policy literature, domestic variables are referred to as a 'domestic bloc' while foreign variables are referred to as 'foreign bloc'.

model. Their results are plagued by economic puzzles, or what Sims [1992] and Obstfeld and Rogoff [2000] refer to as movements in IRFs from macroeconomic variables (like prices, exchange rates, interest rates) that are counterintuitive to conventional economic theory. The recursive model of Raghavan, Silvapulle, and Athanasopoulos [2012] showed an output puzzle because industrial output increased from a contractionary shock to monetary policies. The same type of counterintuitive response was found for exchange rates and money supply under this specification. Alternatively, the non-recursive model in their study had no price puzzle, but IRFs did show the same puzzles for Malaysian output, money supply, and exchange rates.

The non-recursive identification strategy of Abouwafia and Chambers [2015] on Middle Eastern countries provides a clear contrast to Kim and Roubini's [2000] SVAR framework. The primary difference in Abouwafia and Chambers' work is that it emphasizes the role of stock prices through the asset channel of monetary policy transmission mechanisms and dismisses the long-run impact of monetary policy on exchange rates.

Overall, the literature is generally undecided about which identification strategy is superior in modelling the economic effects of monetary policy for small open economies. Arwatchanakarn [2017] used a non-recursive identification strategy to model Thailand's economy to find evidence of an exchange rate puzzle. Nguyen [2014] applied the same strategy to examine short-run monetary policy effects in Vietnam and found the same conclusion, but with the addition of transitory price and liquidity puzzles. Brischetto and Voss [1999] applied a non-recursive strategy on Australian monetary policy effects, but surprisingly found no evidence of economic puzzles.

Based on the literature, the identification strategy (recursive or non-recursive) is clearly an essential step to ensuring that the SVAR framework accurately represents the macroeconomic dynamics of a small open economy while the inclusion of certain macroeconomic variables plays a role in keeping models robust and avoiding economic puzzles.

2.4. Expectations of macroeconomic variables following a monetary policy shock

The analysis of this paper is heavily dependent on the response of credit, output, price, and exchange rates to a (contractionary) monetary policy shock. Expectations similar to that of Kim and Roubini [2000] are applied in this study. They use available macroeconomic theories to characterize the time path of domestic credit, output, prices, and the exchange rate following the increase of domestic policy rates. There is a straightforward decline in domestic credit following this shock because money supply is expected to decrease. In the case of output, there is minimal to no expectation of a decrease in output following a contractionary monetary policy shock.

This is largely because real variables are fixed, and any movements in output should only be considered transitory or short term. The price level is then expected to immediately decline following the shock, but the time period in which the decrease occurs is dependent on whether prices are sticky or flexible in that economy, as argued by Christiano and Eichenbaum [1992, as cited in Kim and Roubini 2000: 572]. Finally, in the case of domestic exchange rates, an initial appreciation is expected, but this is followed by periods of depreciation.[4]

3. Data

This paper makes use of Philippines quarterly data from 1996 Q1 to 2019 Q4. The 23-year period covers several developments in the Philippine economy including financial crises, the formal adoption of inflation targeting by the BSP in 2002, and several supply- and demand-side shocks.

3.1. Descriptive statistics

Table 1 presents the list of variables used in the SVAR framework in their original form. Given that Philippine data on domestic credit to private is only available annually, all variables were adjusted to quarter frequency. *DC* was interpolated from an annual frequency to a quarter frequency to match the remaining variables. Variables were then computed as individual growth rates. Adjustments for seasonality and structural breaks were then implemented to ensure the accuracy of results.

TABLE 1. Variables, data frequency, and sources

Variable name	Abbreviation	Unit	Frequency	Source (notes)
		Endogenous variables		
		(*Domestic bloc*)		
Industrial Production Index	IPI	Index	Monthly	Philippine Statistics Authority
				(Notes: 2010 =100, Volume or constant price value index)
Consumer Price Index	CPI	Index	Monthly	Philippine Statistics Authority
Exchange rate (PHP/USD)	ER	Philippine Peso	Monthly	Bangko Sentral ng Pilipinas
Policy rate	PR	Percent	Monthly	Bangko Sentral ng Pilipinas
Domestic credit to private sector (Percent of GPD)	DC	Percent	Annual	World Bank - DataBank

[4] The following studies cited by Kim and Roubini [2000] outline the expected and responses of domestic exchange rate to contractionary monetary policy and are relevant to analysis of this paper: Dornbusch [1976], Eichenbaum and Evans [1992], and Grilli and Roubini [1995].

TABLE 1. Variables, data frequency, and sources (continued)

Variable name	Abbreviation	Unit	Frequency	Source (notes)
Exogenous variables (*Foreign bloc*)				
Dubai crude prices	Oil	Dollar per barrel	Monthly	World Bank – Commodity Markets
US Federal Funds Rate	IR	Percent	Monthly	United States Federal Reserve

Based on the Jarque-Bera Test statistics from Table 2, all variables do not possess a normal distribution. Along with a large standard deviation for most variables, this lack of normality is likely associated with the regular volatility and seasonal patterns of each indicator like the *CPI*, *Oil*, and *IPI*.

TABLE 2. Descriptive statistics in level form

	IPI	DC	ER	CPI	PR_PHP	Oil	IR_US
Mean	115.03	36.69	45.95	85.97	6.59	54.42	2.37
Median	108.53	35.44	46.48	87.79	5.88	52.47	1.74
Maximum	187.34	55.84	56.37	125.12	15	116.67	6.52
Minimum	73.16	27.5	25.76	46.67	3	11.07	0.07
Std. Dev.	22.29	7.93	7.29	23.05	3.28	31.77	2.19
Skewness	1.06	0.59	-1.08	-0.03	0.98	0.45	0.47
Kurtosis	3.86	2.19	4.14	1.7	2.99	2.01	1.62
Jarque-Bera	21.09	8.12	23.81	6.73	15.45	7.14	11.11
Probability	0	0.02	0	0.03	0	0.03	0
Sum Sq. Dev.	47,214	5,981	5,049	50,472	1,023	95,888	455

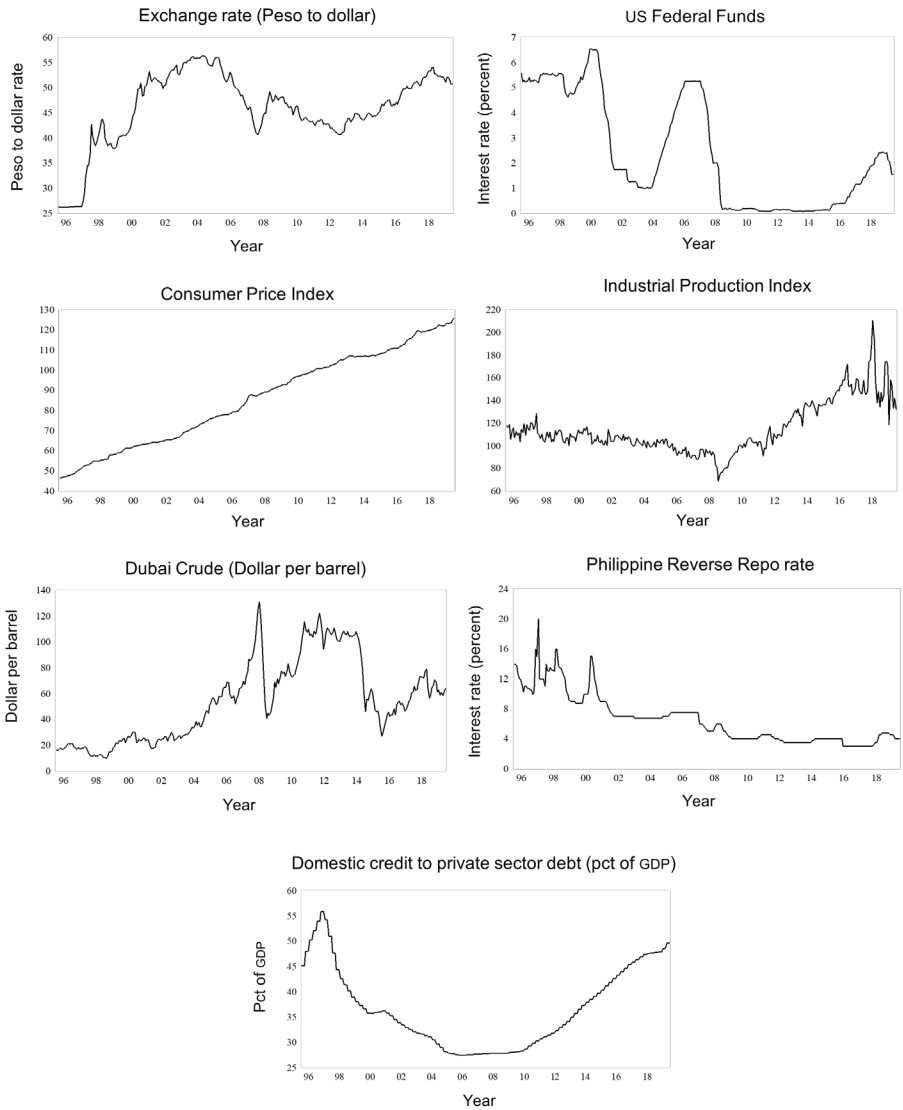
Based on Figure 1, all variables except interest rates for both the Philippines and the US are trending upwards. The figure demonstrates clear non-mean reverting characteristics and seasonal trends in variables like the *CPI*.

3.2. Data preparation for time-series analysis

3.2.1. Corrections for seasonality and structural breaks

Most macroeconomic indicators require the implementation of seasonal adjustment techniques. Otherwise, the econometric models may produce imprecise estimates that are unable to distinguish cyclical effects from other factors [Granger 1978]. There are various methods to correct for seasonality in time-series data, but this paper corrected for seasonal trends using ARIMA-X12 on EViews, as it is conventionally used to accommodate the stochastic processes found in aggregated macroeconomic data.

FIGURE 1. Non-adjusted data (1996–2019)



Another concern with long time-series is the presence of structural breaks. Failing to account for these breaks also leads to the imprecise estimates in the SVAR models. Therefore, two types of tests were implemented to account for known and unknown breaks.

Chow's [1960] Breakpoint Test is conducted to determine known structural breaks by fitting subsamples of linear regression models while allowing for structural breaks in each time period. After, using an F-test, there is a comparison of unrestricted and restricted sum of squared residuals.

A similar process can be applied to the unrestricted and restricted log likelihood function and a Wald Statistic. Two potential structural breaks were identified: the Asian financial crisis (May 1997[5] to January 2001) and the Global financial crisis (August 2008 to April 2013).

To look for unknown structural breaks, a Quandt-Andrews breakpoint test is performed. This test is essentially a single Chow Breakpoint Test that is performed at every observation between two dates and then summarized through the Maximum Statistic, the Exp Statistic, and the Ave Statistic as discussed by Andrews and Ploberger [1994] and Andrews [1993]. These statistics are provided through likelihood, *F*, and Wald tests.

Since these tests are not applicable to SVAR, the autoregressive coefficients of these VAR models can be estimated separately through the ordinary least squares (OLS) method without loss of estimation efficiency. Both tests use the same specification as the VAR model in the main analysis, but through five separate equations for endogenous variables—*IPI*, *DC*, *ER*, *DC*, *PR*.

3.2.2. Testing for stationarity and optimal lag order selection

The Augmented Dickey-Fuller [1979] test is used to look for the presence of a unit root (or stochastic trend) in the data. Non-stationary data requires first-differencing for SVAR models to ensure the time-series models produce credible estimates that are free of any deterministic trends. Standard notation from Hamilton [1994] specifies an ADF test using the least squares estimator is given by

$$\Delta X_t = \alpha_0 + \beta X_{t\text{-}1} + \delta T + \sum_{i=1}^{P} \alpha_i \Delta X_{t\text{-}i} + \varepsilon_t \quad (1)$$

where the first difference (ΔX_t) of the series at time t is regressed on the level at time t-1, augmented with lag terms (until order P) of the dependent variable. The time trend is $\sum_{i=1}^{P} \alpha_i \Delta X_{t\text{-}i}$ and ε_t is the error term. A hypothesis test is performed on $\beta = 0$ which is equivalent to determining that X_t has a unit root process. Mean-reversion or stationarity is then checked against the significance of the level term, $X_{t\text{-}1}$.

Results from Table 3 required first-differencing (and log transformations) in the SVAR model to be applied to all variables since their level form showed evidence of non-stationarity.

The Schwarz Information Criterion (SIC) identified the optimal number of lags at 2. This criterion was selected over alternatives to preserve degrees of freedom. The sample is also above 60 which would not give Akaike's Information Criterion (AIC) or Final Prediction Error (FPE) computational power over the SIC as argued by Liew [2004].[6]

[5] There were not enough observations to test the start of the Asian financial crisis or the time prior to 1997, but tests for other periods were conducted successfully.

[6] Models with other lag orders were also tested. Particularly, the 3-lag (suggested by HQ criteria) and 8-lags models (suggested by AIC) are tested. The best model among those tested is the one with 2 lags.

TABLE 3. Augmented-Dickey Fuller Test for variables in level and first-difference

	Level		First difference	
	***t*-Statistic**	**Prob.***	***t*-Statistic**	**Prob.***
Industrial Production Index	-0.2121	0.9321	-12.838	0.0001
Domestic credit to private sector (Percent of GPD)	-1.767	0.3946	-4.1512	0.0013
Nominal exchange rate (Philippine peso to US Dollar)	-2.8319	0.0577	-6.2304	0
Consumer Price Index	-0.1627	0.9383	-5.8096	0
Policy Rate	-2.2252	0.1989	-9.8344	0
Dubai Crude price (Dollar per barrel)	-1.6038	0.4766	-8.0249	0
US Federal Funds Rate	-2.1812	0.2145	-4.0988	0.0016
H1: Presence of unit root in the model.				
H0: Stationarity in the model.				

*MacKinnon (1996) one-sided *p*-values.

3.3. SVAR variable selection and choice of policy and target variables

The SVAR models of this paper utilize seven variables. Industrial Production Index growth, Consumer Price Index, Peso-Dollar Exchange Rate growth rate, changes in Policy Rate (PR), and changes in domestic credit to private sector as a percent of GDP are endogenous variables that are meant to control for the domestic economy and the BSP's monetary policy. Alternatively, Dubai Crude prices and the Federal Funds Rate are exogenous variables that control for international conditions such as oil prices and international trade.

Industrial Production Index – represents the output of the Philippine economy. According to International Monetary Fund (IMF) [2021], this index incorporates the real output of a country's manufacturing sector. As a target variable, output is directly influenced by a country's decision to adjust interest rates, because this influences individuals' spending power and firms' production capacity.

Consumer Price Index – represents prices of goods, the basket for which includes food items, electricity, and transportation costs in the Philippines. It directly absorbs inflationary pressures brought from demand- or supply-side inflation that the economy experiences throughout the business cycle.

Exchange Rate – influences an economy's macro-price ratios like those between imports and exports along with those between tradable and non-tradable goods. The exchange rate potentially minimizes inflationary effect on prices if this targeted by the central bank as argued by Frenkel and Taylor [2006]. The Philippines allows a flexible exchange rate even if its frequent weakening potentially contributes to inflation.

Policy Rate (PR) – the primary means of the BSP conducting OMO and signaling the prevailing interest rate of their monetary policy. According to the Bangko Sentral ng Pilipinas [2020], this policy variable, which is also referred to as the Reverse Repurchase Rate, is the rate used by its overnight facility when lending to banks to accommodate their liquidity requirements.

Domestic credit to private sector (*percent of GDP*) – represents the reaction to adjustments in the RRP because this is the amount of credit circulating around the economy's private sector. This variable may be used as a proxy for the economy's money supply.

Dubai Crude prices per barrel – The Philippines is a net importer of oil. In early 2019, Dubai crude imports from the Middle East accounted for 55 percent of imports [Domingo, 2019]. Along with a weakening currency, this dependence on fuel imports has made the economy vulnerable to supply-side shocks caused by the international market and changes in the Organization of Petroleum Exporting Countries' production.

US Federal Funds Rate – As an emerging economy that is heavily dependent on the US market, the Philippine economy is vulnerable to shocks from the Fed's policy, as also argued by the Department of Finance [2018].

4. Methodology

The methodology is presented in two sections. The first section briefly explains the theoretical framework of a SVAR model and why a simple VAR approach is not adequate for (1) demonstrating the price and output effects of Philippine monetary policy and (2) the strength of monetary policy transmission channels. The next section then discusses the two types of identification strategies used in this paper—recursive and non-recursive. There is a discussion of why each identification scheme is an adequate way to characterize monetary policy in the Philippines.

4.1. Empirical Approach

4.1.1. SVAR methodology

A SVAR model is the primary modelling approach taken in this paper, but before providing its representation of the Philippine macroeconomy, it is essential to briefly discuss why a reduced form VAR model is not applicable.

Since its introduction by Sims [1980], much of the literature on monetary policy effects like Bernanke [1990] and Christiano, Eichenbaum, and Evans [1999] implement VAR models to illustrate the effects of monetary policy on domestic output, prices, and even employment through monetary transmission channels.

As defined by Stock and Watson [2001], a reduced form VAR is a system of equations, where each of the dependent variables is a linear function of its own lagged or past values, previous values of other variables, and a serially

uncorrelated error term. A reduced form VAR model can be presented with the following specification:

$$\boldsymbol{Y}_t = \boldsymbol{\alpha} + \boldsymbol{\Phi}_1 \boldsymbol{Y}_{t-1} + \cdots + \boldsymbol{\Phi}_p \boldsymbol{Y}_{t-p} + \boldsymbol{\beta X_t} + \boldsymbol{\varepsilon}_t \tag{2}$$

$$\text{with } \boldsymbol{\varepsilon}_t \sim WN(\mathbf{0},\boldsymbol{\Omega})$$

where $\boldsymbol{Y}_t$ is a $(k \times 1)$ vector of endogenous variables that contains industrial production index growth at time t (*IPI*), change in credit to GDP ratio (*DC*), growth rate of exchange rate (*ER*), CPI-inflation rate (*CPI*) and changes in Policy rate (*PR*).[7]

$\boldsymbol{\alpha}$ is an n-length intercept vector, $\boldsymbol{\Phi}_p$ is a $(k \times k)$ vector of estimated coefficients at lag order p, and X_t is a $(q \times 1)$ vector of exogenous variables which contains Dubai Crude price growth (*Oil*) and the US Federal Funds Rate (*IR*), with the corresponding parameter vector $\boldsymbol{\beta}$. Finally, $\boldsymbol{\varepsilon}_t$ is a vector of error terms, which follow a white noise process with mean 0 and variance-covariance matrix $\boldsymbol{\Omega}$.

The presence of exogenous variables extends this VAR(p) model to a VARX (p, s). In the remaining sections of the methodology, notation referring to exogenous variables is removed for simplicity.

While reduced form VAR models are used to test generically formulated theories in macroeconomics, Cooley and LeRoy [1985] and Canova [1995] argue that their atheoretical nature, missing identification conditions, and correlation among shocks prevent IRFs from depicting accurate responses to shocks and capturing the true dynamic nature of macroeconomic variables. Thus, reduced form VARs are informative but say little about the structural parameters without important identification conditions.

To implement impulse response analyses and capture the dynamic causal effect due to its identification of a macroeconomy, a SVAR model is applied. Using slightly modified notation from Raghavan, Silvapulle and Athanasopoulos [2012], an IRF from this model may be defined as,

$$\frac{\partial Y_{t+s}}{\partial u_{i,t}} = \theta_{i,s} \tag{3}$$

where $s = 1, 2, 3,\ldots$, and $u_{i,t}$ is an unexpected structural shock to variable the ith variable over s period.

Consider the VAR(p) model from equation (2) without exogenous variables using modified standard notation from Hamilton [1994]:

$$\boldsymbol{Y}_t = \boldsymbol{\Phi}_1 \boldsymbol{Y}_{t-1} + \cdots + \boldsymbol{\Phi}_p \boldsymbol{Y}_{t-p} + \boldsymbol{\varepsilon}_t \quad \leftrightarrow \quad \boldsymbol{\Phi}(L)\boldsymbol{Y}_t = \boldsymbol{\varepsilon}_t \tag{4}$$

where $(L^p)\boldsymbol{Y}_t$ represents the lag operator.

[7] Standard growth rates were utilized for the empirical analysis. For simplicity, in the succeeding sections, variables will just be referred to using their abbreviations.

It is from reduced form VAR estimates that the coefficient of $\boldsymbol{\Phi}_1 \cdots \boldsymbol{\Phi}_p$ may be obtained. If $\boldsymbol{\varepsilon}_t$ were the structural shocks, then the IRFs may be taken from the MA representation of the VAR, $\boldsymbol{Y}_t = \boldsymbol{\Psi}(L)\boldsymbol{\varepsilon}_t$, by taking the first derivative.

Since ε_t may be affected by multiple shocks, the structural form of the model using standard notation is:

$$\boldsymbol{B}_0\boldsymbol{Y}_t = \boldsymbol{B}_1\,\boldsymbol{Y}_{t\text{-}1} + \cdots + \boldsymbol{B}_p\,\boldsymbol{Y}_{t\text{-}p} + \boldsymbol{u}_t \;\leftrightarrow\; \boldsymbol{B}(L)\boldsymbol{Y}_t = \boldsymbol{u}_t \tag{5}$$

where $\boldsymbol{E}(\boldsymbol{u}_t\,\boldsymbol{u}_{s'}) = \begin{cases} \boldsymbol{D} \text{ or } \boldsymbol{I} & \text{for } t = s \\ \boldsymbol{0} & \text{for } t \neq s \end{cases}$

Two identification strategies are utilized to capture different representations of the Philippine macroeconomy while the SVAR model of each strategy depicts the response of interest, credit, and exchange rate channels to a shock in monetary policy.

The recursive approach utilizes the foundations provided by Sims [1980; 1992] on imposing restrictions and mimics the small open economy used by Raghavan, Silvapulle, and Athanasopoulos [2012] in Malaysia, but with some modifications to accurately convey dynamics of the Philippine economy. Alternatively, the non-recursive approach heavily draws from the work of Abouwafia and Chambers [2015], but again, with some modifications to the model's identification and ordering.

IRFs are compared between both approaches to determine the more plausible and statistically relevant model. This, along with the FEVD of the superior model is then presented and discussed.

4.1.2. Recursive identification strategy

This study utilizes the order of variables and theoretical expectations set by Kim and Roubini [2000]. Their structural framework has been modified and applied to numerous recursive studies like that of Raghavan, Silvapulle, and Athanasopoulos [2012] on Malaysia. The same is applied in this paper, but with some modifications for the Philippine economy.[8]

The five variable recursive model, y_t = (*IPI*, *CPI*, *DC*, *PR*, *ER*), includes Industrial Production Index growth, Consumer Price Index, growth rate of Exchange Rate, and Policy Rate (or Reverse Repurchase Rate) as endogenous variables, whereas Dubai Crude (*Oil*) and US Federal Funds Rate (IR) are exogeneous variables.

Using a Cholesky decomposition, the model is just-identified when the contempraneous matrix B_0 has $\frac{m(m-1)}{2} = \frac{5(5-1)}{2} = 10$ restrictions for (exact) identification, where five is the number of parameters or variables used in the model.

[8] It is worth noting that there are various representations of the Philippine macroeconomy. Alternative orderings and sample modifications are applied in the sensitivity analysis of the robustness tests section. Other tests included are the Local Projections method to check the model's identification and a VECM to validate the long-run expectations of Philippine monetary policy.

The contemporaneous matrix, B_0, may be restricted to be a lower triangular matrix:

$$\begin{bmatrix} \varepsilon_{IPI,t} \\ \varepsilon_{CPI,t} \\ \varepsilon_{DC,t} \\ \varepsilon_{PR,t} \\ \varepsilon_{ER,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ b_{21} & 1 & 0 & 0 & 0 \\ b_{31} & b_{32} & 1 & 0 & 0 \\ b_{41} & b_{42} & b_{43} & 1 & 1 \\ b_{51} & b_{52} & b_{53} & b_{54} & 1 \end{bmatrix} \times \begin{bmatrix} e_{IPI,t} \\ e_{CPI,t} \\ e_{DC,t} \\ e_{PR,t} \\ e_{ER,t} \end{bmatrix} \tag{6}$$

where $\varepsilon_{i,t}$, refers to shocks and $e_{i,t}$ corresponds to reduced-form forecast errors of the ith variable in the same order of variables as of the recursive model, y_t.

In terms of ordering, the first two variables, *IPI* and *CPI*, are considered to be what Bernanke and Blinder [1990] refer to as non-policy or target variables because it is anticipated that these variables respond to monetary policy rate adjustments. Christiano, Eichenbaum, and Evans [2005] present the nominal rigidity theory to justify the order of these two variables, which states that inertia present in *CPI* and output remains relatively persistent in the face of policy rate shocks. Friedman [1968] states the effect from monetary policy adjustments may occur only two to three quarters depending on timing and extent of the adjustment. This theory and order have been cited in Nguyen, Papyrakis, and Van Bergeijk [2019], while Kim and Roubini [2000] and Raghavan, Silvapulle, and Athanasopoulos [2012] have also used the same ordering of these two variables to show that *CPI* is influenced by *IPI* due to the lag in firms' decision to adjust production or their prices.

The next two variables, *DC* and *PR*, make up what Canova and Pérez Forero [2014] refer to as the monetary policy equation. *PR* (Policy Rate) is the primary policy instrument of the BSP to adjust interest rates, which affects money supply or the proxy variable known as available credit, *DC*. Finally, *ER* is affected by all previous variables because of the BSP's free-flowing exchange rate policy, as argued by Guinigundo [2008], would allow market forces to affect the Philippine exchange rate unless there are extreme volatilities or the rate severely threatens the country's inflation target. As also stated in the literature, (inflation) pass-through effects by the *ER* are not instantenous and likely to occur over time due to its dependence on other macroeconomic variables. Overall, this specification is in majority of the literature that mimic Kim and Roubini's [2000] framework.

4.1.3. Non-recursive identification strategy

The non-recursive ordering and identification in the second component is similar to the ordering and theory specified by Abouwafia and Chambers's [2015] analysis on the Middle East. In a non-recursive fashion, (short- and) long-run restricitions are applied to allow a specification (7) relating structural shocks (ε_t) and endogenous variables.

Essentially, a total of eight restrictions are imposed on B_0 to achieve over-identification conditions that are given by:

$$\underset{y_t}{\begin{bmatrix} IPI_t \\ CPI_t \\ ER_t \\ DC_t \\ PR_t \end{bmatrix}} = C(L) \underset{B^{-1}}{\begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ b_{21} & b_{22} & 0 & 0 & 0 \\ b_{31} & b_{32} & b_{33} & 0 & b_{35} \\ b_{41} & b_{42} & b_{43} & b_{44} & b_{45} \\ b_{51} & b_{52} & b_{53} & b_{54} & b_{55} \end{bmatrix}} \times \underset{\varepsilon_t}{\begin{bmatrix} \varepsilon_{IPI,t} \\ \varepsilon_{CPI,t} \\ \varepsilon_{ER,t} \\ \varepsilon_{DC,t} \\ \varepsilon_{PR,t} \end{bmatrix}} \quad (7)$$

where $C(L)B^{-1}$ refers to long-run restrictions.

The primary difference between (7) and Abouwafia and Chambers's [2015] model is the inclusion of *DC* instead of the asset price channel (or stock prices) in the fourth equation. The characterization of Philippine monetary policy indicates that credit and asset price channels are strongly intertwined which makes *DC* an acceptable substitution in this case.

In terms of ordering, the first two variables, *IPI* and *CPI*, are target variables or they denote the goods market equilibrium. They once again follow Christiano, Eichenbaum, and Evans's [2005] explanation on the nominal rigidity theory, or what may be referred to as the monetary neutrality. This theory indicates that nominal variables have no impact on real economic indicators in the long run. Moreover, it is anticipated there will be some persistence in the short run. Partly due to the lag from firms to adjust to (monetary) policy decisions.

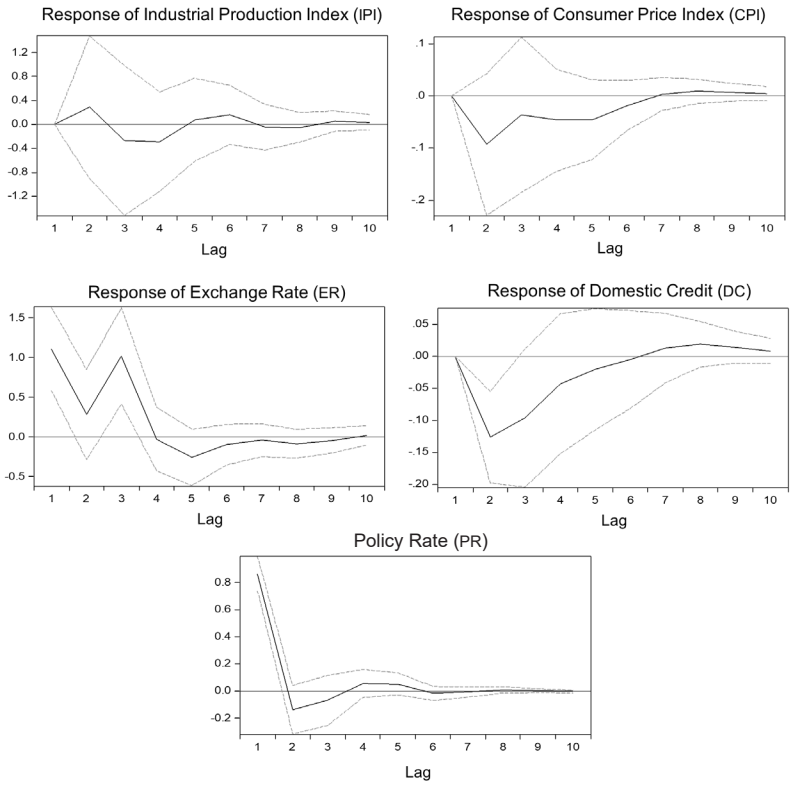
In this identification strategy, there is a clear difference in the response of *ER* because a lag is designated in its reaction. This specification considers Guinigundo's [2008] claim that there are instances in which the domestic exchange rate is completely unfazed by monetary policy adjustments. The remaining two variables, *DC* and *PR*, are monetary policy variables. The specification of *PR* is again based on Guinigundo [2008] characterization of the BSP's behavior which is to make policy decisions based on all available information from other macroeconomic indicators.

5. Empirical results and discussion

5.1. Comparison of results between both identification strategies

Figures 2A and 2B present similar results on the price and output effects of Philippine monetary policy through its transmission channels. It is not unexpected for output to show some persistence in the short run. IRFs show relatively weak credit and exchange rate transmission channels in the country. The predictions of IRFs also show hardly any statistical significance for both methods. However, there are still two notable differences between both models.

FIGURE 2A. IFRs of a contractionary to a domestic monetary shock (SVAR, recursive)

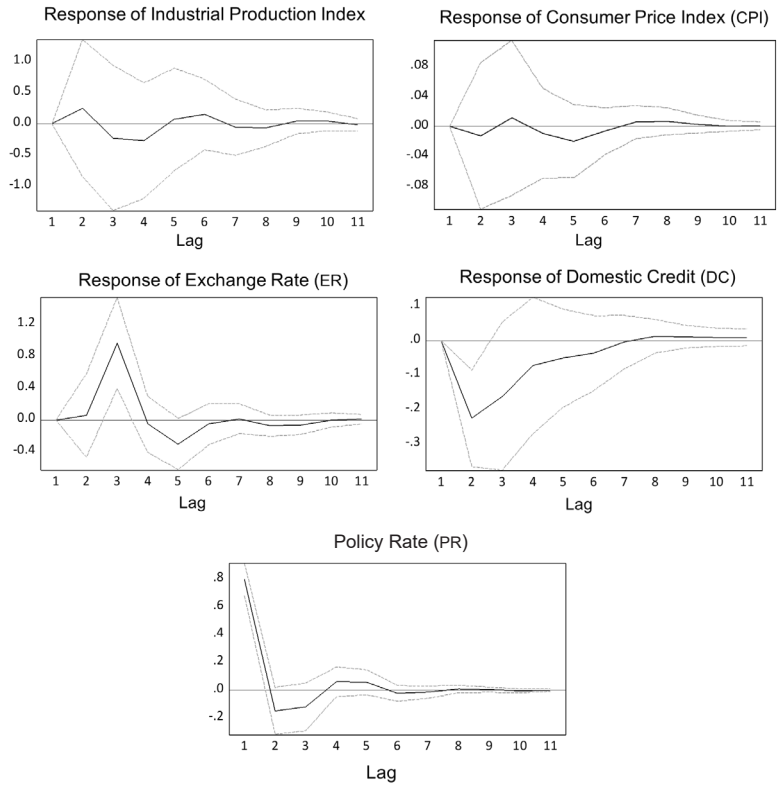


Note: Dashed lines represent 95 percent confidence bands.

In the case of the recursive method, there is evidence of an exchange rate puzzle that directly contradicts Dornbusch [1976]. Conventional theory states that, following a contractionary domestic monetary policy shock, there is a short-run appreciation of domestic currency before steadily declining over time. In most cases, this occurs when there is a floating exchange rate, much like the one applied by the BSP.

Price and output effects from higher interest rates are more pronounced for the recursively identified model while the impact on credit is almost twice as a large for the non-recursive model. Along with its statistical significance, the results presented by the non-recursive method are more consistent with the literature which makes it the preferred model for this paper.

FIGURE 2B. IFRs of a contractionary to a domestic monetary shock (SVAR, non-recursive)



Note: Dashed lines represent 95 percent confidence bands.

5.2. Discussion of non-recursive (preferred model) results and macroeconomic implications

Figure 2A presents IRFs depicting a one-standard-deviation contractionary shock in Philippine monetary policy. All variables demonstrate their response through ten quarters. Dashed lines plotted in each graph represent one-standard-error bands while the blue line depicts the time path of each variable's response. Scales vary among graphs to magnify the time path per variable relative to their respective means, which is represented by the straight black line.

First, the response of *IPI* to the shocks of the policy rate is not significant, but it does conform to the view that monetary policy may potentially only impact output in the short run before it reverts to a fixed level in the long run. While there is persistence, the deviation is not large. After the tightening of Philippine policy rates, there is an initial increase (0.33 percentage point) in the second period, but this is followed by a decline until the fourth period (0.35 percentage point), before rebounding to its pre-shock level, or mean-reverting value, in the

succeeding periods. This result suggests that the initial tightening of monetary policy potentially had an impact on output but after a lag of two periods due to persistence. While the overall time path of this model is consistent with the work of Vargas [2021] and Dakila Jr. and Paraso [2005], results from the preferred model suggests that there is a more noticeable lag of one to two quarters before the impact of higher interest rates is felt on output.

Second, the response of *CPI* is not significant, but it is consistent with conventional macroeconomic theory. An increase in policy rates decreases the price level because it disincentivizes borrowing, investment, and spending. Results show a decrease (0.01 percentage point) in the *CPI* by the second period before showing some minor deviations for the next four periods. Afterwards, there is clear evidence of mean reversion in the seventh period. The time path is consistent with Glindro et al. [2016], but this paper's model shows a much weaker impact on the price level.

Third, the response of the *ER* is only significant for the third quarter, but it does show a time path that is somewhat consistent with delayed overshooting, argued by Kim and Roubini [2000], in which there is an initial appreciation followed by depreciation of the Philippine (domestic) currency in later quarters. The impact appreciation only lasts from the second quarter until the fourth quarter. There is also a strong appreciation of the exchange rate in the third quarter (0.88 percentage point). This is followed by a sharp depreciation of the *ER* two quarters later (0.20 percentage point) before slowly reverting to a value close to zero in the seventh quarter.

Fourth, the response of *DC* is statistically significant for the first two quarters following the shock. The results are closely tied to *CPI*, as there is an immediate decline (0.22 percentage points) after the shock. This time path shows the amount of domestic credit from private firms decreasing shortly after the tightening of policy rates before steadily rising by the eighth quarter. The magnitude of these estimates are less than but still consistent with that of Guinigundo [2008], Glindro et al. [2016], and Tuano-Amador, Glindro, and Claveria [2009] who argue that, in comparison to the alternatives, the credit channel is the strongest monetary policy transmission mechanism due to the prevalence of the banking sector.

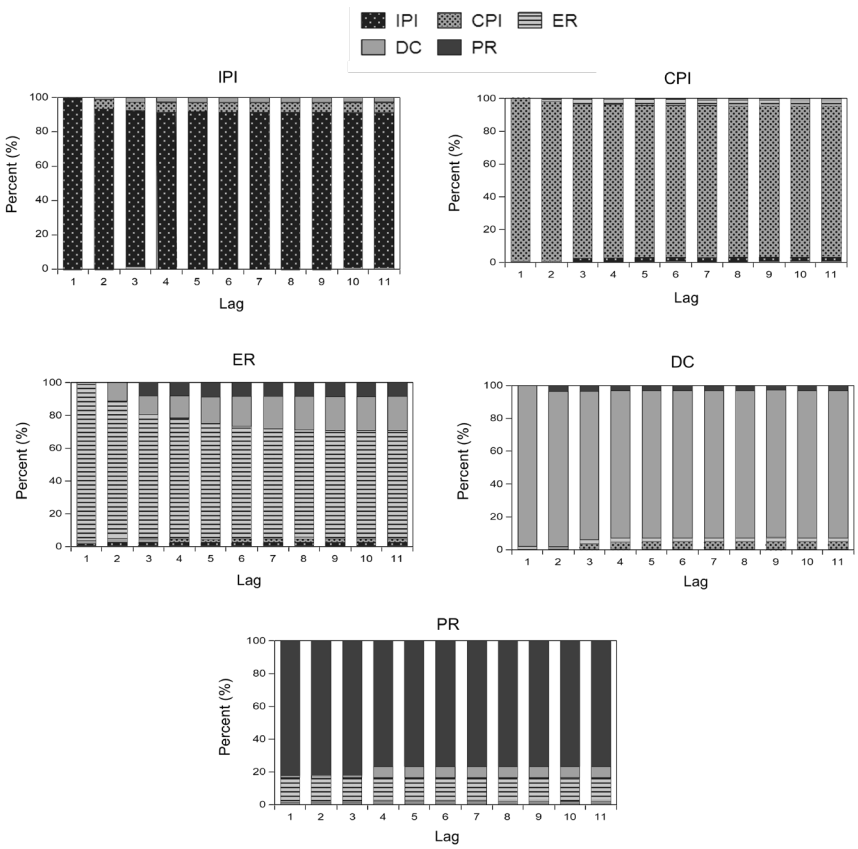
IRFs from *IPI* and *CPI* contain no periods in which the deviation is statistically significant. The impact of contractionary monetary policy also has considerable lags on *IPI* and there is a relatively weak impact on the reducing the price level (in the short run). However, the lag still is within the expectations of conventional macroeconomics of roughly two to eight quarters before the impact of monetary policy adjustments are felt. Credit channels may display the strongest pass-through effects in comparison to the alternatives, but the overall response functions of these channels still suggest a relatively weak pass-through of Philippine monetary policy transmission mechanisms.

5.3. Discussion of VD SVAR results and their depiction of Philippine macroeconomic variables

VD results from the SVAR model in Figure 3 explain the variability of shocks in respective variables over the course of eleven quarters. Results indicate that, except for *ER* and *PR*, 92.30 percent of the forecast variance of *IPI*, *DC*, and *CPI*, on average, is explained by their own shocks.

In the case of *ER*, its own shock accounts for an average of 76.23 percent of the variation of the fluctuation over eleven quarters. *DC* accounts for 12.38 percent in *ER* over this period, but this only rises after the first quarter. This is followed by *PR*, which accounts for 5.93 percent that substantially increases after the second quarter. *IPI* then provides a marginal average contribution of 4.23 percent. Lastly, *CPI* comprises only 1.44 percent of the variation in *ER*. The relatively large sources of variation brought about by other domestic variables are consistent with the BSP's free-floating exchange rate policy.

FIGURE 3. VD of SVAR variables (non-recursive, stacked table)



PR is another variable that contains relatively large amounts of variation driven by other domestic variables. Its own shock contributes to an average of 76.66 percent variation over eleven quarters while 15.18 percent of the variation is attributed to *ER*. The averages of *CPI* and *DC* are 0.80 and 6.12 percent in variation fluctuations, respectively. The contribution of *CPI* rises substantially after the first quarter. *IPI* then accounts for a modest 1.24 percent in variation fluctuations of the BSP's *PR*. This breakdown is generally consistent with the reasoning provided by the country's monetary authorities—that volatilities from *CPI* and potentially *ER* are motivators behind their decision to adjust *PRs*.

5.4. Tests for robustness

Robustness tests are implemented to ensure the absence of economic puzzles,[9] proper model ordering and identification, and the validity of monetary policy transmission in both short- and long-run horizons. These tests include (1) a sensitivity analysis, (2) the Local Projections method, and (3) a VECM.

The rationale behind these three robustness tests are as follows: first, a sensitivity analysis that includes modifications to the sample, ordering, and sign restrictions are simple ways of ensuring credible estimates and time paths of IRFs. Second, Jordà's [2005] Local Projections (LP) method is relatively absent from the Philippine monetary policy literature. This robustness test allows for an alternative computation of IRFs without identification of the underlying multivariate dynamic system. Barnichon and Brownlees [2019] and Ronayne [2011] argue that the LP method is less computationally intensive because it allows for more flexible forecasts of impulse-response estimation along with their nonlinear standard errors. Third, IRFs from SVAR models are less accurate in the long run. Moreover, short-run deviations (like inflationary episodes) may cast doubt on the preferred model's depiction of monetary policy transmission in the short term. In this study, a VECM identifies long-run cointegrating relationships between the policy and target macroeconomic variables which validates the depiction of results from the preferred SVAR model and also provides some characterization of the expectations channel in the Philippines.

5.4.1. Sensitivity analysis (Sample modifications, alternative orderings, and sign imposition)

First, since this paper uses interpolated data for the representation of quarterly domestic credit, there is a minor concern of data precision and distribution. As mitigation, monthly data from the BSP's Depository Corporations Survey (2002 to 2019) on 'domestic claims on private sector' was used in place of *DC*.[10] The

[9] Economic puzzles are often depicted through IRF results which are contradictory to conventional macroeconomic theory and evidence of model misspecification as argued by Sims [1992].

[10] Domestic claims from the Depository Corporations Survey would have been an ideal choice for domestic credit in this study. However, available data from the BSP shows a shorter series by four years which would fail to capture any period before IT was implemented by the BSP.

time paths of IRFs are generally consistent with non-recursive results though the decline on output is more immediate while the there is a one quarter delay before prices decrease. Moreover, unlike the IRFs form the non-recursive model, *DC* and *ER* no longer have any statistically significant periods which could indicate weaker transmission mechanisms.[11]

Second, the ordering from the non-recursive methods is only one way of representing monetary policy transmission in the Philippines. The current conjecture implies target variables (*IPI*,*CPI*) ← policy variables (*DC*,*ER*,*PR*). Changes in the order of firms' response (*IPI*) to changes in the prices (*CPI*) have no impact on monetary transmission in this system. Alternate orderings of policy variables also do not change general results except for a transitory puzzle when *ER* is ordered last in the system. Though there is initial currency depreciation, this is followed by appreciation before gradually reverting to the expected trend. Based on these results, alternate orderings for *IPI*,*CPI*,*DC*, and *PR* from the non-recursive SVAR model appear to be robust. Along with alternative orderings, sign restrictions were also imposed using various orderings, but macroeconomic movements (from IRFs) remained generally consistent with the preferred (non-recursive) model.

5.4.2. Local Projections method

Results from the LP method are generally consistent with the overall trend and statistical significance depicted by the ordering of the non-recursive SVAR model.[12] From this outcome, it is likely that the non-recursive SVAR model is robust in the sense that it is properly identified. However, there are some differences in the time paths and magnitudes of the IRFs from the LP method worth indicating.

First, the impact of a contractionary monetary policy from the LP method shows a clearer decline for *IPI* before gradually rising after the second quarter while there is more persistence from *CPI*. The IRFs from the LP and SVAR methods are similar by showing that the effect of the shock tapers off by roughly the fifth and sixth quarters of the horizon. Second, the impact on *ER* in the LP method is more consistent with Kim and Roubini's [2000] analysis because the (impact) appreciation of the domestic currency following the shock is more pronounced and declines gradually over a longer period before rebounding after the sixth quarter. Third, the impact on *DC* starts at a similar magnitude in second quarter as in the SVAR model, but at a slower pace. In the LP method, *DC* reaches its pre-shock level two quarters later earlier than the SVAR IRF reaches at the seventh quarter.

While an argument can be made for the validity of both sets of IRFs, results from the non-recursive SVAR and LP method do suggest that monetary policy transmission channels are relatively weak at pass-through effects on output and prices in the country.

[11] IRF results using DC from the Depository Corporations Survey may be found in Appendix 2.
[12] IRFs from the LP method results may be found in Appendix 2.

5.4.3. Vector Error Correction results

The Johansen Cointegration Test is performed to determine if there are cointegrating relationships among non-stationary data which are integrated of the same order. Based on the results, such long-run (cointegrating) relationships are present among the variables in this study. The coefficient on the error-correction equation is statistically significant and indicates a correction of the previous period's deviation at an adjustment speed of 0.34 percentage points. Long-run relationships between *PR* and *IPI* are statistically significant and consistent with the primary non-recursive analysis.

Moreover, the IRFs from the VECM depict time paths that are consistent with the non-recursive SVAR results for the short term.[13] Overall, it is likely that Philippine monetary policy can anchor (inflation) expectations and impact domestic output and prices, but there is a potential lag before its effects are fully realized for transmission channels in the short term.

6. Concluding remarks

This paper investigated the price and output effects of Philippine monetary policy. Using adjusted quarterly macroeconomic data from 1996 to 2019, a five-variable SVAR model was identified using two identification strategies (recursive and non-recursive) to estimate how monetary transmission channels like domestic credit, exchange rates, and interest rates exhibit pass-through effects onto Philippine consumer prices and output.

The research addressed two open questions: (1) the (short-run) price and output effects of domestic monetary policy and (2) the relative strength of monetary policy transmission channels in the country. In terms of the first question, though not statistically significant, the tightening of monetary policy is associated with a transitory decrease in output and prices in the short run. The decline in output is significantly less noticeable than the decline of the price level in the second quarter succeeding the shock based on the preferred model. This outcome shows that the movement of the Philippine economy generally adheres to the classical dichotomy, which is beneficial for the BSP. It provides some evidence that the tightening of monetary policy by the government does not disrupt output in the long term. Conversely, the non-existent (or potentially modest) impact of the shock on lowering the price level relative to the literature [Dakila Jr. and Paraso 2005; Glindro et al. 2016] indicates that domestic monetary policy might fail to counteract all of the effects of price shocks from the commodity market.

The characterization of price and output effects on the Philippine economy provide the foundation for the second research question of this paper. In comparison to the literature, the non-recursive model showed relatively weaker

[13] VECM results may be obtained from the author upon request.

pass-through effects on domestic credit which is supposedly the strongest transmission mechanism of monetary policy in the country. Though, with only some statistical significance in the short term, the results confirm that the credit channel is a noticeable (but relatively weak) transmission mechanism of Philippine monetary policy. In the case of the domestic exchange rate, though not statistically significant, there is an immediate impact of interest rate tightening which shows that the BSP may have some ability to counteract effects of US interest adjustments or even oil price shocks. These imperfect monetary transmission mechanisms are not uncommon for developing countries and they are a clear point of contrast to monetary policy studies on developed countries.

The results in this study were verified with several robustness tests but they are not without limitation. The SVAR model used in this study may not completely address the issue of endogeneity, as argued by Phan [2014]. Constant estimates and variances provided over a specific period by the model might also fail to incorporate underlying structural changes. The Philippines adopted inflation targeting, six years into the dataset, which could be a big enough structural impact that alters the model's variances or parameters relating the structural shocks. While dummies were incorporated into the SVAR model prior to 2002 to capture any structural breaks, determining whether these structural changes alter a model's variances and parameters may be best done though a Time-Varying Parameter VAR model. Further research may also be conducted to analyze the reasons behind the strength of monetary transmission channels and provide more controls for asset prices and even inflation expectations.

Overall, the current IT regime has allowed the BSP to anchor inflation expectations and reduce inflation volatility in the country, but persistent supply-side shocks are still expected to occur more frequently in the future. Repeated efforts to boost communications with consumers and businesses in the short run may minimize any delays of monetary policy transmission. Alternatively, the continuation of non-monetary policy measures such as targeted cash transfers or subsidies may also limit the effects of persistent (supply-slide) inflation.

References

Abouwafia, H.E. and M.J. Chambers [2015] "Monetary policy, exchange rates and stock prices in the Middle East region", *International Review of Financial Analysis* 37:14–28.

Andrews, D.W.K. [1993] "Tests for parameter instability and structural change with unknown change point", *Econometrica* 61(4):821–856.

Andrews, D.W.K. and W. Ploberger [1994] "Optimal tests when a nuisance parameter is present only under the alternative", *Econometrica* 62(6):1383–1414.

Anzuini, A., M.J. Lombardi, and P. Pagano [2012] "The impact of monetary policy shocks on commodity prices", *Bank of Italy Temi di Discussione Working Paper* (851).

Arestis, P., G.M. Caporale, and A. Cipollini [2002] "Does inflation targeting affect the trade–off between output gap and inflation variability?", *The Manchester School* 70(4):528–545.

Arwatchanakarn, P. [2017] "Structural vector autoregressive analysis of monetary policy in Thailand", *Sociology Study* 7(3):133–145.

Bagliano, F.C. and C.A. Favero [1998] "Measuring monetary policy with VAR models: An evaluation", *European Economic Review* 42(6):1069–1112.

Bangko Sentral ng Pilipinas [2018] "Monetary policy decisions", Available at: https://www.bsp.gov.ph/SitePages/PriceStability/.

Barnichon, R. and C. Brownlees [2019] "Impulse response estimation by smooth local projections", *Review of Economics and Statistics* 101(3):522–530.

Bayangos, V.B. [2010] "Does the bank credit channel of monetary policy matter in the Philippines?", in *Third Annual Asian Research Network Workshop, Japan*, pp. 25–26.

Bernanke, B.S. [1986] "Alternative explanations of the money-income correlation", *National Bureau of Economic Research Working Paper* (1842).

Bernanke, B.S. and A.S. Blinder [1990] *The federal funds rate and the channels of monetary transmission*. National Bureau of Economic Research, working paper.

Bernanke, B.S. and F.S. Mishkin [1997] "Inflation targeting: a new framework for monetary policy?", *Journal of Economic Perspectives* 11(2):97–116.

Blanchard, O.J. and D. Quah [1988] "The dynamic effects of aggregate demand and supply disturbances", *National Bureau of Economic Working Papers*.

Brischetto, A. and G. Voss [1999] "Estimation results| RDP 1999-11: A structural vector autoregression model of monetary policy in Australia", *Reserve Bank of Australia*.

Canova, F. [1995] "The economics of VAR models", *Macroeconometrics*, Springer:57–106.

Canova, F. and F.J. Pérez Forero [2014] "Estimating overidentified, non-recursive, time varying coefficients structural VARs", *CEPR Discussion Papers* No. 10022.

Chie, K. [2013] "The Central Bank and bank credits in the Philippines: a survey on effectiveness of monetary policy and its measures", *Institute of Developing Economies* (413).

Chow, G.C. [1960] "Tests of equality between sets of coefficients in two linear regressions", *Econometrica* 28(3):591–605.

Christiano, L.J. and M. Eichenbaum [1992] "Liquidity effects and the monetary transmission mechanism", *American Economic Review* 82(2):346–353.

Christiano, L. J., M. Eichenbaum, and C.L. Evans [1999] "Chapter 2 monetary policy shocks: What have we learned and to what end?", *Handbook of Macroeconomics* (1):65-148.

Christiano, L.J., M. Eichenbaum, and C.L. Evans [2005] "Nominal rigidities and the dynamic effects of a shock to monetary policy", *Journal of Political Economy* 113(1):1–45.

Cooley, T.F. and S.F. LeRoy. [1985] "Atheoretical macroeconometrics: a critique", *Journal of Monetary Economics* 16(3):283–308.

Dakila Jr, F.G. and M.D.G. Paraso [2005] "Monetary transmission mechanism in the Philippines: The interest rate channel", *Philippine Review of Economics* 42(1):57-80.

Dickey, D.A. and W.A. Fuller [1979] "Distribution of the estimators for autoregressive time series with a unit root", *Journal of the American Statistical Association* 74(366):427.

Domingo, R. [2019] "Philippine oil import bill jumps 32%", *Philippine Daily Inquirer*. Available at: https://business.inquirer.net/266341/ph-oil-import-bill-jumps-32. Accessed September 2021

Dornbusch, R. [1976] "Expectations and exchange rate dynamics", *Journal of Political Economy* 84(6):1161–1176.

Evans, C. and K.N. Kuttner [1998] "Can VARs describe monetary policy?", *Federal Reserve Bank of New York Research Papers* (9812).

Frankel, J. A. [2006] "The effect of monetary policy on real commodity prices", *National Bureau of Economic Research Working Paper* (12713).

Frenkel, R. and L. Taylor [2006] "Real exchange rate, monetary policy and employment", *United Nations Department of Economic and Social Affairs Working Papers* (19).

Friedman, M. [1968] "The role of monetary policy", *American Economic Review* 58(1):1–17.

Glindro, E., V. Delloro, C. Martin, and J. Allon [2016] "Revisiting the transmission mechanisms of monetary policy in the Philippines", *Monetary Policy Transmission Mechanism in the SEACEN Countries* (1):133-170.

Granger, C.W.J [1978] "Seasonality: causation, interpretation, and implications", in *Seasonal Analysis of Economic Time Series*, National Bureau of Economic Research, Inc. pp. 33-56.

Grilli, V. and N. Roubini [1995] "Liquidity and exchange rates: puzzling evidence from the G-7 countries", New York University, Leonard N. Stern School of Business, Department of Economics Working Papers 95-17.

Guinigundo, D.C. [2008] "Transmission mechanism of monetary policy in the Philippines", in BIS Papers Chapters, in: Bank for International Settlements (ed.), *Transmission Mechanisms for Monetary Policy in Emerging Market Economies*, 35:413-425, Bank for International Settlements.

Guinigundo, D.C. [2015] "Increased financial intermediation in the Philippines: some implications for monetary policy", *Bank for International Settlements* (83q).

Guinigundo, D.C. [2016]. "The role of expectations in inflation dynamics in the Philippines – has it changed following the global financial crisis?", *Bank for International Settlements* (89s).

Hamilton, J.D. [1994] *Time series analysis*. New Jersey: Princeton University Press.

Inflation Targeting December 2019 [2019] Department of Economic Research - Bangko Sentral ng Pilipinas. Manila. Available at: https://www.bsp.gov.ph/Price Stability/targeting.pdf.

Jordà, Ò. [2005] "Estimation and inference of impulse responses by local projections", *American Economic Review* 95(1):161–182.

Kim, S. and N. Roubini [2000] "Exchange rate anomalies in the industrial countries: A solution with a structural VAR approach", *Journal of Monetary Economics* 45(3):561–586.

King, R. and M.W. Watson [1992] *Testing long run neutrality*. Cambridge: National Bureau of Economic Research.

Liew, V. K.-S. [2004] "Which lag length selection criteria should we employ?", *Economics Bulletin* 3(33):1–9.

Mishra, P. and P. Montiel [2013] "How effective is monetary transmission in low-income countries? A survey of the empirical evidence", *Economic Systems* 37(2):187–216.

Mishra, P., P.J. Montiel, and A. Spilimbergo [2012] "Monetary transmission in low-income countries: effectiveness and policy implications", *IMF Economic Review* 60(2):270–302.

Nguyen, H.T. [2014] "Monetary transmission mechanism analysis in a small, open economy: The case of Vietnam", *University of Wollongong Thesis Collection*.

Nguyen, T.M.L., E. Papyrakis, and P.A.G. Van Bergeijk [2019] "Assessing the price and output effects of monetary policy in Vietnam: evidence from a VAR analysis", *Applied Economics* 51(44):4800–4819.

Obstfeld, M. and K. Rogoff [2000] "The six major puzzles in international macroeconomics: is there a common cause?", *NBER Macroeconomics Annual* 15:339–390.

Phan, T.A. [2014] "Empirical essays on monetary policy and transmission", *Australia National University Thesis Collection*.

Raghavan, M., P. Silvapulle, and G. Athanasopoulos, G. [2012] "Structural VAR models for Malaysian monetary policy analysis during the pre-and post-1997 Asian crisis periods", *Applied Economics* 44(29):3841–3856.

Ronayne, D. [2011] "Which Impulse Response Function?", *The Warwick Economic Research Paper Series* 971, University of Warwick, Department of Economics.

Shapiro, M.D. and M.W. Watson [1988] "Sources of business cycle fluctuations", *NBER Macroeconomics Annual* 3:111–148.

Sims, C.A. [1980] "Macroeconomics and reality", *Econometrica* pp. 1–48.

Sims, C.A. [1992] "Interpreting the macroeconomic time series facts: The effects of monetary policy", *European Economic Review* 36(5):975–1000.

"Special Data Dissemination Standard" [2021] *International Monetary Fund*, https://dsbb.imf.org/sdds/dqaf-base/country/PHL/category/IND00.

Stock, J.H. and M.W. Watson [2001] "Vector autoregressions", *Journal of Economic Perspectives* 15(4):101–115.

"The BSP and price stability" [2020] *Bangko Sentral ng Pilipinas*, https://www.bsp.gov.ph/Media_and_Research/Primers%20Faqs/targeting.pdf. Accessed September 2021.

"TRAIN not to blame for inflation" [2018] *Department of Finance*, https://www.dof.gov.ph/train-not-to-blame-for-inflation/.

Tuano-Amador, M., E. Glindro, and R. Claveria, R. [2009] "Some perspectives on the monetary policy transmission mechanisms in the Philippines", *Bangko Sentral Review* 11:18–40.

Vargas, J. J. [2021] "Monetary transmission mechanism in the Philippines: a VAR approach", *Munich Personal RePEc Archive*.