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ASYMMETRIC EXCHANGE RATE PASS-THROUGH: EVIDENCE FROM THE PHILIPPINES

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Abstract

Exchange rate pass-through (ERPT) measures the effect on inflation of the changes in the exchange rate. In contrast to the relative richness of available literature on ERPT, more recent studies that explore possible asymmetric and non-linear characteristic of ERPT especially in the Philippines are not yet available. Exchange rate pass-through coefficients generated from linear modelling techniques may be imprecise but not implausible. Thus, this paper examines whether the response of inflation is asymmetric across depreciation and appreciation episodes.

The study finds evidence of *asymmetry* in the exchange rate pass-through to inflation rate during the IT period. The dynamic simulations show that the directional impact on inflation is symmetrical, with appreciation having milder effect at low levels of exchange rate shocks. This may suggest that with appreciation under normal conditions, prices may be slower to adjust and hence, higher mark-up accrues to producers. As the shocks become bigger, however, depreciation episodes become more pronounced. This implies that exchange rate developments, particularly depreciation episodes, bear close monitoring as the risk of inflation creep is amplified.

JEL Classification: C4, E5, F31

Key Words: ERPT, Inflation Targeting, Non-linear ARDL (NARDL) Model, Asymmetric Effects, Appreciation and Depreciation Episodes

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1. Introduction

Exchange rate pass-through (ERPT) measures the effect on inflation of the changes in the exchange rate. Understanding the behavior of ERPT in an economy has important implications in monetary policy analysis and formulation. Recent literature on exchange rate pass-through (ERPT) recognizes that the assumption of symmetric and linear pass-through to prices may be an imprecise characterization of the exchange rate impact on inflation. Early research papers that explored the non-linear behavior of ERPT included the Markov regime switching process, a non-linear method, to analyze the asymmetry of ERPT that arise from the direction of change and volatility of nominal exchange rate as well as from the level of business activity, as in the case for Turkey (Kal; Arslaner and Arslaner, 2015). Delatte and López-Villavicencio (2011) found that the degree of pass-through is significant and higher in an asymmetric model, particularly, in an autoregressive distributive lag (ARDL) model, compared to linear estimations. Their findings pointed to higher ERPT for major developed economies during depreciations than appreciations.

There are theoretical explanations that support the asymmetry and non-linearity of price adjustments in response to exchange rate changes. Pollard and Coughlin (2004) studied ERPT at the industry level in the US and attributed asymmetric ERPT to the microeconomic pricing behavior of firms. On the one hand, higher pass-through during appreciation of the importer's currency may be attributed to pricing-to-market strategy of firms in order to increase their market share. On the other hand, quantity constraints may contribute to higher degree of pass-through during depreciations of the importer's currency.

Furthermore, recent empirical evidence on asymmetric and non-linear nature of ERPT has been provided in various economies. In Peru, Forero and Vega (2015) examined the asymmetric behavior of ERPT to consumer and import prices by specifying a structural vector autoregressive (SVAR) model. The results of their estimation indicated a higher degree of pass-through during depreciations than appreciations. Such asymmetric behavior was attributed not only to downward price rigidities, but also to the expenditure switching effect[1] and wealth effect that affect the aggregate demand, i.e., the wealth effect due to appreciation shocks was deemed stronger than it is due to depreciation shocks. Meanwhile, a threshold vector autoregressive model (TVAR) was used by Nguyen and Kiyotaka (2015) to examine the asymmetry in the response of exports prices in Japan due to the direction of exchange rate changes.

Przystupa and Wróbel (2009), using Polish data, found asymmetric ERPT to consumer prices depending on the direction and magnitude of exchange rate variations, exchange rate volatilities, and on the expansion or contraction in the business cycle. The results of their study showed stronger pass-through during depreciations than appreciations and during smaller exchange rate variations than larger exchange rate variations.[2] Weaker pass-through when volatility is high was attributed mainly to producers' aversion to adjust prices frequently due to menu costs. A similar study on the asymmetric behavior of ERPT along the business cycle was undertaken by Chew, Ouliaris, and Meng (2009) for the Singaporean economy.

The responsiveness of domestic prices to exchange rate variations in ASEAN-5 was studied by Cortinhas (2007) to explore the prospect of monetary cooperation in the region. Results of the analysis showed that a common currency could be appropriate for Malaysia, Singapore, and Indonesia. Moreover, several studies have provided empirical evidence of declining ERPT after the adoption of inflation targeting (IT) framework in emerging economies. Aleem (2010) used the vector autoregression (VAR) model to examine the presence of ERPT in East Asia and Latin America. Coulibaly and Kempf (2010) investigated the degree of adjustments in import prices, producer prices, and consumer prices in response to exchange rate changes in 27 emerging countries, including the Philippines. Thameur and Daboussi (2014) investigated short-run and long-run ERPT in Brazil, Mexico, Peru, Thailand, Indonesia and Philippines using a VAR model.

For the case of the Philippines, a number of studies have also been carried out to examine the degree of ERPT to consumer prices. Empirical results from an article by Dakila (2002) indicated a higher degree of pass-through before the organization of the Bangko Sentral ng Pilipinas (BSP) in 1993 relative to the entire sample period covered (1980-2001) in the estimation. No statistically significant relationship was found between consumer prices and exchange rate changes during the BSP period (post-1993). Meanwhile, research paper by

[1] Expenditure switching is the adjustment in demand from foreign to domestic goods due to changes in the nominal exchange rate. Expenditure switching effect has positive effect on prices during depreciation and has negative effect on prices during appreciations. However, a comparison of the extent of expenditure switching during appreciation and depreciation was not discussed in the paper.

[2] According to their threshold model, appreciations of more than the threshold of 2% yield lower pass-through to consumer prices as compared to depreciations or appreciations less than the threshold. In addition, volatility of nominal exchange rate higher than 4% is considered high. Otherwise, volatility is considered low.

Tuaño-Amador, Glindro and Claveria (2009) showed a decline in ERPT to prices in both the short-run and the long-run during the IT period relative to pre-IT period. The results obtained in the aforementioned studies were affirmed in a paper by Paderanga (2013).

In contrast to the relative richness of available literature on ERPT, more recent studies that explore possible asymmetric and non-linear characteristic of ERPT in the Philippines, to our knowledge, are not yet available. This paper is patterned after Delatte and López-Villavicencio (2011) using the specification by Xie (2014).

2. Objectives of the Study

Exchange rate pass-through coefficients generated from linear modelling techniques may be imprecise but not implausible. It would be more reasonable to posit that an inflationary environment also affects the responses of economic agents to an exchange rate shock. To a large extent, the degree of exchange rate pass-through depends on the credibility of monetary policy to stabilize inflation in the economy. For an inflation targeting central bank like the BSP, the rate of inflation provides a gauge for monetary policy credibility. Firms perceive any increase in the cost of production beyond a certain threshold to be more persistent in the presence of high inflation rates, with firms passing on the cost to consumers to maintain their mark-up. Exchange rate pass-through to domestic prices tends to be stronger during high inflationary episodes than low inflationary episodes.

Thus, this paper goes one step further by examining whether the response of prices is asymmetric across depreciation and appreciation episodes. It is important for policymakers to understand such asymmetric effects because implied policy responses to sustained depreciation and appreciation episodes would be different.

3. Methodology

In this paper, we test for asymmetries in exchange rate pass-through using the non-linear ARDL (NARDL) model. Each variable was tested first for unit roots to ensure that there is no I(2) variable that could invalidate the results.

The ARDL specification used in this study is patterned after Xie (2014) in the IMF Country Report No. 14/246. This is the same specification used in the earlier research of Glindro, Delloro, Martin and Allon (2016). In lieu of the composite world CPI which was assessed to be I(2), this specification controls for two principal sources of imported inflation, i.e., global oil prices *(loil)* and global rice prices *(lrice)* as well as the nominal peso-dollar exchange rate *(er)*. The model also controls for the effect of excess demand *(ygap)*, which indirectly captures the domestic component of the real marginal cost that is influenced by the impact of interest rate and fiscal policies.

Typically, the two-step method entails estimating first the equation in level form and examining such for cointegration before estimating the short-run equation that integrates the previous period disequilibrium.

Step 1. $p_t = \alpha_0 + \alpha_1 p_{t-1} + \alpha_2 y_{t-1} + \alpha_3 poil_{t-1} + \alpha_4 price_{t-1} + \alpha_5 er_{t-1} + \varepsilon_t$ (Eq. 1)

Step 2. $\Delta p_t = \beta_0 + \beta_1 \Delta p_{t-1} + \beta_2 \Delta y_{t-1} + \beta_3 \Delta poil_{t-1} + \beta_4 \Delta price_{t-1} + \beta_5 \Delta er_{t-1} + \vartheta \varepsilon_{t-1} + \nu_t$ (Eq. 2)

In equation 2, ε_{t-1} corresponds to the previous period disequilibrium and $\vartheta < 0$, measures the speed of adjustment toward equilibrium.

Pesaran, Shin, and Smith (2001) formulated an unrestricted error correction model (ECM), which links the dynamics of both price and inflation in a single dynamic framework as shown in equation 3. To simplify notation, the following variables are redefined as follows: $\Delta p_t = \pi_t$; $\Delta poil_t = \pi woil_t$; $\Delta price_t = \pi rice_t$; $\Delta er_t = der_t$.

$$\pi_t = \beta_0 + \beta_1 p_{t-1} + \beta_2 y_{t-1} + \beta_3 poil_{t-1} + \beta_4 price_{t-1} + \beta_5 er_{t-1} + \sum_{i=1}^{\rho} \gamma_i \pi_{t-i} + \sum_{i=0}^{q} \chi_i ygap_{t-i} + \sum_{i=0}^{q} \zeta_i \pi woil_{t-i} + \sum_{i=0}^{q} \eta_i \pi rice_{t-i} + \sum_{i=0}^{s} \varpi_i der_{t-i} + \epsilon_t \quad \text{(Eq. 3)}$$

The ARDL framework has the flexibility to accommodate asymmetric effects as shown in equation 4 below. Cointegration is established if β_1 is significant. Otherwise, the regression reduces to a linear regression involving only first differenced series (Delatte and López-Villavicencio, 2011). The ARDL equation is estimated with the standard OLS estimation method. The Akaike Information Criterion (AIC) statistic is used as a basis for trimming down the lags.

$$\pi_t = \beta_0 + \beta_1 p_{t-1} + \beta_2 y_{t-1} + \beta_3 poil_{t-1} + \beta_4 price_{t-1} + \beta_5^+ er_{t-i}^+ + \beta_6^- er_{t-i}^- + \sum_{i=1}^{\rho} \gamma_i \pi_{t-i} + \sum_{i=0}^{q} \chi_i ygap_{t-i} + \sum_{i=0}^{q} \zeta_i \pi woil_{t-i} + \sum_{i=0}^{q} \eta_i \pi rice_{t-i} + \sum_{i=0}^{s} \varpi_i der_{t-i} + \sum_{i=0}^{s} (\theta_i^+ der_{t-i}^+ + \theta_i^- der_{t-1}^-) + \epsilon_t \quad \text{(Eq. 4)}$$

Assuming there is cointegration, i.e., $\beta_1 \neq 0$ and $\sum_{j=1}^{6} \beta_j \neq 0$, the time series for which asymmetric effects are being examined, is decomposed into its positive and negative partial sums. In the case of this study, the series under consideration is the nominal exchange rate.

Depreciation : $er^+ = \sum_{j=1}^{t} der_j^+ = \sum_{j=1}^{t} \max(der_j, 0)$ (Eq. 5)

Appreciation: $er^- = \sum_{j=1}^{t} der_j^- = \sum_{j=1}^{t} \min(der_j, 0)$ (Eq. 6)

If there is cointegration, the long-run multipliers can be estimated as $er_{lr}^{+} = \beta_5^{+}/-\beta_1$ and $er_{lr}^{-} = \beta_6^{-}/-\beta_1$ and bounds test undertaken. Long-run symmetry can also be tested by doing the Wald test on the null hypothesis, Ho: $er_{lr}^{+} = er_{lr}^{-}$.

The short-run asymmetric effects of exchange rate are given by $\sum_{i=0}^{s}(\theta_i^{+} der_{t-i}^{+})$ and $\sum_{i=0}^{s}(\theta_i^{-} der_{t-1}^{-})$, which are the partial sum of depreciation and appreciation episodes, respectively. As in the case of short-run multipliers, the Wald test can be performed to test for symmetry, $\sum_{i=0}^{s}(\theta_i^{+}) = \sum_{i=0}^{s}(\theta_i^{-})$.

4. Data

The data used in the NARDL specification consist of headline consumer price index (CPI), real gross domestic product (GDP), nominal peso-US dollar exchange rate (ER), global price of oil in US dollars (OIL), and global price of rice in US dollars (RICE). Unit root tests affirm the absence of I(2) variable in the specification (Table 1).

All the level variables have been log transformed and multiplied by 100. The GDP is seasonally-adjusted first before extracting the cyclical component using the Hodrick-Prescott filter. Various tests of cointegration (i.e., Johansen; Phillips-Ouliaris and Engle-Granger tests) for the full period 1982 – 2016 indicate the absence of cointegration. This is also confirmed by the insignificance of β_1 and failure to reject the null hypothesis of symmetric effects in the sub-period analyses that made use of the one-step method (Pesaran et al., 2001). Hence, the final specification reported herein used series in the first-differenced form.

Figure 1
Data

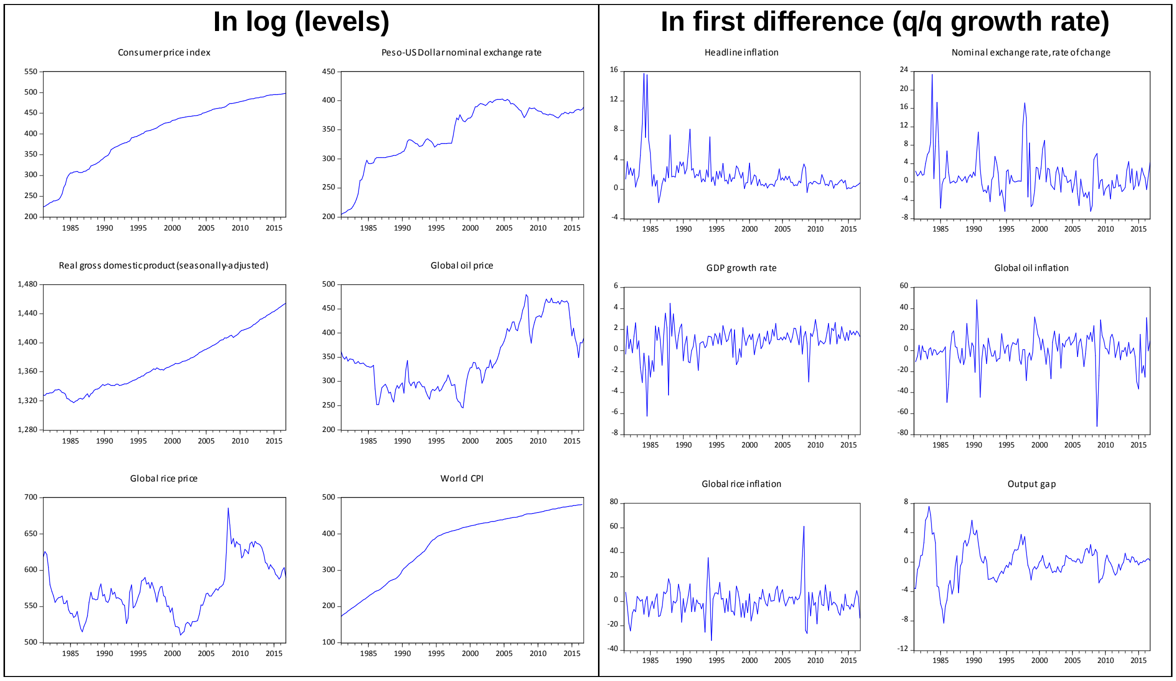


Table 1
Unit Root Test Results

Variables	With Constant						With Constant & Trend						Without Constant & Trend (PP)					
	PP			ADF			PP			ADF			PP			ADF		
	t-stat	Prob.		t-stat	Prob.		t-stat	Prob.		t-stat	Prob.		t-stat	Prob.		t-stat	Prob.	
Consumer price index	-4.05	0.00	***	-3.75	0.00	***	-1.72	0.74	ns	-2.28	0.44	ns	3.88	1.00	ns	1.80	0.98	ns
Nominal exchange rate	-3.21	0.02	**	-3.48	0.01	***	-2.20	0.49	ns	-2.78	0.21	ns	1.80	0.98	ns	1.36	0.96	ns
Global oil price	-1.39	0.59	ns	-0.96	0.77	ns	-2.54	0.31	ns	-2.24	0.46	ns	-0.11	0.65	ns	0.09	0.71	ns
Global rice price	-2.03	0.27	ns	-1.87	0.34	ns	-2.84	0.19	ns	-2.42	0.37	ns	-0.34	0.56	ns	0.11	0.72	ns
Real gross domestic product	2.45	1.00	ns	1.44	1.00	ns	-1.69	0.75	ns	-2.17	0.50	ns	4.94	1.00	ns	2.61	1.00	ns
World CPI	-4.97	0.00	***	-2.48	0.12	ns	-0.58	0.98	ns	-1.34	0.87	ns	3.68	1.00	ns	0.18	0.74	ns
Inflation rate (q/q)	-6.38	0.00	***	-5.40	0.00	***	-7.26	0.00	***	-4.50	0.00	***	-4.50	0.00	***	-4.59	0.00	***
Exchange rate depreciation/appreciation (q/q)	-7.52	0.00	***	-7.44	0.00	***	-7.83	0.00	***	-5.53	0.00	***	-7.17	0.00	***	-7.04	0.00	***
Global oil inflation (q/q)	-9.75	0.00	***	-6.63	0.00	***	-9.73	0.00	***	-6.64	0.00	***	-9.79	0.00	***	-6.65	0.00	***
Global rice inflation (q/q)	-9.84	0.00	***	-4.56	0.00	***	-9.85	0.00	***	-4.50	0.00	***	-9.87	0.00	***	-4.58	0.00	***
Real GDP growth rate (q/q)	-10.51	0.00	***	-3.95	0.00	***	-10.95	0.00	***	-4.44	0.00	***	-8.84	0.00	***	-1.16	0.22	ns
Global inflation	-2.87	0.05	**	-1.24	0.65	ns	-4.46	0.00	***	-2.55	0.30	ns	-1.98	0.05	**	-1.23	0.20	ns
Output gap	-4.10	0.00	***	-6.11	0.00	***	-4.09	0.01	***	-6.27	0.00	***	-4.11	0.00	***	-6.07	0.00	***

Notes: (*) significant at the 10%; (**) significant at the 5%; (***) significant at the 1%; and (ns) not significant.

5. Analysis of Findings

Following the one-step specification by Pesaran, et al. (2001), the Wald tests fail to reject the null hypotheses of (i) no long-run relationship among the level variables and (ii) no long-run exchange rate asymmetry in the level variables during both the pre-IT and IT periods. For the pre-IT period, however, the test rejects the hypothesis of no short-run asymmetric effect (Table 2).

Table 2
Results of the Tests for Exchange Rate Symmetry

Null Hypothesis		t-stat[a/]/F-stat[b/]	
		Pre-IT	IT
1. $\beta_1 = 0$	No cointegration	0.34 [a/]	0.66 [a/]
2. $er_{lr}^{+} = \frac{\beta_5^{+}}{-\beta_1} = er_{lr}^{-} = \frac{\beta_6^{-}}{-\beta_1}$	No long-run exchange rate asymmetry in level	0.53 [b/]	0.58 [b/]
3. $\sum_{i=0}^{s}(\theta_i^{+}) = \sum_{i=0}^{s}(\theta_i^{-})$	No short-run exchange rate asymmetry	0.04 [b/]	0.30 [b/]

N.B. (1) and (2) are based on Pesaran et al.'s (2001) one-step regression with breaks corresponding to the Asian financial crisis of 1997-1999 for the pre-IT period while (3) is based on the final specification reported herein, which used first-differenced series.

A closer examination of the partial sums of appreciation and depreciation episodes (Table 3) shows that during the IT period, the mean as well as the maximum of depreciation and minimum of appreciation episodes are comparable in magnitude, with the standard deviation slightly higher for depreciation episodes. This is in contrast to the pre-IT period in which there has been significant variations in the mean and volatility of appreciation and depreciation episodes.

Table 3
Descriptive Statistics of the Partial Sums of Depreciation $\sum_{i=0}^{s}(\theta_i^{+})$ and Appreciation $\sum_{i=0}^{s}(\theta_i^{-})$ Episodes

	1982 - 2001		2002 -2016	
	Appreciation	Depreciation	Appreciation	Depreciation
Mean	-0.62	2.94	-1.09	1.00
Median	0.00	0.99	-0.57	0.00
Maximum	0.00	23.40	0.00	6.23
Minimum	-6.40	0.00	-6.36	0.00
Std. Dev.	1.45	4.59	1.46	1.59
Observations	80	80	60	60

Since cointegration has not been established, our preferred model is a non-linear ARDL model using series in the log first-differenced form. The non-linear ARDL estimates (Table 4) support the linear estimates of Glindro, Delloro, Martin and Allon (2016), showing that the exchange rate pass-through coefficients have gone down during the inflation targeting (IT) period.[3] It is also consistent with the finding of Guinigundo (2017)[4] of declining exchange rate pass-through in the IT period. Notwithstanding the evidence of declining exchange rate pass-through to inflation following the advent of the floating exchange rate regime, the effect is still non-negligible.

For both pre-IT and IT periods, the estimates show statistically insignificant results for appreciation episodes even after controlling for breaks. In cases of high inflows during the IT period, a number of reforms that included liberalization of the regulatory environment, shifts in the borrowing mix of the government as well as changes in reserves, have been implemented.[5] Moreover, the effectiveness of BSP's foreign exchange intervention during period of high inflows (Guinigundo, 2013) is also an important factor in diminishing the impact of appreciation.

Depreciation episodes, however, are found to be significant in both pre-IT and IT periods. The effect on the inflation rate is stronger during the pre-IT period even after controlling for the impact of the Asian Financial Crisis (Table 4). The findings also hold for short-run exchange rate pass-through, as reported in Annex 1.[6]

Table 4
Estimated Long-run Exchange Rate Pass-through from Non-linear ARDL Model of Inflation

	Output gap	**World rice inflation**	**World oil inflation**	**Exchange rate depreciation**	**Exchange rate appreciation**	**Constant**
With breaks 1997 – 1999						
Pre-IT 1982 Q2 - 2001 Q4	0.19 *(0.006)*	0.21 *(0.001)*	0.04 *(0.125)*	0.59 *(0.000)*	-0.02 *(0.905)*	1.42 *(0.000)*
Without breaks						
IT 2002 Q1 - 2016 Q4	0.31 *(0.019)*	0.03 *(0.008)*	0.06 *(0.000)*	0.18 *(0.045)*	0.04 *(0.542)*	0.74 *(0.000)*

Variables (all are stationary) in the ARDL model are in quarter-on-quarter growth rates. Results of residual diagnostics based on correlogram of Q-statistics do not reject the null hypothesis that the errors from residuals of the models are not serially independent (no evidence of autocorrelation). Output gap is estimated using Hodrick-Prescott filter. The breaks correspond to the Asian Financial Crisis of 1997 – 1999 for the pre-IT period.

[3] The updated estimates with and without breaks are reproduced in Table 5. The original paper did not control for breaks. Nonetheless, the finding of lower exchange rate pass-through in the Philippines holds.
[4] Guinigundo, D., (2017), "Implementing a Flexible Inflation Targeting in the Philippines," Chapter 1, Philippine Central Banking: A Strategic Journey, Bangko Sentral ng Pilipinas (Forthcoming).
[5] See Guinigundo (2013) and Amador, et al. (2009) for a detailed discussion.
[6] Equations with dummy variables for commodity price spikes in 2008 and price declines in 2015 period were also tested but the specification without any break is the most stable one.

Table 5
Estimated Long-run Exchange Rate Pass-through from Linear ARDL Model of Inflation

	Output gap	World rice inflation	World oil inflation	Exchange rate depreciation/ appreciation	Constant
With breaks 1997 – 1999					
Pre-IT 1982 Q2 - 2001 Q4	0.17 *(0.010)*	0.22 *(0.001)*	0.05 *(0.049)*	0.51 *(0.000)*	1.97 *(0.000)*
Without breaks					
IT 2002 Q1 - 2016 Q4	0.32 *(0.008)*	0.05 *(0.010)*	0.06 *(0.000)*	0.16 *(0.034)*	0.86 *(0.000)*

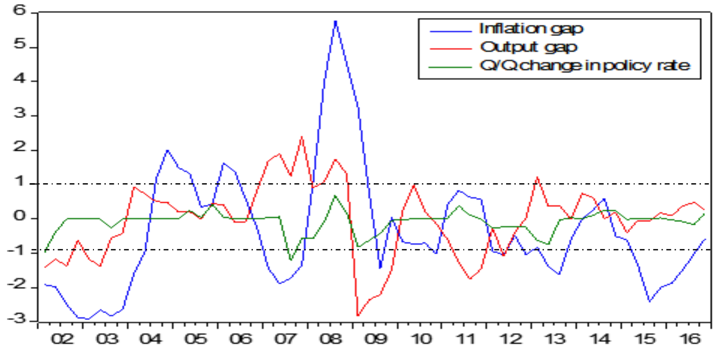
Updated estimates from Glindro, Delloro, Martin, Allon (2016).
Variables (all are stationary) in the ARDL model are in quarter-on-quarter growth rates. Reported coefficients correspond to long-run coefficients with p-values in parenthesis. Results of residual diagnostics based on correlogram of Q-statistics do not reject the null hypothesis that the errors from residuals of the models are not serially independent (no evidence of autocorrelation). Output gap is estimated using Hodrick-Prescott filter.

The finding of higher coefficient of the output gap in the IT period remains. While the specification is recognizably imperfect due to measurement limitations and failure to control for credibility,[7] the estimated increase in the sensitivity of inflation to demand conditions implies that with the presence of adverse supply shocks, interest rate adjustment may be relatively less aggressive. The higher coefficient of aggregate demand suggests that the reduction in output following an upward adjustment in interest rate has a stronger dampening impact on inflation. This conjecture is not without any basis. The IT period has been characterized by significant, albeit unfinished, structural and institutional reforms in the economy. The average growth has been rising with marked increase since 2010 and inflation has been low and stable.

To broadly gauge the extent of the interaction between developments in output gap and inflation gap (measured as deviation of inflation from the mid-point of the inflation target) relative to the quarter on quarter change in the weighted monetary operations rate, Figure 2 shows that in the aftermath of the Lehman episode, there has been pre-emptive downward adjustment in the monetary policy rate. As the Global Financial Crisis (GFC) unraveled and commodity prices continued to rise steeply and were transmitted into domestic inflation, the post-Lehman pre-emptive cumulative reduction in weighted monetary operations rate was reversed in 2008. The GFC-induced economic downturn saw the output gap plummeting to its deepest trough in the IT period. The second largest decline in the output gap occurred in 2011, which has been attributed to government underspending that followed the controversy about the alleged misuse of the Congressional priority development assistance fund. This period also overlapped with episodes of escalating global food and oil prices that led to a higher policy rate.

[7] Glindro, et al., 2016.

Figure 2
Inflation Gap, Output Gap and Quarter-On-Quarter Change in Weighted Monetary Operations Rate[8]



For comparability, inflation is an annual rate given that policy rate and target rate are expressed as annual rates.

- Inflation gap refers to deviation from mid-point of the target.
- Output gap is estimated using Hodrick-Prescott filter.
- Policy rate refers to weighted monetary operations rate.[9]

In terms of the major sources of external price shocks, the pass-through of global oil inflation has gone up slightly whereas that of the global rice inflation has declined. In the pre-IT period, the government maintained the Oil Price Stabilization Fund (OPSF). The OPSF was meant to stabilize the prices of petroleum products by reimbursing oil companies for cost increases in crude oil and imported petroleum products that were induced by exchange rate adjustment and/or increase in world market prices. In contrast, the IT period was characterized by the deregulation in the oil industry. Whereas the stability in pass-through can be ascribed to the oil price subsidy in the pre-IT period, the IT period's is attributed to the enhanced price discovery mechanism following deregulation. [10]

The lower exchange rate pass-through, higher yet stable pass-through of global oil inflation, and declining global rice inflation pass-through coincided with the period of lower external indebtedness during the IT period. These developments could have attenuated disruptive exchange rate movements and external supply shocks on domestic inflation.

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[8] The q/q change in policy rate shows more clearly the direction and magnitude of policy rate adjustment with the zero line indicating no change in policy stance. As for inflation gap, the $\pm$ 1 band reflects the target band relative to the mid-point of the target.

[9] The weighted monetary operations (WMO) rate refers to the weighted average of BSP's reverse repurchase rate, overnight deposit account rate, and term deposit facilities (7-day and 28-day) rates beginning second half of 2016 when the interest rate corridor system was implemented. Prior to 2016, the WMO rate corresponds to the weighted average of BSP's RRP and special deposit account (SDA) rate.

[10] "Recurring deficits (most prominent of which occurred in 1995) threatened the fiscal stability of the economy. The OPSF was in effect from October 1984 upon the passage of Presidential Decree No. 1956, until February 1998 when Republic Act 8479, Downstream Oil Industry Deregulation Act of 1998, was signed into law." (Philippine Institute for Development Studies, (2000),"Oil Deregulation," Economic Issue of the Day, February No. 2 and Executive Order No. 137).

6. Dynamic Simulations

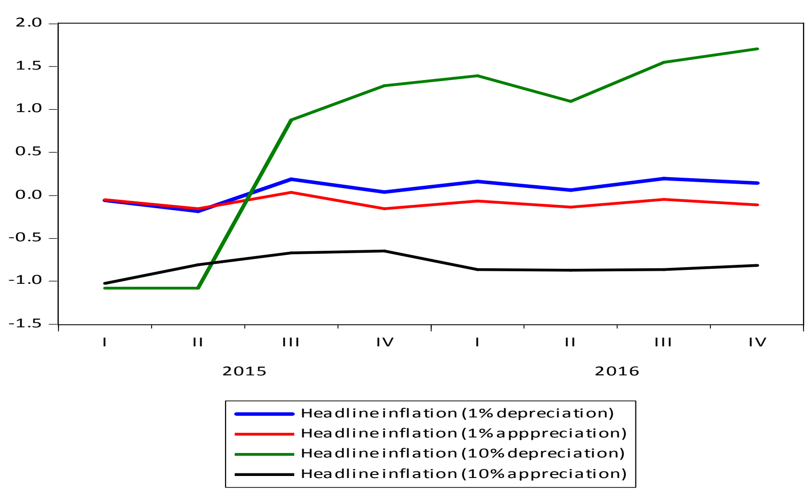
An in-sample simulation for the more policy relevant IT period was first conducted to assess the fit of the selected NARDL model before the dynamic simulation was conducted. A comparison is made vis-à-vis a random walk naïve model to gauge the relative performance of the selected NARDL model (Table 6).

Table 6
Forecast Evaluation Statistics (in-sample) for 2002 – 2016

Forecast evaluation statistics	NARDL model	Naive random walk (RW) model
Root mean square error (RMSE)	0.335	0.729
Ratio of RMSE NARDL to RMSE of RW	0.460	

Two scenarios for the dynamic simulations are conducted, i.e., sustained shocks equivalent to (i) historical mean of one percentage point and (ii) an above-historical mean of 10 percentage points change in the exchange rate for the period 2015 – 2016. The dynamic simulations (Figure 3) reveal that direction-wise, shocks to the exchange rate are comparatively similar. However, magnitude-wise, depreciation episodes have a stronger impact. As the shocks are magnified, the divergence in impact become more pronounced.

Figure 3
Cumulative Impact of Sustained Exchange Rate Shock



7. Conclusion

Using the non-linear autoregressive distributed lag model for inflation rate, the study finds evidence of asymmetry in the exchange rate pass-through to inflation rate during the IT period, with depreciation episodes having stronger effect. As shown in the dynamic simulations, the directional impact on inflation is symmetrical, with appreciation having milder effect at low levels of exchange rate shocks. This may suggest that with appreciation under normal conditions, prices may be slower to adjust and hence, higher mark-up accrues to producers. As the shocks become bigger, depreciation episodes have a stronger and more pronounced impact. It goes without saying that exchange rate developments, particularly depreciation episodes, bear close monitoring as the risk of inflation creep is amplified. As emphasized by Guinigundo (2013), “while price stability is the primary goal of monetary policy, wide swings in the exchange rate may have destabilizing effects on the economy, and hence they too must be managed.”

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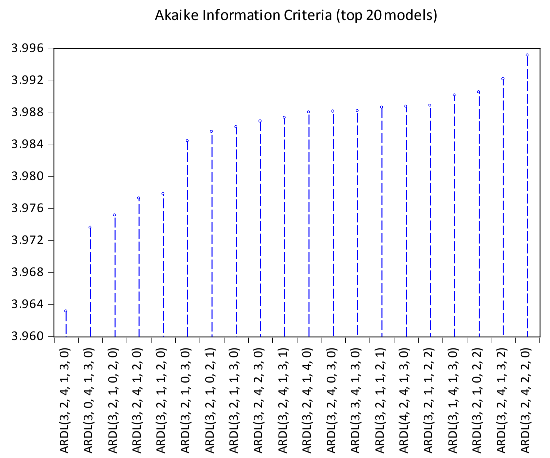
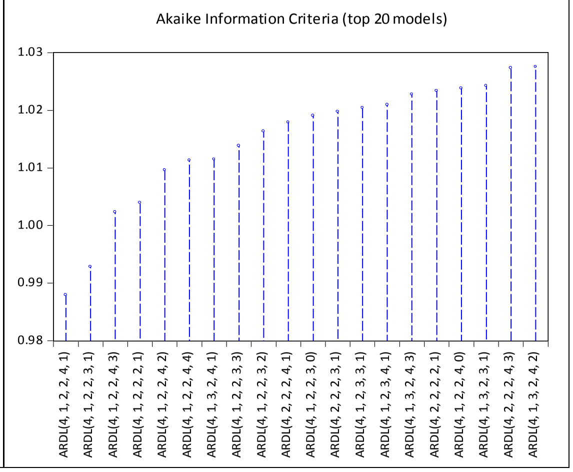
REGRESSION RESULTS AND DIAGNOSTIC RESULTS
Asymmetric Exchange Rate Pass-Through

a. Akaike Information Criteria

Pre IT (1982 – 2001)



IT (2002 – 2016)



b. Wald Coefficients Test Summary

Null hypothesis: the sum of coefficients is equal to zero

Reported values are the p-values

Variables	Short-run Coefficient	Pre-IT (with break)		Short-run Coefficient	IT (without break)	
		F-stat	Chi-square		F-stat	Chi-square
DLCPI	0.244	0.027	0.023	0.413	0.001	0.001
YGAP	0.140	0.005	0.003	0.182	0.007	0.005
DLRICE	0.158	0.001	0.000	0.020	0.020	0.016
DLOIL	0.030	0.120	0.114	0.034	0.000	0.000
DLER_POS	0.446	0.001	0.000	0.106	0.043	0.037
DLER_NEG	-0.014	0.905	0.905	0.026	0.539	0.536

c. ARDL Bounds Test

Pre IT (1982 – 2001) – with breaks

ARDL Bounds Test
Date: 03/10/17 Time: 10:31
Sample: 1982Q2 2001Q4
Included observations: 79
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	9.177810	5

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.08	3
5%	2.39	3.38
2.5%	2.7	3.73
1%	3.06	4.15

IT (2002-2016) – without breaks

ARDL Bounds Test
Date: 03/01/17 Time: 14:49
Sample: 2002Q1 2016Q4
Included observations: 60
Null Hypothesis: No long-run relationships exist

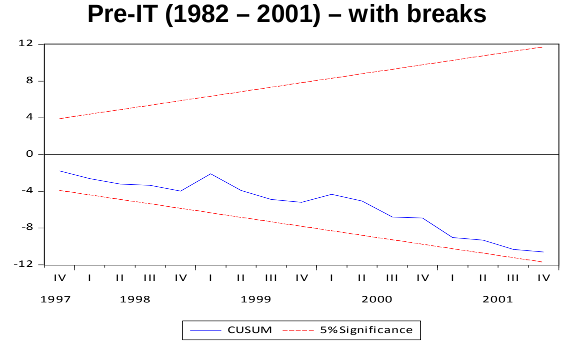
Test Statistic	Value	k
F-statistic	6.694756	5

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.08	3
5%	2.39	3.38
2.5%	2.7	3.73
1%	3.06	4.15

d. Cumulative Sum (CUSUM) Test and CUSUM of Squares Test

Pre-IT (1982 – 2001) – with breaks



IT (2002 – 2016) – without breaks