



WP/19/153

IMF Working Paper

Decomposing the Inflation Dynamics in the Philippines

by Si Guo, Philippe Karam, and Jan Vlcek

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I N T E R N A T I O N A L M O N E T A R Y F U N D

IMF Working Paper

Asia and Pacific Department

Decomposing the Inflation Dynamics in the Philippines

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Authorized for distribution by Luis E. Breuer

July 2019

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Abstract

Inflation rates rose sharply in the Philippines during 2018. Understanding the demand and supply sources of inflation pressures is key to monetary policy response. Qualitatively, indicators have pointed to evidence of inflation pressures from both sides in 2018, with the supply factors, by and large, associated with commodity-price shocks and demand factors deduced from gleaning at the wider non-oil trade deficits seen in the Philippines.

Quantitatively, we deploy a semi-structural model to decompose the contributions of various shocks to inflation. Our main findings are (1) supply factors (mainly global commodity prices) played a prominent role in explaining the rise in inflation in 2018; (2) demand factors also contributed to inflation in a non-negligible way, justifying the need for tighter monetary policy in 2018; (3) the size of the estimated output gap (an important indicator of demand pressures) could be larger, when considering the widening trade deficits in 2018; and (4) a delayed monetary policy tightening can be costly in terms of higher inflation rates, requiring larger and more aggressive interest rate hikes to bring inflation under control, based on a counterfactual exercise.

JEL Classification Numbers: E3, E5

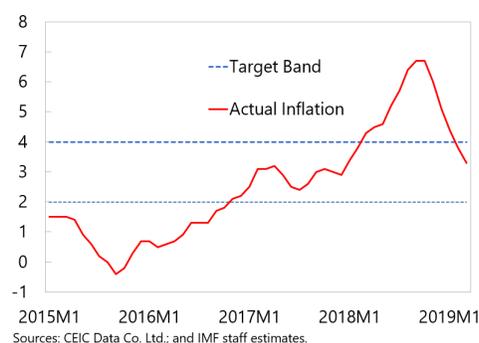
Keywords: inflation, monetary policy, the Philippines

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1 INTRODUCTION

Inflation rates rose sharply in 2018 in the Philippines. Measured on a year-on-year (y/y) basis, headline inflation rates were above the 2-4 percent inflation target band from March 2018 (4.3 percent) to January 2019 (4.4 percent), peaking at 6.7 percent in September and October 2018 (Figure 1).

Figure 1: Monthly headline inflation in the Philippines.
(y/y; in %)



Many factors have likely contributed to the rise in inflation in the Philippines in 2018, and they can be largely divided between supply- and demand- driven. Supply factors include the rise in international oil prices, the disruptions to rice inventories, and the changes to excise taxes on selected “sin” items imposed in the Philippines¹. Demand factors are largely associated with the “overheating” risks of the economy, partly fueled by the lumpy public infrastructure investment (IMF (2018)).

Understanding the source of the inflation pressures is important for monetary policy decisions. The common view is that a tighter monetary policy stance is generally suitable if the rise in inflation rates is demand-driven. The case for tightening monetary policy would be less certain, however, if inflation pressures are supply-driven.²

This paper seeks to decompose inflation pressures in the Philippines following two approaches. The first approach, a version of the exclusion method, is to track the inflation rates of the “core services” items (such as haircut and hospital services). The rationale is that the price changes of these items are more related to domestic factors (such as labor costs) compared with other items,

¹The Philippines started a broad tax reform in late 2017, with the purpose of creating “a simpler, fairer, and more efficient tax system” to “promote investment, create jobs and reduce poverty”. The tax reform includes several packages. The first package of the tax reform, which is of interest here, includes “adjusting oil and automobile excise taxes, and introducing excise tax on sugar-sweetened beverages” along with changes to other taxes. Source: <https://www.dof.gov.ph/taxreform/>.

²In some cases, monetary policy response may still be optimal to some degree, even if the change in inflation is solely caused by an oil price shock (e.g. Blanchard and Gali (2007)). This is especially the case in models where “divine coincidence” does not hold. However, even in these models, understanding the source of inflation would still be important for optimal monetary policy.

which makes the core service inflation a better indicator of domestic-demand pressures on inflation. The second approach is model-based, in which we first construct a semi-structural New Keynesian model that broadly maps the key dynamics of the Philippine economy, followed by Kalman filtration to estimate the realizations of various shocks and their quantitative contributions to inflation.

Both approaches suggest that alongside the prominent role that supply-side factors (mainly oil prices) have played, the demand-side contributions are non-negligible in explaining the rise in the Philippines' inflation in 2018. This justifies the tighter monetary policy deployed by the Banko Sentral ng Philipinas (BSP) in 2018. Counterfactual exercises are constructed for policy analysis, to gauge the effects of a delayed policy response on inflation.

The paper is structured as follows. Section 2 provides an overview of the Philippine inflation targeting (IT) framework since the early 2000s and highlights some salient stylized facts about inflation. Section 3 describes the rise of inflation rates in the Philippines during 2018 and the BSP's policy responses. Section 4 illustrates the decomposition of inflation by constructing core goods and core services baskets, a version of the exclusion methods. Section 5 describes a model-based approach to decomposing inflation, highlighting the role of the semi-structural model in quantifying the contributions of different shocks and conducting counterfactual experiments as well as its use for forecasting purposes. The model structure is discussed in detail in the Appendix. Section 6 concludes.

2 MONETARY POLICY FRAMEWORK IN THE PHILIPPINES

The Philippines moved to an IT regime in 2002.³ The inflation target is defined in terms of the average y/y change in the consumer price index (CPI) or headline inflation over the calendar year. In the initial setup period during 2002-2010, inflation targets were changed frequently (almost annually). The targets were subsequently set at 4 percent during 2011-14 and within a 3 percent +/- 1 ppt tolerance band during 2015-18 (Figure 2) by the National Government, with the same targets imposed for 2018-2020. The primary objective of the BSP's monetary policy is "to promote price stability conducive to a balanced and sustainable growth of the economy. It also aims to promote and preserve monetary stability and the convertibility of the national currency."

The IT regime successfully lowered the inflation rates and growth volatility. Average annual inflation decreased from 8.7 percent in the 1990s to 5.1 percent and 3.3 percent during 2002-09 and 2010-18 respectively. Episodes of inflation outside the band have generally been short-lived. In addition, macroeconomic (inflation and output) volatility has moderated (Figure 3).

Historically, inflation in the Philippines has been highly affected by oil prices. Energy and

³The monetary policy regime prior to 2002 was classified as "monetary aggregate targeting".

Figure 2: Annual headline inflation and inflation targets.
(y/y; in %)

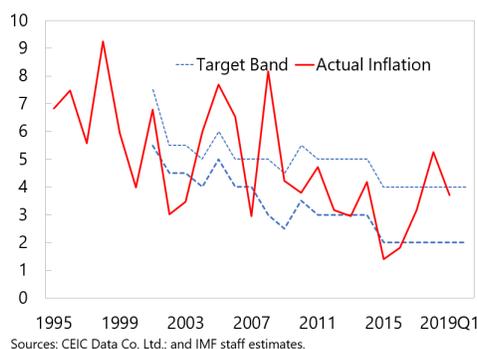
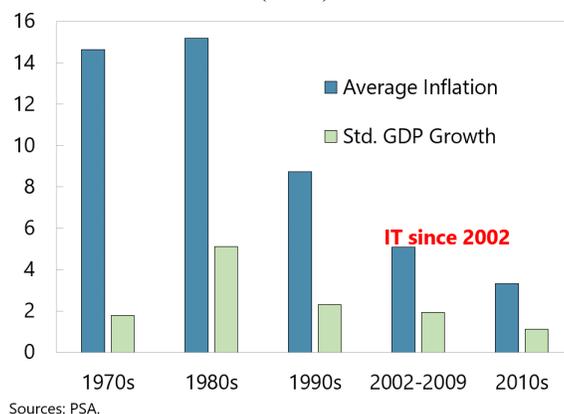


Figure 3: Average inflation rates and the standard deviation of GDP growth rates.
(in %)



energy-intensive items (electricity, gas, fuel and transportation) account for about 15 percent of the consumption basket in the Philippines. The oil-price hikes in 2005, 2008 and 2018 were all associated with notable pickups in inflation (Figure 4). This feature is largely driven by the fact the Philippines is a small open economy, heavily affected by external factors. This also poses challenges to policymakers, especially when it becomes difficult to disentangle the impact of oil prices (a typical supply shock) with demand factors when both oil prices and headline inflation move in the same direction.

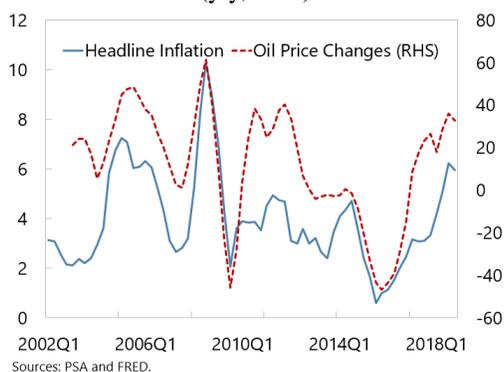
3 THE RISE IN INFLATION IN 2018

3.1 Inflation dynamics

The Philippines experienced a sharp rise in inflation in 2018. Headline inflation increased from 2.9 percent (y/y) on average in 2017 to 5.2 percent (y/y) in 2018, with rates staying above the BSP’s inflation target of 2-4 percent, during March 2018-January 2019 (Figure 1).

Several supply-side factors contributed to the rise in inflation in 2018 in the Philippines, includ-

Figure 4: Change in CPI and world oil prices
(y/y, in %)



ing

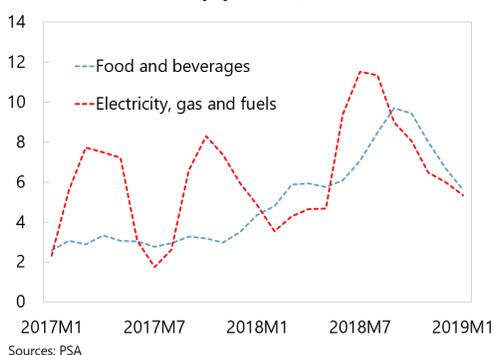
(1) *World oil prices.* Brent oil price increased from US\$46 per barrel in June 2017 to US\$81 per barrel in October 2018. Oil prices are not subsidized in the Philippines, and the increase in world oil prices have a direct impact on domestic prices.

(2) *Excise taxes.* As part of the broader tax reform, excise taxes on selected "sin" items and oil products were raised in January 2018. The Department of Finance estimates that the total impact of tax reform on inflation is about +0.4 to +0.7 percent (y/y) in 2018.⁴

(3) *Rice prices.* The share of rice consumption in the CPI basket is 9.6 percent in the Philippines. Rice prices rose and peaked at 10.7 percent y/y in October 2018, owing to domestic food supply issues with restrictive rice import quotas.

As a result, energy and food (including alcohol and tobacco) inflation increased substantially for most part of 2018 (Figure 5).

Figure 5: Food and energy inflation rates in the Philippines.
(y/y; in %)



However, the following observations suggest that demand-side factors may have also played a

⁴For details, see <http://www.dof.gov.ph/taxreform/index.php/2018/12/30/prrd-econ-team-takes-decisive-steps-vs-inflation-2018/>.

role in the acceleration of price increases in 2018. First, neighboring ASEAN oil-importing countries (for example, Thailand, Singapore and Vietnam) did not experience a sharp increase in inflation rates during the same period, pointing to the possibility that other non-oil factors may have driven inflation up in the Philippines, while acknowledging the role of different oil subsidy-arrangements in these countries (Figure 6).⁵ Second, the non-mineral trade deficit rose substantially in 2018 in the Philippines, which can be difficult to attribute to an increase in excise taxes, or rice and oil prices. Hence these observations leave room for interpreting the acceleration in inflation as being demand driven, as stronger domestic demand tend to have upward pressure on inflation and trade deficits.

Figure 6: Monthly inflation rates in ASEAN countries.

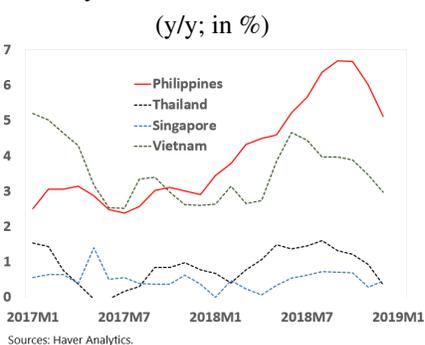
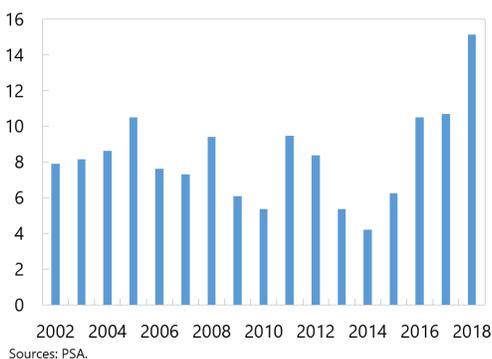


Figure 7: The Philippines: non-mineral trade deficits (in % of GDP)



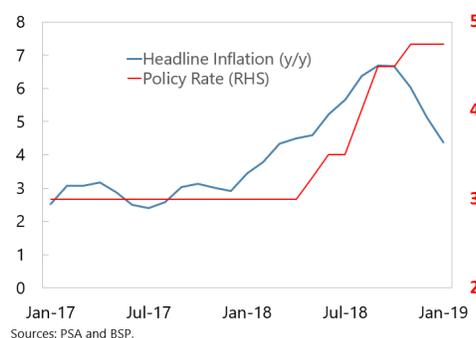
3.2 The BSP’s policy responses in 2018

The BSP initially adopted a wait-and-see approach in early 2018. Following the March 2018 policy meeting, the BSP kept its policy rate unchanged, explaining that “*while recent inflation outturns show an elevated path in 2018, the latest baseline forecasts continue to show inflation remaining within the inflation target in 2018 and moderating further in 2019*” (BSP (2018)).

⁵Indonesia is excluded from the sample of Figure 6 because its domestic oil prices are subsidized.

As actual inflation rates and inflation expectations continued to rise in April, the BSP started to raise policy rates. Headline inflation rose to 4.3 and 4.5 percent y/y in March and April 2018, exceeding the upper bound of the inflation target (4 percent). In May 2018, the BSP announced its first policy rate increase since 2014 by 25 basis points, followed by four additional consecutive rate hikes from June to November 2018, totaling 175 basis points in 2018. Inflation rates (y/y) started to fall in November 2018. With inflation decelerating and expected to settle within the target band, the BSP kept its policy rates unchanged at 4.75 percent in its last three policy meetings (December 2018, February and March 2019).

Figure 8: The BSP's policy rates
(in %)



4 INFLATION DECOMPOSITION – EXCLUSION APPROACH

To analyze the different channels impacting inflation, we decompose the CPI basket into key components: (1) *Food and energy basket* includes food, (alcoholic and non-alcoholic) beverages, tobacco, fuel, electricity and transportation services items - the latter two are included because their prices are also sensitive to oil-price changes. This sub-basket represents about 52 percent of the entire CPI basket.

(2) *Non-market-based basket* includes items with administered prices. The total share of non-market-based items is close to 6 percent of the CPI basket, composed mainly of education services and water supply. The average inflation rate for non-market-based items during 2013-18 (2.6 percent) is slightly lower than the average headline inflation rate (3.1 percent).

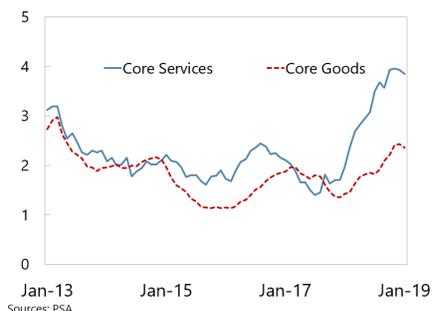
(3) *Core services basket* includes the non-energy, non-food, market-based *services* items such as housing and hospital services. The prices of core services items are more affected by local factors such as labor costs. Core services items represent 29 percent of the entire CPI basket.

(4) *Core goods basket* includes the non-energy, non-food, market-based *goods* items such as furniture and vehicles. Core goods inflation has generally been lower than core services inflation,

reflecting a general trend of rising relative prices of services as a country develops. Core goods inflation is also more affected by global factors (than core services inflation). In particular, the weak growth of Chinese PPI seems to have contributed to the mild core goods inflation in the Philippines during 2014-16, similarly observed in several ASEAN countries. Core goods items represent 13 percent of the entire CPI basket.

Figure 9 shows that the core services inflation rates rose more sharply than core goods items in 2018, hinting to demand-side inflation pressures at work. Compared to core goods items, core service items have a larger domestic component, making their price changes more sensitive to local demand conditions. Thus, a sharp increase in core services inflation is more consistent with demand-side factors. One caveat of this approach is that rental housing represents a large share of the core services basket,⁶ and to some extent, the rise in core services inflation may reflect the tightness of the housing market rather than the broader economy.⁷ Another potential caveat is that some other components of the core services basket (for example, catering) may have been impacted by food prices.

Figure 9: Core goods and services inflation rates
(y/y; in %)



5 INFLATION DECOMPOSITION - A MODEL-BASED APPROACH

5.1 Methodology and model structure

A semi-structural, forward-looking model, with an emphasis on cyclical dynamics of the economy, is calibrated to the Philippines. The model uses a small number of behavioral equations, derived

⁶Rental housing accounts for 12 percent of the entire CPI basket, or 40 percent of the core services basket.

⁷It should be noted that the “core” (goods plus services) basket we construct is not the same core basket used by the BSP (despite some overlap). The BSP constructs the “core” basket mainly based on the price volatility of each item, thus some food and energy items with low price volatility are also included in the BSP’s core CPI basket. Hence, the weighted average of core goods and core services inflation rates used in our paper is different from the core inflation published by the BSP.

from open economy New Keynesian economic theory, to characterize the evolution of key macroeconomic variables.

The model is a version of the IMF's "Forecasting and Policy Analysis System" (FPAS) based model.⁸ It bears similarities to those used at many central banks for forecasting and policy analysis including at the BSP. It has a standard core structure, with equations for output gap, core inflation, policy interest rate, and exchange rate. These equations include: (1) three Phillips curves; (2) a dynamic IS curve; (3) an uncovered interest parity; and (4) a version of the Taylor rule. Expectations are forward-looking, consistent with the projections of the model itself, but the behavioral equations also embody significant lags and rigidities. The Appendix includes the details about the model structure.

Compared with the standard open economy New Keynesian models (for example, [Gali and Monacelli \(2005\)](#)), the model has all the important dynamic equilibrium conditions. However, most coefficients of these equilibrium conditions in the model are calibrated rather than being derived from deep parameters (such as risk aversion or the frequency of price adjustment). The "semi-structural" feature allows a better match of the data (especially, persistence) without added complexities. Compared with earlier versions of the FPAS-based model, it has separate Phillips curves for headline, food and energy inflation, important for the Philippines with inflation being heavily affected by food and oil prices. Furthermore, we expand the base model by adding exports and imports. As it will be shown later, adding foreign trade to the model can have a non-negligible impact on the estimation of output gaps.

The calibrated model is applied to historical Philippine data (2002Q1-2018Q4) to estimate the realizations of various unobservable shocks using a Kalman filter. A decomposition exercise is conducted to quantify the contributions of various exogenous shocks to the dynamics of macroeconomic variables of interest, including inflation, output and real exchange rates. Beyond understanding past economic developments, the model is also used for forecasting purposes and constructing counterfactuals for policy analysis.

5.2 Model results

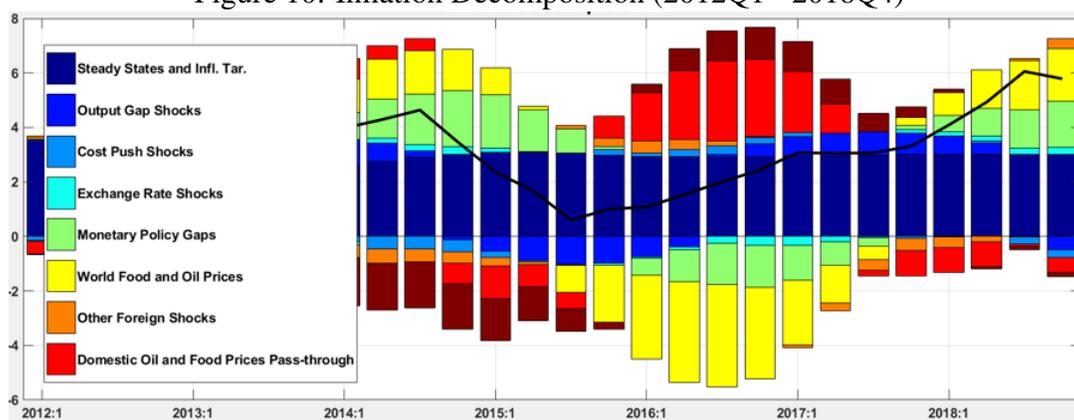
Figure 10 shows the contributions of different categories of shocks to the inflation dynamics in the Philippines, with a number of conclusions drawn.

First, the increase in global commodity prices (oil and food) contributed substantially to the rise in inflation rates in the Philippines in 2018. The contributions of world commodity prices to domestic inflation are shown in the yellow bars in Figure 10, reflecting the higher world food prices

⁸See [Berg, Laxton, and Karam \(2006\)](#) for an early version of the FPAS-based model.

in 2017⁹ and continued growth of world oil prices in 2017 and 2018. The most recent oil price hikes which started in the second half of 2017 did not result in an immediate increase in headline inflation rates, owing to the delayed oil price pass-through in the Philippines. Although fuel prices are not subsidized in the Philippines, the price adjustments of crude oil-related / energy-intensive items, such as transportation, utilities, and retail fuel prices, have usually lagged fluctuations of international oil prices. The delayed passthrough was also observed for food prices, possibly because the quota system (for rice imports) broke the link between international and domestic food prices. The delayed pass-through effects (red bars) have tended to offset the contributions of commodity price movements (yellow bars) then gradually waned. Thus, part of the commodity-driven inflation that would have occurred in 2017 was postponed to 2018, owing to the lagged responses of domestic food and energy prices.

Figure 10: Inflation Decomposition (2012Q1 - 2018Q4)



Note: The figure is in quarterly frequency. The black line is the y/y headline inflation.

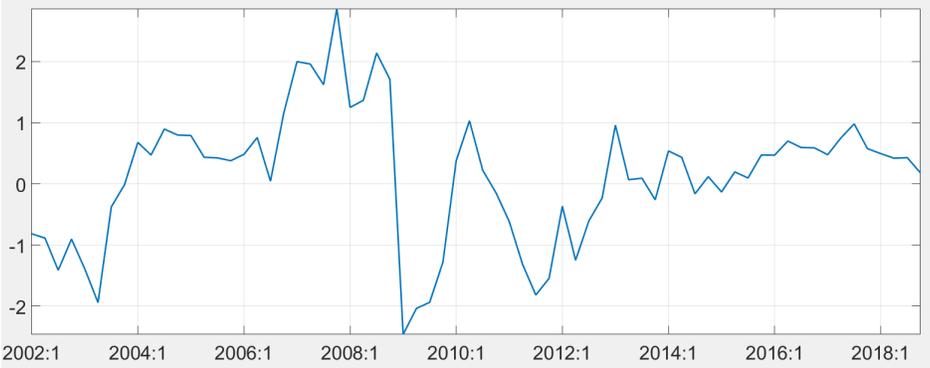
Second, externally, the pickup of growth and inflation in the United States in 2018 has also impacted domestic inflation. This has materialized through several channels, albeit the quantitative impact was moderate (the orange bars in 2018Q3 and 2018Q4): (1) larger positive output gaps in the United States could have contributed positively to the Philippine output gap; and (2) other things equal, higher U.S. interest rates (in response to strengthened growth and inflation momentum) may have contributed to the depreciation of peso, in turn increasing the import-good prices in the Philippines.

Third, domestically, inflation was also driven by demand factors. This was mainly attributed to the contributions of relatively accommodative monetary policy stance before the start of the tight-

⁹World food prices declined in 2018 after the strong increase in 2016 and 2017. However, the overall contributions of world food prices to the headline inflation in the Philippines were still positive in 2018 as the transmission effect from the positive world food inflation in 2016-2017 dominated.

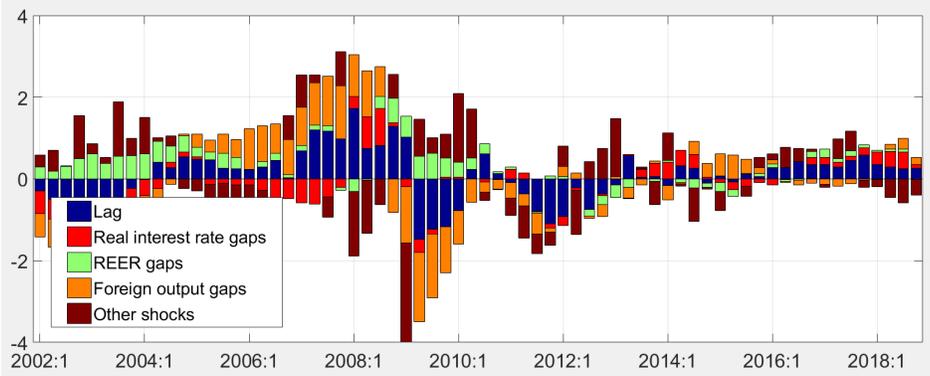
ening cycle in April 2018 (the green bars in Figure 10). Model estimates show that the interest rate adjustments had been lagging the pace implied by the Taylor rule before the sharp increase in policy rates starting in 2018Q2, in the context of real interest rates estimated at below their neutral rates.¹⁰ The accommodative monetary policy contributed positively to inflation through output gaps (Figure 11 and the red bars in Figure 12). It should be noted that despite the sharp increases in interest rates from 2018Q2 to 2018Q4, the contributions of monetary policy gaps to inflation grew larger during the same episode (green bars in Figure 10), explained by the delay in the transmission of monetary policy. The increasing contributions of monetary policy to inflation reflect the propagation of loose monetary policy stance in the past (pre-2018), rather than a concurrent loosening of policy stance.

Figure 11: Estimated output gaps (2012Q1 to 2018Q4)



Note: Output gaps are in percent of potential GDP. The figure is in quarterly frequency.

Figure 12: Output gaps decomposition (2012Q1 to 2018Q4)



Note: in percent of potential GDP. The figure is in quarterly frequency.

¹⁰A caveat of the model is that the long-term average neutral real interest rate (NRIR) is imputed rather than estimated. IMF (2018) estimates that the NRIR in the Philippines was around 1-2 percent annually in 2017 using the Laubach-Williams method. In this paper, we assume the long-term average real neutral rate to be 0.5 percent, lower than the estimates in IMF (2018), in allowing a more conservative estimate of the contribution of the accommodative monetary policy to inflation in 2018. Changing the long-term average real neutral rate to 1-2 percent in the model calibration will yield a larger contribution of monetary policy stance to inflation.

Excise taxes.

Higher excise taxes were implemented in January 2018, and were imposed on oil products, tobacco and beverages, classified as “energy” and “food” items in the model. Hence, their positive contribution to headline inflation should be part of the red bars in Figure 10, albeit cannot be separated from other idiosyncratic shocks to domestic food and energy prices in the model, because it would require the specification of separate Phillips curves for tobacco and beverages.

5.3 Trade deficits

Net exports tend to be countercyclical as in standard business cycle models (for example, [Backus, Kehoe, and Kydland \(1994\)](#)). Other things equal, larger observed trade deficits are associated with large output gaps, indicating a larger likelihood or extent of overheating. The impact of trade deficits on estimated output gaps depends strongly on the standard deviations of idiosyncratic shocks to exports and imports: if exports and imports are highly predictable (i.e. their conditional standard deviations are low), a jump in trade deficits is more likely to be caused by higher output gaps than by idiosyncratic shocks. As the conditional standard deviations of exports and imports get large, trade balances become irrelevant to the estimation of output gaps, because the variations of exports and imports will be interpreted as idiosyncratic shocks, orthogonal to output gaps.¹¹

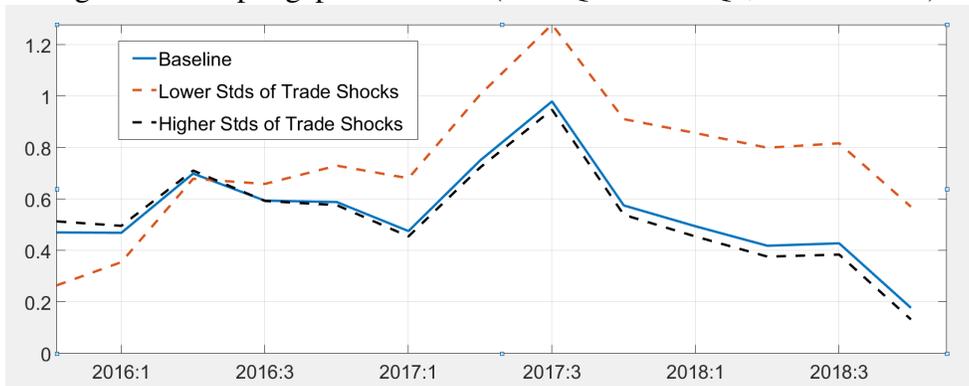
Figure 13 compares the estimated output gaps under the baseline calibration and alternative parameterizations with lower or higher (close to infinity) standard deviations of idiosyncratic shocks to imports. The black dashed line corresponds to the case when the standard deviation of idiosyncratic shocks to imports is close to infinity, and hence no information from trade statistics is used in the filtration process. The blue line corresponds to a baseline calibration, in which the standard deviation of import shocks is set at a relatively high level so the baseline model (conservatively) does not extract much information from trade statistics in filtration. This can be seen from the small differences between the black dashed line and the blue solid line. However, as the standard deviation of import shocks is lowered (to 25 percent of the level in the baseline), estimated end-2018 output gaps increase from 0.2 percent (baseline, blue solid line) to 0.6 percent of GDP (red dashed line). This is not surprising, as the jump in the Philippines’ trade deficits in 2018 would be interpreted as a symptom of positive output gaps when trade statistics are highly predictable.

On policy implications, Figure 13 implies that even though in the baseline calibration the estimated end-2018 output gaps are relatively small (0.2 percent, the blue line), they could have been at the low side. The estimated end-2018 output gaps could be much larger (0.6 percent, the red line) if

¹¹Hence using filters without net exports, such as the HP filter or the multivariate filter as in [Blagrove, Garcia-Saltos, Laxton, and Zhang \(2015\)](#), is likely to underestimate the output gaps when trade deficits are large (relative to steady state).

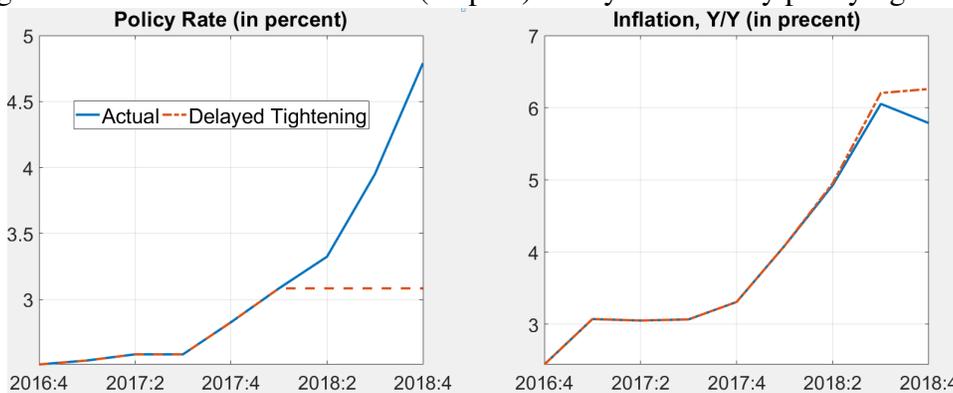
the larger trade deficits in 2018 were not driven by idiosyncratic shocks orthogonal to domestic demand. A joint Bayesian estimation of the standard deviations of all the shocks in the model (which is not included in this paper) would be required to get a more precise estimate of output gaps.

Figure 13: Output gaps estimation (2016Q1 to 2018Q4, in % of GDP)



Note: The blue solid line shows the estimated output gaps under the baseline calibration. The red (black) dashed line shows the estimated output gaps with lower (higher) standard deviations of idiosyncratic import shocks. The figure is in quarterly frequency.

Figure 14: Counterfactual exercise (ex-post): delayed monetary policy tightening



5.4 Counterfactual policy experiments

We further use the model to conduct counterfactual policy experiments to analyze the impact of the BSP's monetary policy adjustments on inflation during 2018. Specifically, we assume the BSP keeps the nominal interest rates unchanged from the end-2017 level through 2018¹² and compare the

¹²One question is which interest rate in data should correspond to the "interest rate" in the model. In theory, it could be either the short-term market interest rate or policy rate (as long as they have the same tenor), as the two rates tend to be close to each other. In the Philippines, however, the short-term market interest rate (the interbank rate) had been substantially lower than the policy rate before late 2017 due to issues in the BSP's liquidity management. Since late

simulated inflation rates with the actual rates.¹³ Figure 14 shows that a delayed monetary tightening would have resulted in a further increase in inflation by about 0.5 percent (y/y) by end-2018.

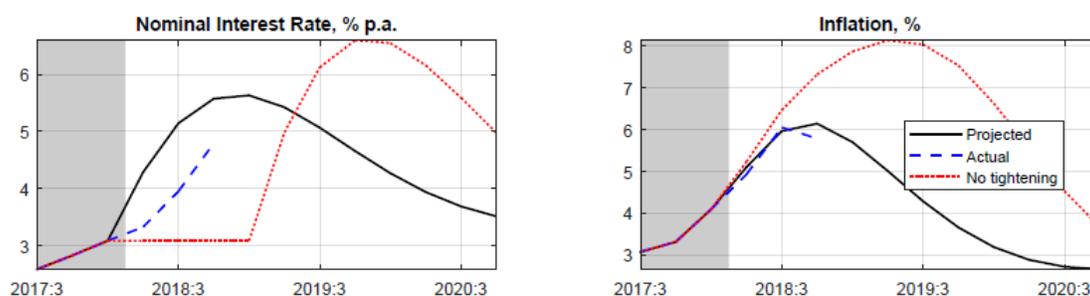
5.5 Model-based inflation forecast

Monetary policy decisions in a flexible inflation targeting regime relies on inflation forecasts. This is because the transmission of monetary policy takes time, and inflation/disinflation pressures caused by temporary factors would fade away soon before the effect of monetary policy change takes place.

We perform an out-of-sample forecast using information up to 2018Q1. 2018Q1 is selected because it is the last quarter before the inflation breached the target band (triggering the monetary policy tightening discussion that followed). A forecast exercise using information up to 2018Q1 would better mimic the environment for real time policy decision in early 2018 than undertaking a counterfactual exercise using all information up to 2018Q4 as in Section 5.4.

The model-based forecast would heavily depend on the assumptions about the future nominal interest rate and oil price paths. For oil prices, the IMF’s WEO forecast, based on oil derivatives is assumed. For future nominal interest rate paths, we assume rates to follow the ones implied by the model’s Taylor rule. For comparison purposes, we also forecast the inflation under the assumption of no monetary tightening.

Figure 15: Counterfactual policy experiment (ex-ante): delayed monetary policy tightening



Note: Both figures are in quarterly frequency. The left panel shows interest rates following Taylor rule (black line) or staying constant in 2018 (red dotted line). The right panel shows the corresponding inflation rates in the two scenarios. The blue dashed lines show the actual nominal interest rates and inflation rates, in the respective panels.

2017, however, the BSP’s liquidity management has been substantially improved, and the two interest rates (policy rate and interbank rate) have been close to each other. Therefore, we use "interbank rate" as the model counterpart of the interest rate for periods before 2018. For periods after 2018, we simply use the less-volatile policy rate as the model counterpart. The effect of the better liquidity management can be seen from Figure 14, which shows the market interest rate (in the left panel) gradually increased from around 2.5 percent as of 2016Q4 to a level close to the policy rate (3 percent before the policy rate hike in May 2018) by 2018Q1.

¹³The realizations of other shocks come from the filtration of historical data.

Figure 15 shows the out-of-sample forecast using information up to 2018Q1 in two scenarios, with or without monetary tightening. Under the scenario that interest rates would adjust following a Taylor rule, the model projects an inflation path that is close to the actual inflation path (the right panel, black and blue lines) up to 2018Q4, at the cost of moderately higher-than-actual interest rates (the left panel, black and blue lines).

The comparison of inflation forecast under different interest rate paths confirmed the need for monetary tightening in 2018. If the policy rate was kept at the level observed in 2018Q1 for the entire year of 2018, peak inflation would have been above 8 percent (y/y) with inflation not returning to the target band until end-2020. This would have called for a much more aggressive monetary tightening following the delayed response.

6 CONCLUSION

In this paper, we build a semi-structural model, specifically seeking to answer a key topical question in the Philippines: to what extent have domestic and global supply-side factors, versus domestic factors, driven inflation in recent years. Importantly, the model has enabled us to better understand the channels through which each factor contributes to inflation, and hence to better analyze the potential impact of different monetary policy actions.

The model allows for identification of key (structural) shocks, notably global oil price shocks and country-specific demand shocks and for analysis of their transmission mechanisms in an internally and externally-consistent framework. The model is also shown to be largely suitable for constructing counterfactuals for policy analysis, including a delayed policy response to demand shocks.

Our results show that the increase in global commodity prices contributed substantially to the rise in inflation rates in the Philippines in 2018, with some delay noted in the pass-through of international oil and food prices. Domestically, inflation is also shown to be driven by demand factors attributed to a relatively accommodative monetary policy, with model estimates showing interest rate adjustments lagging the pace implied by the central bank's inflation forecast-targeting interest rate rule before May 2018 (the onset of the tightening cyclical). Results also show that widening trade deficits in 2018 corroborated the importance of demand-driven factors (through larger output gap) in influencing inflation. The counterfactual experiment simulation results suggest that had the BSP delayed its action, the Philippine inflation would have risen by an additional 0.5 percentage points compared to baseline by end-2018. Finally, results also showed how the model can be used to construct out-of-sample forecasts, under alternative scenarios of monetary or no monetary tightening, and confirming the need for monetary tightening in 2018 to avoid a much more aggressive interest rate reaction following a delayed response.

Appendix

This appendix lists the main equations in the model. The model expands [Berg, Laxton, and Karam \(2006\)](#) by separating the Phillips curves for core, energy and food consumption baskets. Other important additions include the external trade accounts and the revised version of UIP condition.

For any arbitrary variable " V " (except prices and inflation), we use v to denote its log value. We use \bar{v} and $\hat{v} = v - \bar{v}$ to denote the trend and cyclical components of v . The past and expected forward values of v are denoted as v_{-1} and v_{+1} , respectively. We use π and π^4 to denote the quarter-to-quarter (annualized) and year-to-year inflation rates.

The IS curve. Output gap is a function of its lagged term, the monetary condition index (MCI), and foreign output gap. Monetary condition is summarized by the real interest rates (relative to neutral rates) and the real exchange rates (relative to trend).

$$\hat{y} = b_1 \hat{y}_{-1} - b_2 MCI + b_3 \hat{y}_t^* + \epsilon_y$$

$$MCI = b_4 \hat{r} + (1 - b_4)(-\hat{z})$$

The Phillips curves. There are separate Phillips curves for core inflation, oil (energy) inflation and food inflation.

Core inflation depends on its lagged term, expectation on future core inflation, and the real marginal cost (RMC). The real marginal cost for core basket items depends on output gaps, real exchange rates, and the prices of core item basket relative to the entire consumption basket.

$$\pi_{core} = a_1 \pi_{core,-1} + (1 - a_1) \pi_{core,+1} + a_2 RMC + \epsilon_{core}$$

$$RMC = a_3 \hat{y} + (1 - a_3)(\hat{z} - \hat{r} p_{core})$$

$$r p_{core} = \text{Ln}(CPI_{core}) - \text{Ln}(CPI)$$

The Phillips curve for food inflation is similar with the Phillips curve for core inflation except that the relevant real marginal cost index (RMC_{food}) depends on world food prices (relative to its trend) and the relative prices of food to the entire consumption basket.

$$\pi_{food} = a_{21} \pi_{food,-1} + (1 - a_{21}) \pi_{food,+1} + a_{22} RMC_{food} + \epsilon_{food}$$

$$RMC_{food} = a_{23} \hat{p}_{food}^* + \hat{z} - \hat{r} p_{food} + (1 - a_{23}) \hat{y}$$

$$r p_{food} = \text{Ln}(CPI_{food}) - \text{Ln}(CPI)$$

Similarly, we have the Phillips curve for oil (energy) inflation

$$\pi_{oil} = a_{31}\pi_{oil,-1} + (1 - a_{31})\pi_{oil,+1} + a_{32}RMC_{oil} + \epsilon_{oil}$$

$$RMC_{oil} = \hat{p}_{oil}^* + \hat{z} - \hat{r}p_{oil}$$

$$rp_{oil} = Ln(CPI_{oil}) - Ln(CPI)$$

The headline inflation is aggregated as

$$\pi = w_{oil}\pi_{oil} + w_{food}\pi_{food} + (1 - w_{oil} - w_{food})\pi_{core} + \epsilon_{\pi}$$

UIP condition.

$$s = (1 - e_1)s_{+1} + e_1[s_{-1} + 2/4(\pi_{TAR}^4 - \pi_{TAR}^{4*} + \Delta\bar{z})] + (-i + i^* + premium)/4 + \epsilon_s$$

The first term in the UIP condition is the model-consistent expectation of future nominal exchange rate. The second term captures the fact that the central bank may want to smooth the exchange rate movements with some exchange rate target in mind. This implicit exchange rate target, in theory, is calculated as the past exchange rate (s_{-1}) plus the change in exchange rate within the next two quarters at its "long-run" pace.

Monetary policy reaction function

$$i = g_1i_{-1} + (1 - g_1)[\bar{r} + \pi_{+1}^4 + g_2(\pi_{+3}^4 - \pi_{TAR,+3}^4) + g_3\hat{y}] + \epsilon_i$$

Exports and Imports. The cyclical components of exports (\hat{x}) and imports (\hat{m}) follow

$$\hat{x} = \rho_{\hat{x}}\hat{x}_{-1} + \alpha_{xz}\hat{z} + \alpha_{xy}\hat{y}^* + \epsilon_{\hat{x}}$$

$$\hat{m} = \rho_{\hat{m}}\hat{m}_{-1} - \alpha_{mz}\hat{z} + \alpha_{my}\hat{y} + \alpha_{m,oil}\hat{p}_{oil} + \epsilon_{\hat{m}}$$

Long-term trends.

We assume the following variables follow a AR(1) process around their long term steady state values:

$\bar{\pi}_{rp,food}$: the trend changes of relative price of food basket,

$\bar{\pi}_{rp,core}$: the trend changes of the relative prices of core basket,

$\bar{\Delta}y$, domestic potential output growth

$\bar{\Delta}y^*$: foreign potential output growth,

\bar{r} : domestic neutral real interest rate,

\bar{r}^* : foreign neutral real interest rates,

\hat{p}_{oil}^* : international oil price gaps,

$\bar{\pi}_{oil}^*$: trend inflation of international oil prices,

\hat{p}_{food}^* : international food price gaps,

$\bar{\pi}_{food}^*$: trend inflation of international food prices,

The dynamics of trend real exchange rates follows a AR(1) process with the impact of Balassa-Samuelson effect:

$$\Delta \bar{z} = \rho_{\bar{z}} \Delta \bar{z}_{-1} + (1 - \rho_{\bar{z}})((\Delta \bar{z})_{ss} - \chi_z \Delta \bar{y}_{-1}) + \epsilon_{\bar{z}}$$

The dynamics of country premium follows

$$Premium = \rho_{pre} Premium_{-1} + (1 - \rho_{pre})(-\Delta \bar{z}_{+1} + \bar{r} - \bar{r}^*) - \alpha_{pre} \hat{x} + \epsilon_{pre}$$

Hence the long term steady state of the premium is determined by $-\Delta \bar{z}_{+1} + \bar{r} - \bar{r}^*$ where the term $\alpha_{pre} \hat{x}$ is added to better fit the impulse response of exchange rates after an oil price shock (which will enlarge trade deficits).

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