

The Cointegration Behavior and Diagnostic Stability of Philippine Monetary Policy Implementation During the Period From 1990 to 2022

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Abstract

The observations made in this study were used to evaluate the diagnostic stability of the Philippine Central Bank's selected monetary policy targets, namely, the Gross Domestic Product and inflation, with money supply, credits, interest rates, and exchange rates, as independent variables, using the autoregressive distributed lag and error correction model analysis. The co-integrating behavior depicted that all p -values of less than the 5% significance level generated different behaviors. However, analysis of the Central Bank's performance showed that there were no unit roots at all ($p > .05$) that signified a strong indication of cointegration behavior. The diagnostic stability of the Philippine monetary policy implementation was established over the period from 1990 to 2022. Further, money in circulation caused increases in domestic prices, interest rates, and inflationary pressure, and ultimately affected GDP (ppp). Understanding cointegration behavior is an imperative implication for policy makers to observe and take into consideration.

Keywords: *Philippine central bank strategy, monetary policy, stability*

Overview

The three pillars of the Central Bank of the Philippines (Bangko Sentral ng Pilipinas, or BSP) are price stability, financial stability, and an efficient payments and settlement system. The country's monetary policies are based on the long-run growth equation of inflation or Δy_t (INF), and national income or Δy_t (GDPg), which are interacting with the country's money supply or M_0 /GDP, interest rate changes or Δi , domestic credit development (CRE/GDP), and exchange rate of the Philippine Peso (EXCH). A monetary policy is defined as a set of tools employed by the BSP to control the volume of the country's money supply, particularly money in circulation (M2), plus bank deposits among others, through the institution's open-market policies, as well as promoting economic growth through the banking system's interest rates and reserve requirements. These are embedded in three main goals of any country's monetary policy; i.e., controlling inflation, keeping the employment rate under control, and maintaining a stable exchange rate in terms of the US Dollar. Even though they do not indicate a particular level of effectiveness, they reflect how monetary policy is performing.

In the Philippines, the Gross Domestic Product (GDP), an income indicator, increased 6.7% during the period of study. After the 1998 Asian financial crisis, the GDP increased at a rate of 7.3% while inflation declined from 2.3% to 1.9%, not to mention other monetary indicators (Table 1). Bangko Sentral ng Pilipinas (2023) has forecasted an inflation rate of 3% for the period 2023–2026 merely to comply with a stable monetary policy implementation.

Table 1 *Indicators of Philippine Monetary Variables (1990–2022)*

Year	Gross Domestic Product (ppp) [†] USD-Billion	Target Inflation %	Money Circulating P-Billion	Interest Rate %	Domestic Credit Development P-Billion	Exchange Rate P/USD
2022	404.3	5.8	15,895.5	7.1	10752.7	54.5
1998	74.5	9.2	1,138.4	16.8	1279.7	40.9
1990	50.5	12.2	297.3	24.1	270.4	24.3
Growth %:						
1990–2022	6.7%	-2.3%	13.2%	-3.7%	12.2%	2.6%
After crisis	7.3%	-1.9%	11.6%	-3.5%	9.3%	1.2%

Data Source. World Bank (2022). *Code.* †ppp represents nominal and purchasing power parity.

Mathai (2023), on behalf of the International Monetary Fund (IMF), clearly affirmed that in any monetary policy implementation, priority must be given to target inflation (INF) and output increase (GDP in ppp), which corresponds to the formulae used in this study.

Chen and Phelan (2023) supported this approach as a special and urgent priority, while Smets (2014) reiterated the importance of linking monetary policy and price stability in any monetary system. This is how a stable level of output is achieved using the monetary variables under study.

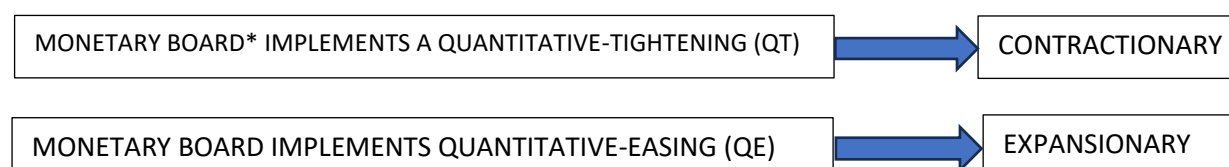
Monetary Conditions

Money supply (M), coined by the IMF, is comprised of money in circulation and in business vaults (M1), money in circulation M2, or M1 plus banking system deposits, and M3, which consists of M2 plus large time deposits and money market short-term investments (Lim & Sriram, 2003). The changes in the elements of money supply in the economy indicate the volume of economic transactions, as Suman (2023) explained. A greater supply of money will trigger more business in the economy, and vice versa. Suman cited Irving Fisher's equation on the theory of money: $M \times V = P \times T$, where

M = Money supply,
V = Velocity or turn-over of money changing hands,
P = Level of prices in the economy, and
T = Trade or business transaction in the economy.

The above changes noted in money supply should indicate how the economy is behaving. The changes may be contractionary or expansionary, as indicated in Figure 1.

Figure 1 Simple Behavior of How Monetary Conditions React to Money Supply Changes



Code. * The Monetary Board normally consists of the Minister of Finance (chair), Governor of the Central Bank (secretary), treasurer, and related governmental agencies.

Brunner and Meltzer (1972) argued about Friedman's theory of how the behavior of monetary conditions must be complemented without implementation of the government's fiscal policy, which the Keynesian economic school of thought had theorized to affect the volume of economic transactions.

Monetary Policy

As mentioned earlier, monetary policy affects money supply in the economy, which leads to the economic growth and development of a country. Friedman (1968), a well-known economist who introduced modern monetary theory, explained that monetary policy affects money supply and drives interest rates down in the short run, but up in the long-run as the level of national output increases. He indeed emphasized that money supply was the main driver of a higher level of economic transactions, as explained earlier in Fisher's theory of money. Responding to this definition, Mehar (2023) further argued that the common strategy of testing the effectiveness of monetary policy was to observe the impact of interest rates on GDP growth, investment, and the inflation rate.

Several monetary tools are utilized in adoption of the following goals of a monetary policy: Increasing a country's national income or expressed in terms of GDP (in nominal and purchasing power parity, or ppp values), controlling inflation (INF), money supply (M), interest rate management (i), credit management of the banking system (CRE), and managing exchange rates of the local currency in a prevalent reserve currency such as the US Dollar (EXCH).

The monetary tools available to the monetary board are as follows:

1. Open-Market Policy. This policy affects the money supply in the economy. First, a quantitative-tightening or QT is exercised by the government (the Central Bank and/or the Treasury Office) by selling government securities like Treasury Bills, Treasury Bonds, and other government or private securities to the market. By selling those securities, the money supply that circulates in the economy is reduced.

Second, a quantitative-easing or QE is exercised by the government by buying government and private entities' securities from the market. By buying these securities, the money supply that is in circulation will increase.

2. Adjusting the Discount Rate. The interest rate in the market depends on the discount rate set by the Central Bank. In a QT cycle, the discount rate will be increased to make credit more expensive, and vice versa in a QE cycle.

3. Adjusting the Reserve Requirement Imposed on the Country's Banking System. A higher reserve requirement tends to curtail the credit granted to the market in a QT, and vice versa in a QE.

Types of Money and Their Functions

Having known the essential characteristics of a monetary policy, it is worthwhile to observe how money is classified, including how it functions.

There are fundamentally three main types of money: fiat money, commodity money, and commodity-based money. Fiat money, also termed as the legal tender of a country, takes the form of paper money, and is a unit of account that specifies how much an asset is worth as an investment (store of value) or money settlement (medium of exchange). Second, commodity money is money that is made of precious metals with significant intrinsic value such as gold or silver. After the Bretton Woods conference from 1944 until 1971, gold could be converted into US Dollars and vice versa. However, due to inadequate availability of gold stock to serve the world's international trade, the convertibility of currency into gold was ended (Zoeller & Bandelj, 2019). Third, commodity-based money is a type of currency guaranteed by a certain commodity like gold or silver, as well as other commodities, to facilitate confidence in the currency.

The functions of money vary according to the types. The main roles of fiat money are as a medium of exchange, a store of value, and a unit of account. A market is formed when a buyer pays the price of goods to the seller in the medium of exchange. An investor in a gold or silver investment expects the store of value to remain high, with less depreciation. Unit of account refers to something that is used to value goods, services, keep track of investment and debt value, and most of all, for calculation of profit and loss, as well as a measure of wealth.

Research Gap, Questions, and Hypotheses

Though extensive research has been done in the past on monetary policies, it appears that there is a need for more study of efforts by the Philippine Central Bank to bring stability to the country's monetary policies during the past 30 years; this is the research gap that was the focus of this study.

In this study three main research questions were asked as follows.

First Research Question

Were there any unit roots in the cointegration variables of the Philippine's monetary variables? How did they behave in the order of integration?

The null hypothesis (H_0) of this question was: The cointegration of the Philippine's monetary variables had unit roots.

Second Research Question

Were domestic prices and GDP (ppp) growth, as the main objectives of the Philippine BSP monetary policy, diagnostically stable in the long run?

The null hypothesis (H_0) of the question was: Domestic prices (INF) and GDP (ppp) growth were not diagnostically stable in the long-run.

Third Research Question

Should diagnostically stable monetary policies exist, did targeted GDP and inflation as monetary goals Granger-cause changes in the money supply (M2), interest rate (i), credits (CRE), and Peso exchange rate (EXCH)?

The null hypothesis (H_0) of the question was: Targeted GDP and inflation as monetary goals did not Granger-cause changes in the money supply (M2), interest rate (i), credits (CRE), and Peso exchange rate (EXCH).

Research Methodology

In this section, the method of research, data and their analysis, and the relevant cointegration formulae that were used are explained.

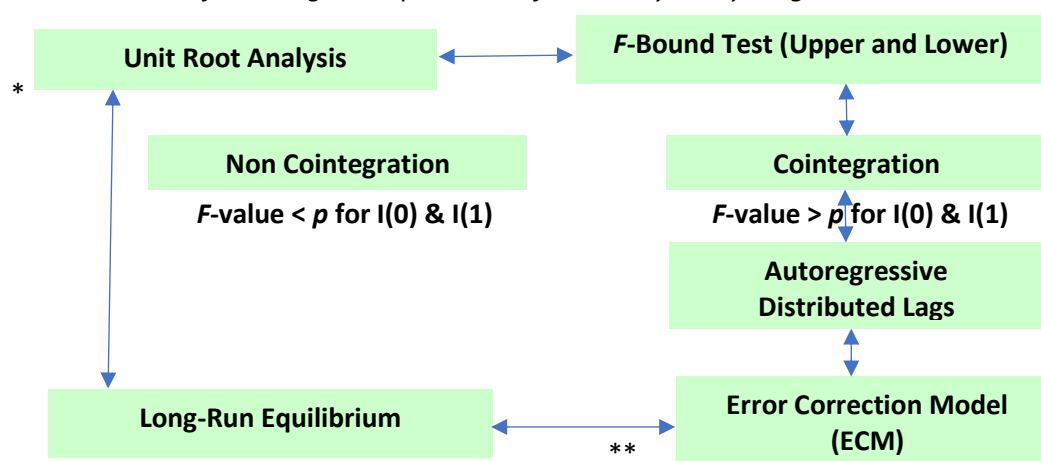
Method of Research

The study used a quantitative cointegration analysis that sought to test the theory of Frank Smets (2014) from the European Central Bank, who discovered that financial stability must start from the right implementation of the central bank's monetary policy.

Data and Their Analysis

The data used in the study were the panel time series of the Philippine monetary policy indicators during the period from 1990 to 2022, particularly price monitoring or Δy_t (INF) and the country's GDP growth, or Δy_t (GDPg) in the midst of other variables like the country's broad money supply or M_0/GDP , interest rate changes or Δi , credit as a percentage of GDP or CRE/GDP , and the exchange rate of the Philippine Peso in terms of the US Dollar or EXCH.

Figure 2 Framework of the Long-run Equilibrium of Monetary Policy Targets



Code. *Unit root and F-bound test leading to ARDL for short-run. **ECM for the long-run equilibrium.

The data were all gathered from international institutional statistics like the World Bank, the International Monetary Fund, the Bank of International Settlements, and the Organization of Economic Cooperation and Development. Other sources included the ASEAN Financial Innovation Network, ASEAN Banking Integration Framework, and Ernest & Young Fintech Census reports.

The first research question was answered using the unit root test in the cointegration analysis, while the second research question was answered using autoregressive distributed lags, or ARDL, for

the Philippines short-run monetary policies implementation, and error correction model, or ECM for the long-run implementation. The third research question was answered using the Granger-causality test to explore behavior of the monetary policy variables on a two-vector relationship (Figure 2).

Bhatta and Shrestha (2018) confirmed that unless the order of integration does not have any unit roots or is expressed as $I(0)$, the method of vector autoregressive or VAR should not be used in the cointegration analysis. Instead of the VAR test run using the trace and maximum eigenvalue tests (Johansen, 2020), the long-run equilibrium of the normalized hypothesis was determined through the error correction model and the Granger-causality relationship test.

Relevant Cointegration Formula

The time series of the Philippine monetary policy variables interact on the basis of short and long-term trends. The short-term relationships were tested with the F -bound test, and the long-run relationships were tested with the ECM, which refers to the λ $ECM_{t-1} + e_t$ as presented below.

$$\Delta y_t \text{ (INF) and } \Delta y_t \text{ (GDPg)} = a_0 + \sum \beta_{1i} y_{t-i} + \sum \beta_{2i} M_0/GDP_{t-i} + \sum \beta_{3i} i_{t-i} + \sum \beta_{4i} CRE/GDP_{t-i} + \sum \beta_{5i} EXCH_{t-i} + \sum \beta_{6i} GDPg_{t-i} \text{ or } (\sum \beta_{6i} INF_{t-i}) + \lambda ECM_{t-1} + e_t \text{ where}$$

Δy_t (INF) or the CPI (price consumer index) and Δy_t (GDP growth) or the GDP in purchasing power parity or ppp, as the measure of price stability.

a_0 = Alpha or the constant

$\beta_{1i} y_{t-1}$ = Coefficient of y , value in the period t and before t .

The same applies with those for $\beta_{2i} M_0/GDP_{t-1}$ (money/GDP), $\beta_{3i} i_{t-1}$ (interest rate), $\beta_{4i} CRE/GDP_{t-1}$ (credits in the Philippine banking system/GDP), $\beta_{5i} EXCH_{t-1}$ (Δ Philippine Peso exchange rate), $\beta_{6i} GDPg_{t-1}$ (GDP growth) (*short-run equilibrium*)

λECM_{t-1} = The λ of the error correction model generates the values that determine the long-run equilibrium posed by the ECM (*long-run equilibrium*)

e_t = vector of error terms.

Results and Discussion

The research questions posed were analyzed, and the outcomes are presented and discussed under a number of headings in this section.

First Question—Unit Root and F-Bound Test

By means of the unit root test and the F -Bound test, an attempt was made to answer the first research question. The pattern of the cointegration behavior was investigated, which further demonstrated the types of order integration, or $I(0)$ or $I(1)$ and > 1 . The information obtained led to rejection of the H_0 that unit roots were found. It was shown that there were no unit roots at all ($p > .05$), which signified a strong indication of cointegration behavior.

Table 2 Unit Roots Analysis of BSP's Monetary Policy Target (1990–2022)

Variable	MONETARY POLICY TARGET					
	GDP and INF	Unit Root Statistics		F-Bound Test Result		
	ADF	p	Order	F-Bound	$I(0)$	$I(1)$
GDP*	-2.964	.000	Level	20.169	2.390	3.380
CPI (INF)**	-2.971	.000	1 st	9.754	2.390	3.380
M (M/GDP)	-2.968	.000	1 st	4.123	2.390	3.380
CRE (CRE/GDP)	-2.972	.035	1 st	9.870	2.390	3.380
I	-2.972	.002	1 st	7.954	2.390	3.380
EXCH (EXCH g)	-2.964	.001	Level	12.785	2.390	3.380

Note. * & ** These were the two BSP monetary policies under examination.

The analysis in Table 2 revealed that there was a mixture of the $I(0)$ or order at level and $I(1)$ or order at first difference with most p -values less than the 5% significance level. This implies that compliance with the stationarity rule of the GDP (ppp) and CPI (INF) was giving rise to a good level of cointegration in the monetary policy indicators. The GDPppp (F -Bound = 20.169) and EXCH (F -Bound = 12.785) had the highest ratio of explained variance to that which was unexplained. All Philippine monetary policy indicators also had a comfortable level of integration at order 1 or $I(1)$, which were all > than 3.380 order of $I(1)$. And with the asymptotic $N = 1000$, the period under observation (1990–2022) or 32 years indicated critical t -values of 2.390 and 3.380 for the order of integration of $I(0)$ and $I(1)$, respectively. The data would normally be interpreted to mean that a cointegration existed at a certain order of integration statistically, even though its diagnostic stability must be tested first.

Second Question—Diagnostic Stability of BSP Monetary Policies

The testing of the diagnostic stability of Philippine monetary policy indicators was taken to mean that the BSP had indeed done a good job in the implementation of monetary policies for the country during the period from 1990 to 2022. The null hypothesis (H_0) that “Domestic prices (INF) and GDP (ppp) growth are not diagnostically stable in the long-run” was rejected. Hence, there was strong evidence of diagnostic stability. Since the unit roots varied, the autoregressive distributed lags or ARDL and the error correction model or ECM were used to reveal behavior over time. With the mixture of $I(0)$ and $I(1)$, the F -Bound test scheme is a good tool to use for reflecting the long-run and short-run equilibrium in the diagnostic stability through ECM and ARDL, respectively.

Using Breusch-Godfrey serial correlation, the target values of monetary policies implementation indicated no serial correlation that would cause estimated variances of the regression coefficients to be biased or would lead to unreliable H_0 testing. With this finding, the equation formulation for the short and long-run equilibrium of the BSP monetary policies target was derived as follows:

$$\text{GDP (ppp) target: } \Delta y_t (\text{GDP ppp}) = \text{GDP (ppp) target: } \Delta y_t (\text{GDP in ppp}) = -0.002 + 0.057\text{GDP}(-1) - 0.106\text{M/GDP}(-1) - 0.044i(-1) + 0.164\text{CRE}(-1) + 0.002\text{EXCH}(-1) + 0.097\text{INF}(-1) - 0.884\text{ECM}(-1) + e_t$$

$$\text{INF (inflation) target: } \Delta y_t (\text{INF}) = -0.004 - 0.330\text{INF}(-1) - 0.258\text{M/GDP}(-1) + 1.013i(-1) - 0.048\text{CRE}(-1) - 0.162\text{EXCH}(-1) - 0.278\text{GDP}(-1) - 0.948\text{ECM}(-1) + e_t$$

Table 3 Implementation of the BSP Monetary Policy Targets to Test Their Diagnostic Stability

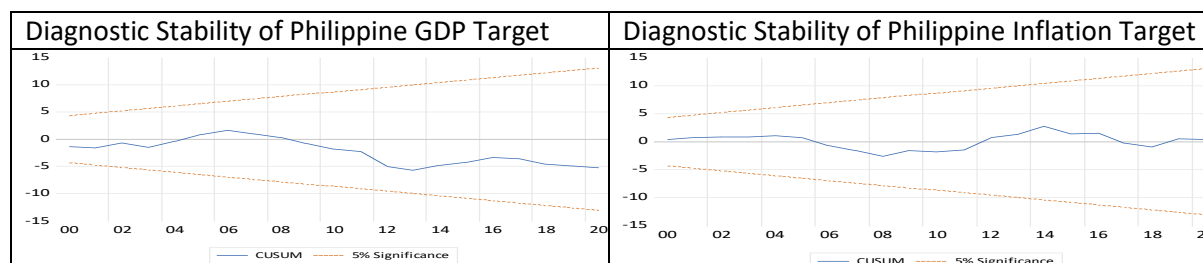
INDICATOR	GDP(ppp) TARGET			INF TARGET		
	Coefficient	t -value	p	Coefficient	t -value	p
C	-0.002	-0.352	.728	-0.004	-1.078	.293
d(GDPppp (-1))	0.057	0.349	.730	-0.278	-2.470	.022
d(INF(-1))	0.097	0.566	.577	-0.330	-1.995	.059
d(M(-1))	-0.106	-0.619	.542	-0.258	-1.960	.063
d(i(-1))	-0.044	-0.122	.904	1.013	3.689	.001
d(CRE(-1))	0.164	1.07	.297	-0.048	-0.405	.689
d(EXCH(-1))	0.002	0.055	.956	-0.161	-4.891	.000
ECM (long-run)	-0.884	-3.062	.006	-0.948	-3.980	.000

In terms of diagnostic stability, the cumulative sums (CUSUM) of the two BSP monetary policy targets significantly depicted the long-run equilibrium within the +5% level of significance upper bound and -5% level of significance lower bound, without showing any deviations or structural breaks. Besides, the chance for any errors to be corrected during the next period was high at 88.4% and 94.8% for the monetary policy targets GDP_{ppp} and INF, respectively (Figure 3).

Third Question—Two-Vector Granger-Causality Relationship

Based on the highest F -values of the two selected important BSP monetary policy target indicators, the Granger-causality relationship clearly revealed the specific phenomena of Philippine money supply (M) policy that caused INF and GDP at the rates of (F -value = 11.902, p = .002) and (F -value = 8.472, p = .007), respectively.

Figure 3 Diagnostic Stability Chart of BSP Monetary Policy Targets (GDP_{ppp} and INF)



Other strong causality in Philippine monetary policy implementation was the interest rate (i) to inflation (INF) at the rate of F -value = 19.093 and p = .000. Other indicators, in spite of the acceptable level of their Granger-causalities, did not indicate a strong significance like those of the previous two policies, i.e., the demand for money and its Granger-causality toward the interest rate (CRE to i) and GDP (CRE to GDP) at the rates of (F -value = 4.733, p = .039) and (F -value = 5.095, p = .032), respectively. The related hypothesis was properly tested.

Based on the analysis of the observation, the following findings, implications, and conclusions on the pattern of diagnostic stability of the BSP's monetary policy implementation, during the period from 1990 to 2022, are presented below.

Summary of Findings

1. The behavior of GDP (ppp) and EXCH (Peso/USD) at an order of $I(1)$ integration varied from the rest of Philippine monetary policy variables. In comparison with other cointegration studies reported in Tan et al. (2020), they reflected the following similarity, difference, and benefit for other economies.

Similarities. The cointegration behavior reflected the same effects on the monetary policy targets as in the present study.

Differences. In spite of the relatively similar monetary variables with the present study, fragmentation of cointegration behavior was indicated in the study conducted by Tan and colleagues (2020). Interest rate had a negative impact on economic growth, as well as on fiscal policy variables that were not used in the present study.

Benefits for Other Economies. Any other Asian country's Monetary Board may use the same uniform findings to test for monetary and fiscal policy stability. However, the study reported here did not include the latter.

2. In terms of diagnostic stability, the cumulative sums of the two selected BSP monetary policy targets, gross domestic product (GDP_{ppp}) and inflation (INF), indicated a good level of cointegration with the following findings:

- With the error correction model (ECM), the long-run equilibrium of the monetary policy targets were within the upper and lower bounds with a probability of .884 (GDP_{ppp}) and .948 (INF) for deviations to be corrected during the later period.
- Hence, they clearly indicated a good performance of the Philippine BSP in keeping the selected monetary policy targets stable during the period from 1990 to 2022 with the following emphases. First, increased GDP (ppp) generation (F -value = 20.169, p = 0.000); second, management of Philippine Peso exchange rate (F -value = 12.785, p = 0.001); third, money demand through the Philippine banking system credit management (F -value = 9.870, p = 0.035); and fourth, consumer and industrial prices management (F -value = 9.754, p = 0.000).

In comparison with other cointegration studies in India, Pakistan, Nepal, Bangladesh, and Sri Lanka, Nasreen and Anwar (2023) reflected the following similarities, differences, and benefits for other economies.

Similarities. Using the same ARDL method, the cointegration behavior of the five Asian countries demonstrated the same correlation between monetary policy variables and financial stability.

Differences. The existing study strictly used the related monetary policy variables (GDP, INF, M, i, EXCH), while Nasreen and Anwar's (2023) study resulted in different reactions to stability in inflation (INF) experienced by the five Asian countries.

Benefits for other economies. Any other Asian country's Monetary Board may use the same uniform findings, particularly with regard to the monetary goals (GDP and EXCH), to plan for its monetary stability, but not for inflation (INF).

3. The Granger-causality test clearly revealed that Philippine money supply (M2) did cause inflation (INF) and GDP (ppp) growth, as well as money supply (M), and interest rate (i) to inflation (INF). In comparison with the other cointegration studies in the India and Pakistan, Pradhan et al. (2017) reflected the following similarities, differences, and benefits for the other economies.

Similarities. The ARDL bound test, as found in the existing study results, showed the same cointegration behavior in inflation (INF) and GDP growth variables as in India and Pakistan.

Differences. The existing study strictly used the related monetary policy variables (GDP, INF, M, i, EXCH), while Pradhan and colleagues (2017) added financial depth into the equation.

Benefits for other economies. Any other Asian country's Monetary Board may use these findings, particularly with regard to its monetary goals (INF, i, and EXCH) to plan for its monetary stability.

Implications

First, given evidence of monetary stability in the Philippines, the Monetary Board—with the assistance of the country's banking system—must further endeavor to improve the system's efficiency in payments and settlements, as well as in real-time cross-border transactions (Popescu, 2022). Delivorias (2021) and Wang et al. (2022) referred to a Central Banking Digital Currency as a revolution leading to an improved monetary system, which is expected to give increased stability to the system.

Second, the cointegration behavior of monetary policy variables seems to need additional relevant variables, such as financial depth and currency volatility, in terms of the US Dollar as the existing reserve currency, whether it is fiat or digital money. Iancu et al. (2020) evaluated the importance of a reserve currency in an evolving international monetary system, which Zhang (2020) reinforced with the proposed introduction of a new form of digital money for monetary stability. Kurup (2018) commented that this implication stemmed from how financial technology has been disrupting the financial and banking sector, particularly in the payments and settlements system.

Conclusions

Based on the study's findings, it was concluded that the analyses had clearly shown convincing the diagnostic stability behavior of the BSP's monetary policy implementation during the period from 1990 to 2022 with the following insights for the future.

- It is high time now for the Philippine Monetary Board to study the further implementation of a Central Banking Digital Currency or other digital currency in the quest for a newly designed monetary system for the country.
- The new design may include investment in modern, digital payment infrastructure to enable swift and secure domestic transactions.
- The implementation of a new monetary system design for the Philippines must always be aligned with that of ASEAN's monetary policy stability framework.

Once the diagnostic stability behavior of the BSP's monetary policies implementation has been duly tested, the question for Philippine, as well as other countries' policymakers, is "what's next then?" The answer seems to be an innovative monetary policies system that facilitates digital payment infrastructure like the Central Banking Digital Currency or other digital currency system for domestic transactions, hand-in-hand with the existing fiat money system.

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