The Dynamics Between Monetary Policy Rate and Inflation in the Philippines

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Abstract

The paper examines the relationship between interest rate and inflation in the Philippines using 204 monthly observations from January 2003 to December 2019. The variables were tested using Vector Autoregression, Granger Causality, Impulse Response Function, Cholesky Variance Decomposition, Johansen Cointegration, and Vector Error Correction. The results confirmed the existence of Fisher Effect and a unidirectional causality function to interest rate from inflation. The empirical analysis also validated the existence of significant positive short-run and long-run relationships between the two variables.

Keywords: Philippine Monetary Policy; Interest Rate; Inflation; Fisher Effect; Vector Autoregression; Johansen Cointegration

1. Introduction

Across economies, inflation rate is seen to impact not just formal financial market participants but the grassroots consumers as well. It is universally defined as an increase in the general price level of basic goods and services in an economy over an observed period. Likewise, it is also used to gauge economic activities where a gradual increase in inflation indicates a strong demand for business activities. The exponential increase in inflation also known as hyperinflation drastically depreciates the purchasing power of currency and may lead to economic instability (Mises, 1996). On the other hand, deflation implies less consumer spending and weak demand in industrial production which may reduce economic growth (Cargill & Parker, 2003; Eggertsson & Woodford, 2003).

During the 2008 Global Financial Crisis, the Philippine inflation rate posted a 10.3% monthly average in the third quarter which is nearly four times higher than the figures in the same quarter of 2007, and the highest from 2002 to 2019 data. From 2007 to 2008, extreme movements in lending rate from 9.75% to 7.0% and monetary policy rate from 7.5% to 5.0% were recorded while the 91-day treasury bill yield climbed from 2.9% to 5.7% per annum. The sporadic spike in inflation triggered massive selloffs in the stock market with the Philippine Stock Exchange Index plunged to at least negative 30% from its all-time high of 3,758.97 points in October

2007. Furthermore, the economy contracted from a 7.6% GDP annual growth rate in 2007 to 3.1% in 2008. After the crisis, monetary policy and inflation rates threaded downward with the former recorded its lowest at 3.0% in June 2016 while the latter at -0.4% in September 2015.

The study is anchored to Fisher's Theory on the relationship between the nominal interest rate and expected inflation rate. The theory introduced an equation that the nominal interest rate is the sum of the real interest rate and inflation rate. Thus, any change in inflation causes a change in both nominal and real interest rates. In economics, this relationship is also known as Fisher Effect. The same theory was adopted and interpreted by Ayub, Rehman, Iqbal, Zaman, and Atif (2014), Hassan (1999), Berument and Mehdi (2002), and Jayasinghe and Udayaseela (2010).

While there are already numerous studies on determining inflation in well-developed countries, the literature in an emerging economy like the Philippines is still unsaturated and underworked. Moreover, various studies produced diverse findings regarding the direction of causality among the variables. Hence, this study contributes to the existing literature by examining the existence of Fisher Effect and the dynamics between interest rate and inflation.

2. Literature Review

2.1 Inflation on Interest Rate

The paper of Alexander (2006), using cointegration technique, confirmed the long-run relationship between inflation and nominal interest rate in South Africa from 2000 to 2005. Similar results were confirmed by Lardic and Mignon (2003) in G-7 countries, Saeidi and Valian (2009) in Iran, Million (1999), Mishkin (1992) in the US, and Yuhn (1996) in Germany. Further, Berument (1999) concluded the causality function of inflation to nominal interest rate in the UK. Using Johansen statistics, Marci (2006) examined the consumer price index and 90-day bill of Australia from 1979 to 2005 and found the existence of long-run cointegration. Moreover, Chan (1994) and Tzavalis and Wickens (1996) also validated the positive correlation between inflation and interest rate.

However, the working paper of Herwartz and Hans-Eggert (2006) tested the Fisher hypothesis using series data from 114 countries and found the non-existence of long-run cointegration between inflation and interest rate in a few countries with high inflation. Paleologos and Georgantelis (1996) also found no cointegration between inflation and interest rate in Greece. Also, Ghazali (2003) found no strong correlation between the two variables. Nevertheless, the works of Beyer and Haug (2009), Lanne (2001), and Sundqvist (2002) revealed inconsistent results on Fisher effect.

2.2. Interest Rate on Inflation

Using a multivariate framework, Mohanty and John (2015) found that India's inflation is influenced by crude oil prices, output gap, fiscal policy and monetary policy. The positive relationship between nominal interest rate and inflation is also noted in the works of Adu and Marbuah (2011), and Greenidge and Dianna (2008). According to Aurangzeb (2012), exchange rate, interest rate, fiscal deficit and unemployment have a significant positive relationship with inflation. Moreover, monetary policy plays an important role in price shocks and stability (Anugrah, Ismaya & Pratama, 2019; Dwyer & Leong, 2001). The paper of Ayub et al. (2014) established the existence of a long-run relationship between nominal interest rate and inflation in Pakistan from 1973 to 2010.

On the other hand, a study in Malaysia by Hashim, Osman and Elias (2014) determined that gross domestic product, interest rate and government expenditures have a negative relationship with inflation. However, Khan and Gill (2010) found that nominal interest rate is not a significant predictor of inflation rate.

3. Methodology

The study was designed to determine the relationship between interest rate and inflation rate. The data were derived from the online resources of the Bangko Sentral ng Pilipinas (BSP) and Philippine Statistics Authority (PSA). In particular, the BSP's monetary policy rate which is the benchmark for other interest rates was utilized as a proxy for the nominal interest rate. The unit of analysis is 204 monthly values of the variables from January 2003 to December 2019. The list of variables is presented in Table 1.

Table 1. Variable Identification

Abbreviation	Description	Unit of Measure
INFL	Inflation rate is the increase in prices of basic commodities over a period	Percentage
INTR	Interest rate on the BSP's overnight reverse repurchase facility	Percentage

The Augmented Dickey-Fuller and Phillips-Perron tests were used to determine if the variables are stationary at a certain level. The Vector Autoregression (VAR) was employed to explore if each endogenous variable is explained by its own lag or by other variable's lag (Juselius, 2006; Gujarati, 2004).

In this study, the general equation of VAR at one lag is expressed as:

$$Y_{1,t} = \alpha_1 + \beta_{1,1} * Y_{1,t-1} + \beta_{1,2} * Y_{2,t-1} + \varepsilon_{1,t} \tag{1}$$

$$Y_{2,t} = \alpha_2 + \beta_{2,1} * Y_{1,t-1} + \beta_{2,2} * Y_{2,t-1} + \varepsilon_{2,t} \tag{2}$$

Where $Y_{1,t}$ and $Y_{2,t}$ represent INTR and INFL, respectively, while $Y_{1,t-1}$ and $Y_{2,t-1}\ldots$ indicate their lag values. The α is the constant term, β is the coefficient and ε is the error term.

The Granger Causality was applied to detect if the past values of INF predict TBILL and vice versa. The Impulse Response Function (IRF) was used to identify the short-run impact of a standard deviation shock in random error terms while the Cholesky Variance Decomposition was directed to explain the variability of each variable against lag terms. Furthermore, Johansen Cointegration was used to test the long-run relationship while the Vector Error Correction (VEC) was employed to estimate the speed of short-run error correction towards long-run equilibrium.

4. Empirical Results

4.1 Test for Unit Root

Table 2 shows the results of the unit root test using Augmented Dickey-Fuller and Phillips-Perron. The variable INFL, without considering the trend and intercept, rejected the null hypothesis of non-stationarity at level while INTR became stationary after taking the first difference. To meet the assumptions of VAR that all variables are stationary, the two variables were transformed to first difference, I(1).

Table 2. Unit Root Test

Variables	Augmented Dickey-Fuller				Phillips-Perron			
	With Trend		Without Trend		With Trend		Without Trend	
	at Level	1st Diff.	at Level	1st Diff.	at Level	1st Diff.	at Level	1st Diff.
INFL	-3.5262**	-7.4279*	-3.1997**	-7.4516*	-3.1920***	-7.4281*	-2.8283***	-7.4513*
INTR	-1.5092	-11.4378*	-1.4214	-11.4301*	-1.7595	-11.8185*	-1.4947	-11.8230*

*Denotes significance at 1%
**Denotes significance at 5%
***Denotes significance at 10%

4.2 Model Specification

As pointed out by Nkoro and Uko (2016), the parsimonious model with the least values of Akaike Info Criterion (AIC), Schwarz Information Criterion (SC) and Hannan-Quinn Information Criterion (HQ) should be used. On the same account, the model with one lag was selected after satisfying the assumptions of ordinary least squares regression. Table 3 displays that at least one coefficient of each endogenous variable is not equal to zero. The current value of $INTR_t$ is predicted by $INTR_{t-1}$ and $INFL_{t-1}$ with $\beta = 0.1948, p < .05$ and $\beta = 0.0673, p < .05$, respectively. Thus, a percentage increase in previous realizations of interest rate and inflation causes a total of 0.26% increment in the current value of interest rate. The positive correlation was also pronounced by Chan (1994), and Tzavalis and Wickens (1996).

Residual diagnostics are enumerated in Table 4 which confirms that the residuals of the model, except for lag 5 and 12, has no serial correlation and homoscedastic.

Table 3. Unrestricted VAR Estimates

	D(INTR)	Standard error	t-stat	D(INFL)	Standard error	t-stat
D(INTR(-1))	0.1948	0.0681	2.8587*	0.1350	0.1614	0.8367
D(INFL(-1))	0.0673	0.0255	2.6411*	0.5475	0.0604	9.0679*
C	-0.0116	0.0118	-0.9766	0.0061	0.0281	0.2170
R-squared	0.0780			0.2987		
Adjusted R-squared	0.0688			0.2917		
S.E. of regression	0.1687			0.3996		
Durbin-Watson stat	2.0756			1.9738		

*Denotes significance at 5%

The equations (1) and (2) of the VAR model is restated as:

D(INTR) = - 0.0116 + 0.1948*D(INTR(-1)) + 0.0673*D(INFL(-1)) (3)

D(INFL) = 0.0061 + 0.1350*D(INTR(-1)) + 0.5475*D(INFL(-1)) (4)

Table 4. Residual Diagnostics

Test	Statistics	*p-value*	Null Hypothesis (H_0)	Interpretation
LM Test, Rao F-stat, Lag 1	1.8693	0.1150	No serial correlation	Accept H_0
LM Test, Rao F-stat, Lag 2	0.9789	0.4189	No serial correlation	Accept H_0
LM Test, Rao F-stat, Lag 3	0.6063	0.6583	No serial correlation	Accept H_0
LM Test, Rao F-stat, Lag 4	0.8521	0.4929	No serial correlation	Accept H_0
LM Test, Rao F-stat, Lag 5	3.5355	0.0075	No serial correlation	Reject H_0
LM Test, Rao F-stat, Lag 6	0.8100	0.5193	No serial correlation	Accept H_0
LM Test, Rao F-stat, Lag 7	0.8529	0.4924	No serial correlation	Accept H_0
LM Test, Rao F-stat, Lag 8	1.7967	0.1286	No serial correlation	Accept H_0
LM Test, Rao F-stat, Lag 9	1.0014	0.4066	No serial correlation	Accept H_0
LM Test, Rao F-stat, Lag 10	0.2186	0.9281	No serial correlation	Accept H_0
LM Test, Rao F-stat, Lag 11	0.2796	0.8912	No serial correlation	Accept H_0
LM Test, Rao F-stat, Lag 12	14.7761	0.0000	No serial correlation	Reject H_0
White, Chi-squared	17.4620	0.1330	No heteroscedasticity	Accept H_0

The graphical representation of inverse roots is presented in Figure 1 which confirms the stability of the model since the eigenvalues of the coefficient matrix are inside the unit imaginary circle (Öztürk & Agan, 2017).

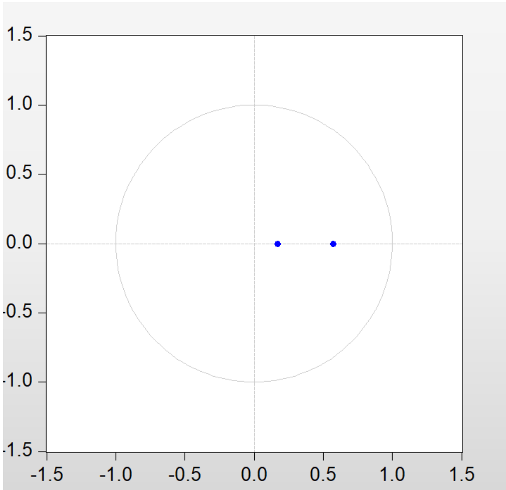

Figure 1. Inverse Roots of AR Characteristic Polynomial

4.3 Granger Causality

The result of causality test is shown in Table 5. The existence of a unidirectional causality is determined to interest rate from inflation, X^2 *(1, N = 204) = 6.9, p < .05*, which explains that variability in INTR is explained by INFL and its lag terms. Nevertheless, the result is inconsistent with the findings of Aurangzeb (2012), and Mohanty and John (2015) which concluded a reverse direction.

Table 5. Granger Causality / Block Exogeneity Wald Test

Dependent variable: D(INTR)			
Excluded	Chi-squared	df	Prob.
D(INFL)	6.9754	1	0.0083
All	6.9754	1	0.0083
Dependent variable: D(INFL)			
Excluded	Chi-squared	df	Prob.
D(INTR)	0.7000	1	0.4028
All	0.7000	1	0.4028

4.4 Impulse Response Function

Analytic asymptotic simulation with 100 repetitions from the unrestricted VAR was used to generate impulse response at 12 periods. Figure 2 shows the response of interest rate to a standard deviation shock in inflation. The x-axis represents the duration of the shock, i.e. 12 months, while the y-axis indicates the intensity and direction of the impulse. A positive shock to inflation produces an immediate effect to interest rate in the second period and gradually declines until it hits the steady state in the 11th period and remains in the positive region.

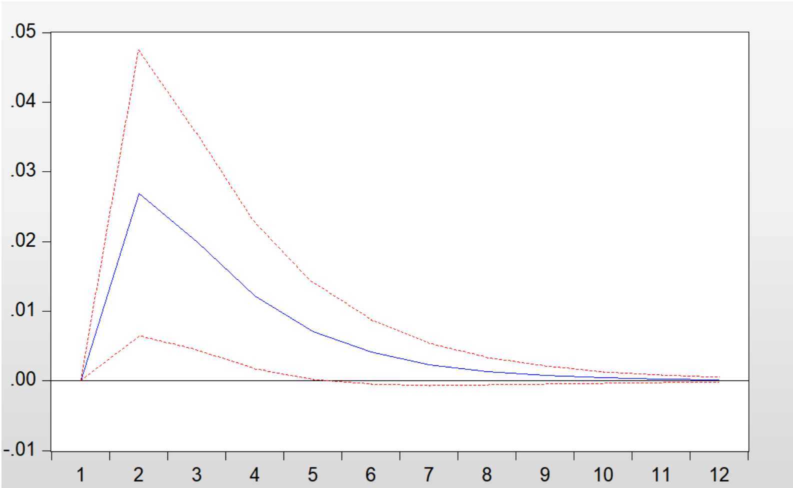

Figure 2. Response of D(INTR) to D(INFL) Innovation using Cholesky (d.f. adjusted) Factors $\pm$ 2 S.E.

4.5 Variance Decomposition

Table 6 was generated with Cholesky decomposition at 12 periods which explains how much variability in interest rate is lagged by its own variance. The result shows that the forecast error variance of interest rate in the second period is 97.60% explained by its own lag and 2.40% explained by the lag of inflation. Likewise, inflation accounts for a periodic average of 3.74% error variance of interest rate in the short run.

Table 6. Variance Decomposition of D(INTR)

Period	Standard error	D(INTR)	D(INFL)
1	0.168722	100.0000	0.000000
2	0.173920	97.60680	2.393195
3	0.175231	96.34335	3.656648
4	0.175674	95.87934	4.120662
5	0.175821	95.72276	4.277242
6	0.175870	95.67111	4.328885
7	0.175885	95.65419	4.345808
8	0.175891	95.64866	4.351343
9	0.175892	95.64685	4.353152
10	0.175893	95.64626	4.353743
11	0.175893	95.64606	4.353936
12	0.175893	95.64600	4.354000

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4.6 Cointegration Test

The Johansen Cointegration test was performed using the natural form of the variables. The result confirmed the existence of at least one cointegration vector in the series. The Trace statistics for H_0 of no cointegrating equation was rejected at 5% critical value, thus long-term relationship exists between interest rate and inflation. A similar finding was ascertained by Alexander (2006) and Marci (2006). The results are shown in Table 7.

Table 7. Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.084362	20.22183	15.49471	0.0090
At most 1	0.010933	2.242561	3.841466	0.1343

Trace test indicates 1 cointegrating equation(s) at the 0.05 level; *Denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

4.7 Vector Error Correction

The normalized cointegration equation is displayed in Table 8. The outcome indicated the existence of a significant long-run relationship between interest rate and inflation, $\beta = 1.6290, p < .01.$ Thus, a percentage increase in inflation causes a 1.63% increase in interest rate in the long run, holding all factors constant.

Table 9 accounts for the Vector Error Correction Model which confirmed that the previous realization of inflation is a significant predictor of interest rate, $\beta = 0.0585, p < .05.$ The correction term is expressed by CointEq1 with $\beta = -0.0098, p < .05$ suggesting the presence of short-run error correction towards long-run equilibrium at the minimal speed of 1% each period.

Table 8. Cointegrating Equation

	CointEq1		
INTR(-1)	1.0000		
		Standard error	t-stat
INFL(-1)	-1.6290	0.34638	-4.70304*
C	1.318008		

*Denotes significance at 1%

Table 9. Error Correction

	D(INTR)	Standard error	t-stat
CointEq1	-0.0098	0.0039	-2.5379*
D(INTR(-1))	0.1620	0.0685	2.3668*
D(INFL(-1))	0.0585	0.0254	2.3048*
C	-0.0121	0.0117	-1.0337
R-squared	0.1067		
Adjusted R-squared	0.0933		
S.E. of regression	0.1665		
Durbin-Watson stat	2.0461		

*Denotes significance at 5%

5. Conclusion and Recommendation

The study confirmed the existence of Fisher Effect with a unidirectional causality to interest rate from inflation and found a significant positive correlation both in the short-run and long-run horizon. In general, this can be explained that an increase in inflation rate may prompt the BSP to tighten monetary policy. This type of intervention prevents the economy from entering a negative real interest environment where the financial market is more volatile. From an economic perspective, negative real interest rates occur when the growth of inflation is faster than the growth of nominal interest rate. To illustrate further, the BSP strived to keep a positive spread between nominal interest rate and inflation rate except for the years 2008, 2011, and 2018 when the inflation rate unexpectedly hit record highs of 10.1%, 5.2%, and 6.7%, respectively. The significant economic events partially responsible for the negative real interest rates were the Global Financial Crisis in 2008, Dubai crude oil price hike from $72 to $108 per barrel in 2011, and the demand-pull triggered by the country's Tax Reform for Acceleration and Inclusion (TRAIN) Act in 2018. As a counter-inflationary maneuver, the BSP attempted to stabilize the market by increasing the interest rate from 5% to 6% in 2008, 4% to 4.5% in 2011, and 3% to 4.75% in 2018.

Likewise, it was analyzed that for a structured increase in the monetary policy rate of 0.25% or 25 basis points, the study model only accounts 1.7 basis points in the short run while 2.3 basis points in the long run. The variance is caused by other factors not covered in the study.

Furthermore, the study is recommended to retail and wholesale investors of money market and fixed income instruments. With the notion that the price valuation of both investments reacts inversely with interest rate, the consideration of the prevailing inflation trend may offer a better position when to buy, hold and sell. The results may also be considered by the BSP, policymakers, government regulators and private financial institutions to collaboratively promote a stable investment and trade ecosystem. Nonetheless, the study is endorsed to the academic community for further review and investigation with the inclusion of other economic factors in the model and the use of alternative scientific methods.

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