

A Simple Econometric Analysis of the World Gold Price Behavior as A Hedge to the Philippine Inflation and Peso Exchange Rate during the Crisis-Terminal Period 1980-2020

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Abstract: Gold seems to be one of the favorite investments in the Philippines, as much as part of the international reserves of many countries. The study sought to analyze the cointegration of the world price of gold, inflation and Peso exchange rate in the Philippines. Was gold price a hedge against inflation and Peso exchange rate? The behavior of how this hedge functioned during the three sets of periods, each ended with a terminal crisis, prescribed by the US National Bureau of Economic Research or NBER, was discussed and evaluated in terms of their cointegration among the time series during the crisis-terminal period 1980-1998 (Asian financial crisis), 1980-2008 (US financial crisis), and 1980-2020 (covid-19 pandemic). The variables in the time series consist of the gold price change (GP), GDP (ppp) growth (GDP), net trade balance (NTB), inflation rate (INF), and exchange rate (ER). The Granger-causality analysis was also used to determine the function of one variable to the other within the vector autoregression or VAR model. The cointegration and Granger-causality analyses are denoted as the simple econometric analysis in this study. The first and second research questions were answered by the cointegration test of the three crisis-terminal periods of GP, GDP, NTB, INF and ER, and Granger-causality test, respectively. The study concluded that the cointegration of all variables took place during the covid-19 pandemic (1980-2020) and US financial (1980-2008) crisis-terminal periods. The vector autoregression discovered that INF Granger-caused GP, without embedding the ER in its statistics. So, gold investment does seem to be a good hedge of inflation in the Philippines.

Keywords: Crisis-terminal, hedge, gross domestic product or GDP, net trade balance or NTB, inflation rate of INF, Peso exchange rate or ER.

JEL: D40, E31, F33, O13, Q32

I. BACKGROUND OF THE STUDY

The question, whether gold is still imperatively necessary to keep as part of any country's international reserve basket or not, is still haunting many policy-makers, particularly after the Bretton Woods' fixed rate system

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collapsed, when President Richard Nixon from the US froze gold convertibility as part of international payments. Hinkel, A. (2021) commented in his write up that gold demand remains unbroken due to several reasons, some of which are the lower investment portfolio risk and gold price change function as a hedge. He also mentioned about the huge national debts that any country must sustain with gold as another reason, in spite of what John Maynard Keynes mentioned gold as a barbarous relic (Salter, A.W., 2020). The author of the study has added several other reasons why people might want to keep gold. He envisions that any country's banking system must sooner or later be competitive enough to combat the disruptive innovation posed by the 4th technology revolution coming against several industries, that an innovative banking and gold bullion banking system must be developed. It is a banking system which is denominated in precious metals, including gold, rather than the fiat money or legal tender currencies. The Editors (2020) of the Harvard Business Review illustrated examples of how business is disrupted because of this innovation created by competitors; i.e. banks, steel manufacturing, travel business, and several more, are disrupted by the more innovative competitors. The uncertainty of the US economic performance with the mounting national debts and dwindling confidence of US\$ as a reserve currency, has also caused the speculation of Chinese yuan to be a reserve currency.

Gold as a hedge against inflation and exchange rate is generally understood as the reason why investors are still keeping gold in their portfolio. United National Industrial Development Organization or UNIDO (2017) reported that people in the Philippines, with 17.4 MT production in 2020, still value gold as a good personal investment. And regardless of whether the US\$ reserve currency was convertible to gold before President Richard Nixon froze it in 1971, today the world central banks still hold gold in their international reserve accounts. Statistic on world largest gold reserve holders as of September 30, 2021 was published by Statista Research Department (2021) as follows: United States (8133 metric tons or MT), European countries (9903 MTs), Russian Federation (2295 MTs), and Asian countries (4203 MTs). The Philippine Bangko Sentral ng Pilipinas or BSP as the central bank of the country held some 136.8 MTs (gold buying price

= US\$ 1,895.6/ounce) as of September 30, 2021, which stood at 0.6% from the total world gold holders. Cooper, R.N. (1982) simply described gold standard as comprising of the gold itself, the US\$ reserve currency, and a composite of goods and services. Since then, the fiat US\$ is continued to be used as the international reserve currency in spite of its volatility, and the nearly-lost confidence as an international reserve currency. Reaffirming on the uncertainty of the US economic performance, Tamas, G. (2021) evaluated the possibility of Chinese Renminbi to become the international reserve currency as the Asean countries have agreed to peg their currencies to Renminbi, which is a composite component of the ACU.

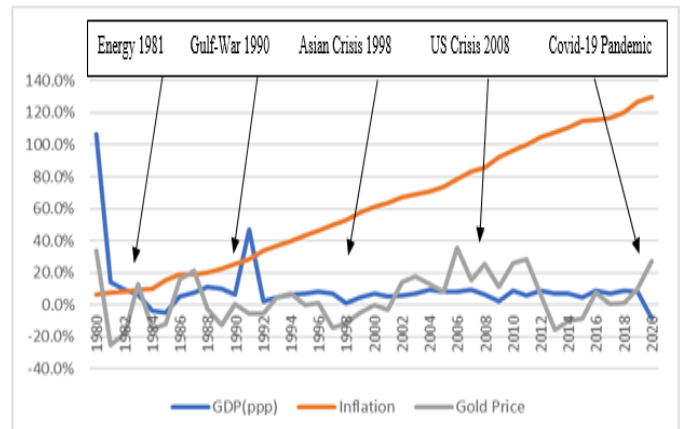
II. HISTORICAL USE OF THE GOLD STANDARD

Gold was used since the ancient kingdom of eastern Roman Empire as legal tender in its economy. Unfortunately, with the limitation of its supply and the rising demand of international trade settlement nowadays, President Richard Nixon of the United States had discontinued the convertibility of £ (United Kingdom's pound sterling) and US\$ (United States of America's US dollar) into gold coins or bars in August 1971. Humpage, O. (2013) confirmed the history of this gold standard application until the year 1914, before the great depression in the 1930s and the Bretton Woods conference in 1944, when each member could redeem its currency with US\$, instead of gold. It was ultimately corrected by the Smithsonian Agreement before the end of 1971, when the G-10 member countries (US, Britain, Germany, France, Japan, Italy, Switzerland, Netherlands, Sweden, Belgium and Canada) agreed to raise the price of an ounce of gold from US\$ 35 to US\$ 38, including that of depreciating their currencies in terms of US\$.

NBER's Formulation of Crises

In spite of what some looked at the period 1980-2020 as a long boom, when several economic progresses occurred in the Asian regions (Schwartz, P. and Leyden, P., 1997), the US National Bureau of Economic Research, or NBER, has formulated and documented its analysis of the crises that occurred in the period 1980-2020. As the study evaluated the cointegration of the Philippine economy's reaction of the world gold price against inflation and Peso exchange rate, the crises are briefly described as follows. First, the energy crisis of 1981 originated from the 1973 oil crisis, when the Iranian government increased oil price by withholding oil supplies. Second, the Gulf-war crisis in 1990 was triggered by Iraq's move to Kuwait's annexation. Third, the Asian financial crisis of 1998 was due to the currency exchange rate and money market problems in the region, which started with the Baht devaluation in Thailand. Surprisingly, Roy, S. and Kemme, D.M. (2020), recently discovered that in between the period 1980 and 1990 financial liberalization and large capital flows occurred due to the collapse of the European Exchange Rate or ERM mechanism.

Figure 1. Philippine GDP (ppp), Inflation and Gold Price Growth Percentages-1980 to 2020



Fourth, the US financial crisis of 2008 was preceded by the collapse of the large financial institutions like the Lehman Brothers and Bear Stearns (investment banks), AIG (insurance company), Freddie Mac and Fannie Mae (financial services companies). Curtin, S. (2012) reported that the crisis incurred a total loss of US\$ 12.8 trillion, not to include the potential GDP loss after the year 2008. The NBER declared the crisis to end after a period of more than a year. Fifth, the covid-19 pandemic crisis was declared as an outbreak in January 2020. Since the outbreak, the world economies practically collapsed. According to the World Bank, East Asia and the Pacific would only grow by 0.5%, while severe contraction would occur to South Asia (2.7%), Sub-Saharan Africa (2.8%), Middle East (4.2%), Europe (4.7%), and Latin America (7.2%), as quoted from the World Bank Feature Story (World Bank, 2020).

From the several crises, the study has only adopted the three crisis-terminal periods of 1980-1998 (Asian financial crisis), 1980-2008 (US financial crisis), and 1980-2020 (covid-19 pandemic crisis) for the cointegration and Granger-causality analysis.

Gold Standard (Until 1914)

Historically speaking, Sir Isaac Newton, a physicist master mint, who discovered the law of gravity, mistakenly set the silver to gold exchange rate, that caused silver to go out of circulation. It led the Great Britain to use gold system in 1717. The gold standard itself was first formulated and implemented in UK in 1821, after which a bimetallic regime of gold and silver was used outside the UK. It further led to the establishment of a monometallic gold standard by Germany, France and USA, followed by other countries. Since then, the use and abandonment of gold system by developed and developing countries seemed to be confusing and unclear. For instance, after the 1717 using the system and abandoning it in 1914, UK resumed using it in 1925 for a couple of year until 1931. The US abandoning it in 1933, adopted the system again when the Bretton Woods agreement was signed, until 1971, when President Richard Nixon froze

the gold convertibility again. Even though there are no developed countries using gold standard any more, many countries are still holding gold as part of their international reserves reported by their central banks in the balance sheet. As earlier mentioned, they hold gold as a hedge against inflation and exchange rate.

In spite of the world-wide holding of gold reserves and inconsistency of why it was frozen by President Richard Nixon in 1971, Bordo, M.D. (2020) explained why a gold standard is not a favorite nowadays. First, he cited Milton Friedman as concluding that the 2.5% cost of gold coin standard from the US gross national product in 1960 was a huge cost to maintain. In current price this cost is estimated at US\$ 525 billion as of 2020, which is 104.7% of the total US current account share. Second, unemployment and inflation growth rates were the culprit of why the gold standard was frozen by the Nixon Shock, even though he reported that the 4% inflation rate was higher than that under the gold standard regime.

Economic Upheaval in the Philippines

Van Hoang, T.H. et. al. (2016) evaluated world gold price as a hedge of inflation in the US, UK, France, China, Japan and India, using the non-linear autoregressive distributed lags or NARDL, and discovered that it was indeed a hedger, but it was only in a short run and did not form a long-term equilibrium. These R_{INF} and R_{GP} rates in the Philippines also revealed the same phenomena. The fiat Peso served as the legal tender currency in the Philippines, in spite of the volatility of its Peso exchange rates. Yap, J.T. (1996) suggested a good point for combatting inflation by involving the exchange rate stabilization and less importation strategy, which was reinforced by Dornbusch, R. (1986) as to comprise of the stopping of hyperinflation and a scheme formulated by the Simonsen-Pazos Mechanism, where institutional wage setting frequent adjustment is applied like in the case of the Brazilian wage mechanism (wage earners should receive increased compensation for past wages at regular yearly intervals until 1980, and six-month intervals until 1986). This strategy is advisable if world gold price doesn't function anymore as a hedge against inflation and/or exchange rate.

Table 1: World Gold Price, Philippine Inflation and Exchange Rate: Growth and Hedges (1970-1974)

YEAR	Gold Price	Inflation	Exch Rate	Growth %		GP Hedges	
	(GP-US\$)	(INF-%)	(ER-Peso)	GP	ER	R_{INF}	R_{GP}
		(b)		(b)	(c)	(b)-(a)	(b)-(c)
1970	36.0	15.0%	6.0	n/a	n/a	n/a	n/a
1971	40.6	21.6%	6.4	12.8%	6.7%	-8.8%	6.1%
1972	58.4	8.4%	6.7	43.8%	4.7%	35.4%	39.1%
1973	97.4	16.4%	6.8	66.8%	1.5%	50.4%	65.3%
1974	154.0	34.1%	6.8	58.1%	0.0%	24.0%	58.1%
HEDGING AVERAGES:							
	Gold price growth %			45.4%			
	Inflation %	19.1%					
	Exch rate growth %				3.2%		
	To Inflation (GP/INF)					25.3%	
	To Exch Rate (GP/ER)						42.2%

Source: Analysis made from the Philippine Statistical Year Book of 1970-1974

The upheaval in the Philippine economy under the administration of President Ferdinand E. Marcos (1965-1986) until the Smithsonian Agreement took place in 1971 to 1974, revealed a high rate of R_{INF} and R_{GP} of 25.3% and 42.2%, respectively, as an indication of world gold price as a hedge. Refer to Table 1.

The general sentiment in the Philippine economy is still to regard gold as a hedge against inflation and exchange rate to the extent of holding as much gold wealth is advisable. The Philippine President, Ferdinand E. Marcos in his speech before the US Congress mentioned that – “My earthly goods have been placed in the custody and faith

disposition of the Marcos Foundation dedicated to the welfare of the Filipino people.” (Marcos, F.E., 2006). Contact Phoenix Journal Review further commented that the earthly goods he was referring to was, none other than, the legitimate ownership of 192,000 MTs of gold bullions, which Congressman Marcos earned when he was the lawyer of the Tallano clan for delivering the service of returning the 640,000 MTs gold to the Philippines, which the clan previously lent to the Vatican. This 192,000 MTs represented some 30% commission the Congressman earned. Unfortunately, there seemed to be a missing link of the official report on that Marcos gold. The hypothesis of the

legitimate gold ownership, yet to be tested in the near future and if it is true, may benefit the country as the Marcos Foundation had inherited them for the benefit of the country, Philippines, and the south-east Asian region.

III. STATEMENTS OF PROBLEM, RESEARCH QUESTIONS and HYPOTHESES

Many economists are even confused and uncertain of whether the gold system is much better than that of the fiat money system. Hence, the study sought to answer the main problem of “*what gold system can do to better in hedging Philippine inflation rate and Peso exchange rate, learning from the three crisis-terminal periods; the Asian financial crisis, US financial crisis, and covid-19 pandemic disease?*” The following research questions and hypotheses were mainly answered:

First, how did the world gold prices cointegrate as a hedge with the Philippine GDP, NTB, INF and ER during the crisis of the following span of period:

- Asian financial crisis (1980-1998),
- US financial crisis (1980-2008), and
- Covid-19 pandemic crisis (1980-2020)?

The H0 was expressed as “*world gold prices did not cointegrate as a hedge against the Philippine GDP, INF and ER during the Asian and US crises, as well as during the covid-19 pandemic crisis.*”

Second, how did the world gold price Granger-cause the Philippine GDP, NTB, INF and ER during the crisis of the following span of period:

- Asian financial crisis (1980-1998),
- US financial crisis (1980-2008), and
- Covid-19 pandemic crisis (1980-2020)?

The H0 was expressed as “*world gold prices did not Granger-cause the Philippine GDP, INF and ER during the Asian, US crises, as well as during the covid-19 pandemic crisis.*”

IV. UNDERLYING THEORIES and RELATED LITERATURE

Underlying Theories

Theories underlying the potential economic factors, leading to the determination of the stable equilibrium of the world gold price (GP), explain how its concept as a hedge work. *Hedging is basically defined as a risk management strategy formulated and implemented to offset losses incurred due to increased prices of consumers’ products or exchange rate depreciation, as well as of any financial losses.*

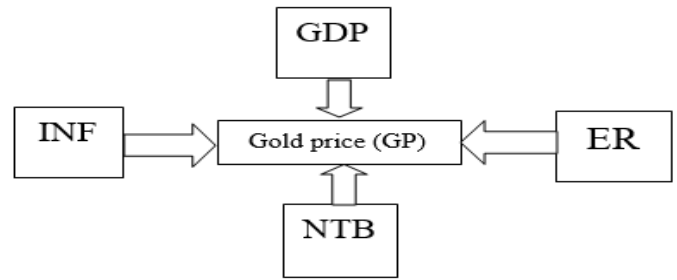


Figure 2. Conceptual Framework of the Gold Price as A Hedger

In this study, the GDP (ppp) growth and NTB as a % of GDP are added to the independent variables as that shown in Figure 2. In a formula form, the equation is structured as: $(GDP, NTB, INF \text{ and } ER) = f(GP)$.

General Hedging Concept. Hirshleifer, D. (1990) mentioned about Keynes and Hicks’ normal backwardation theory, when producers take short positions to hedge their long positions in the commodity futures market. Short position refers to a buy decision, and long position refers to a sell decision. There seems to be a need to differentiate between hedge and speculation. Minsky, H.P. (1977) agreed with Keynes, who differentiated these two. Hedge finance decision is made when cash flows from the loss is sizably large, when the speculation finance is expected to safeguard relatively smaller loss. Hence, the hedging motive is dependent on the cost. Hedgers pay a risk premium to speculators for assuming risk. In this study, the application of risk premium gives rise to the concept of “buy low, sell high.” Lesser price increase, due to inflation rate, is matched against the higher gold price growth. This is how the risk premium derives the difference. It also goes in line with gold investment as a hedge against inflation as evaluated by Barro, R.J. and Misra, S. (2013), who argued that crisis directly affects consumption and not gold investment. The $n_t^g > 0$, for gold equals the ratio of the marginal utility of gold services to the marginal utility of ordinary consumption, which is given by his formula: $n_t^g = (1 - a_t)/a_t \times (c_t/g_t)^{1-\sigma}$, where c_t/g_t is high and a_t (equal the constant, and $0 < a < 1$) is low.

Hedging Against Inflation (INF). In addition to the finding that gold price is not affected by any crisis, Barro, R.J. (1979) generally reaffirms his hunch about the stability of the world gold price as a hedge of inflation. He argued that the stability occurs because the Federal Reserve Bank as the central bank supports the gold nominal price in the market. However, in India, in spite of the positive cointegration between inflation and gold price, the relationship is not for long-term, considering that gold is a favorite consumer’s product (Singh, N.P. and Joshi, N., 2019), which is subject to the demand & supply law. Mehta, K.D. (2019), in his thesis attempted to test equities in addition, in developed countries like the US, UK and Switzerland. The result indicated that gold investment proved significantly less volatile than that of equity investments, which made the former as the best hedge against inflation.

Hedging Against Peso Exchange Rate (ER). In the context of India, Nair, G.K., et.al. (2015) attempted to test whether Rupee exchange value in terms of US\$ was also a hedge against inflation in the three crisis scenarios, the pre, during and post-crisis of 2008. The result of their study showed that Indian Rupee’s exchange rate in terms of US\$ seemed to Granger-cause the gold price before and after the crisis, as F-value = 0.460 and p = 0.005 under the pre-crisis, and F-value = 5.745 and p = 0.000 under the post-crisis, respectively. However, other studies didn’t prove similar phenomena as India, when Kunkler, M. and MacDonald, R. (2016) argued that the price of gold is not equal to the global price of US\$ due to unpredictable political attitudes of a country. They advised that global price of gold should not be the basis for hedging individual currency risk.

V. RESEARCH METHODOLOGY

Method of Research

The study adopts a simple econometric method of research to answer the first and second research questions, or cointegration and Granger-causality analysis within the realm of vector autoregression. The cointegration analysis sought to prove the integrated order of the variables’ time series, and Granger-causality to test their two-way vector relationship. The conceptual framework is depicted in the earlier Figure 2.

Data Used in the Study

The data, econometrically analyzed, are to be tested using the selected NBER-formulated crisis-terminal periods; the 1998 Asian financial crisis (1980-1998), the 2008 US financial crisis (1980-2008), and the 2020 covid-19 pandemic crisis (1980-2020). All research questions used KNOEMA and STATISTA economic panel data. Refer to Table 2.

Table 2: Data Used in the Study

CODE Economic Term		Related Ratio	STATUS OF THE DATA
GP	Gold price	$(GP_t/GP_{t-1})-1$	Dependent variable of being a hedge against INF (inflation) and ER (exchange rate)
GDP	Gross domestic product yearly growth rate %	$(GDP_t/GDP_{t-1})-1$	Independent variable of GP determinants
NTB	Net trade balance % of the GDP	NTB/GDP	Independent variable as a % of GDP (also for GP)
INF	Consumer price index	As researched	Independent variable of what to hedge with the GP
ER	Exchange rate	$(ER_t/ER_{t-1})-1$	Independent variable of what to hedge with the GP

*t refers to the year, semi-annual, quarterly, or monthly period, i.e. GP_{1981}/GP_{1980} , and so on.

Econometric Formulation

The first and second research questions answered the behavior of the time series of the gold price or GP and its functions; the GDP, net trade balance or NTB, inflation or INF and Peso exchange rate or ER. The cointegration formulation begins with the ADF unit root testing, lag optimality, Johansen test, and Granger-causality test.

ADF Unit Root Test. First, in the vector autoregressive or VAR model, the stationarity of the time series is the first to test. The H0: “There is a unit roots” must be rejected for stationarity purposes. One category of unit root test classification is the Augmented-Dickey Fuller or ADF test. The formulation:

$Y_t = \alpha Y_{t-1} + \beta x_e + u_t$, where
 Y_t = Value of the time series at time “t”
 Y_{t-1} = A lag, or a passing time among the time series.
 X_e = Exogenous variable
 u_t = Error.

The lag optimality is the next step to take in the vector autoregressive model. In economics there is always a delay between an action and consequence as formulated above. It could be a no lag (at 0 level) or at 1.

Johansen Test. Second, from all unit root tests that are discussed above, all time series variables seemed to show the pattern as an integrated order of 1. This type of test seeks to prove that the above time series $Y_1, Y_2, \dots Y_3$ are each integrated of a certain order. For the vector autoregressive or VAR model, there are generally two Johansen tests, the trace statistics and eigenvalue statistics. For Johansen trace it tests the H0 that the number of cointegrating vectors, k (or the likelihood ratio $_{trace}$) = m (or the cointegrating vector) to compare with the alternative $k > m$. For Johansen eigenvalue it works on the premise that the cointegration rank is k as H0 versus (k + 1) as the alternative hypothesis.

Granger-causality Test. Third, the Granger-causality test the two-vector relationship of a time series variables. If Y_1 Granger-causes Y_2 , then it means that Y_1 has the characteristics that predicts Y_2 , and vice versa. The procedures are worked as follows: First, a H0 and Ha are set up. H0 says that Y_1 doesn’t Granger-cause Y_2 . Second, if the probability or p is lesser than 0.05 as the level of significance, the H0 must be rejected and Ha accepted. Third, the p of < 0.05, lead to rejection, is interpreted that the variable Y_1 Granger-causes Y_2 , and so on.

Data Analysis

The first and second questions dealt with unit roots, Johansen’s co-integration and Granger-causality. The hypotheses of the two research questions at null form (H0) tested the cointegration and Granger-causality relationship of the study. Refer to Figure 3.

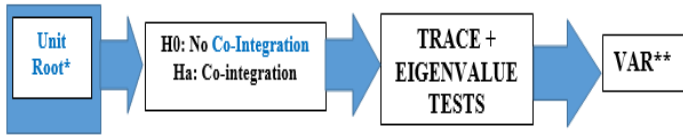


Figure 3. Priority Steps in Co-Integration Statistics for Achieving Stable Long-term Equilibrium

*1st step: Determination of optimal lag. **2nd step: Vector autoregressive for a long-range equilibrium.

VI. RESULTS AND DISCUSSION

The cointegration analysis sought to explore the behavior of the world gold price as a hedge against the Philippine inflation rates and Philippine Peso exchange rate during the three crisis-terminal period 1980-2020. The Granger-causality test was used to evaluate the causality behavior, while the cointegration particularly tested the long-term equilibrium of the hypothesized cointegrating equation, ceteris paribus, after it dealt with unit roots, optimal lag selection, and Johansen cointegration test.

Research Question 1 – Crisis-Terminal Period Cointegration

The Augmented Dickey-Fuller or ADF test examined the stationarity of the GP and all its functional indicators. The unit root test indicated that all indicators must reject the H0

that there was a unit root in the time series indicators at a 0.05 level of significance. The series of unit root proved that there was a strong co-integration in the world gold price, because of the integrated of order 1 or I (1).

Unit Root Analysis and Optimal Lag Selection. The ADF tests the H0 that a unit root is available in a time series. It is actually a negative number, which indicates a stronger rejection of the H0, the more negative it is. Even though NTB has a strongest H0 rejection at a negative 26.998, it doesn't indicate any direction affecting the GP. The GP for the three crisis-terminal periods indicated strong rejection, of course, with the covid-19 pandemic crisis as the highest with ADF = -5.604. While INF for the crisis-terminal period of covid-19 pandemic crisis and the Asian financial crisis indicated the strongest behavior with ADF = -12.577 and ADF = -10.347, respectively, followed by the 2008 US crisis at -6.900.

The lag, as explained in the methodology, is a fixed amount of passing time among the time series data, which the covid-19 pandemic crisis indicated as an order 1, unlike the other two crisis-terminal periods at an optimality of 2. The appropriate lag selection used the Akaike information criterion (AIC = 4.658), the lowest from those of Schwarz, Hannan and LR. Refer to Table 4.

Table 4: Johansen Co-Integration and Normalized Co-Integrating Coefficient (Cc)

INDICATOR	COVID-19 PANDEMIC			2008 US CRISIS			1998 ASIAN CRISIS		
	ADF	Critical	p	ADF	Critical	p	ADF	Critical	p
GP	-5.604	-2.945	0.000	-4.263	-2.971	0.003	-4.873	-3.099	0.002
GDP	-13.105	-2.937	0.000	-11.551	-2.972	0.000	-8.997	3.040	0.000
NTB	-26.998	-2.960	0.000	-5.731	-2.972	0.000	-4.515	3.040	0.003
INF	-12.577	-2.937	0.001	-6.900	-2.991	0.000	-10.347	3.099	0.000
ER	-6.331	-2.937	0.000	-5.297	-2.972	0.000	n/a	n/a	n/a

Johansen Cointegration. Cointegration of the GP and all its functions would include the Johansen cointegration test and hypothesized co-integrating VAR. First, the unit root tests mentioned earlier seemed to indicate that the variables belonged to integrated of order 1 or I (1). It means that GP indicator, including all its functional indicators, show a strong cointegration at integrated order of 1. Second, the trace statistics of Johansen co-integration test showed strong numbers of co-integration as the hypothesized numbers are all < than 0.05. None, at most 1 and 2, all derived significance values of 0.000, similar to that of the eigenvalue statistics. Third, in the long-run GP (coefficient = 1.000) and all its functional indicators' t-values indicate a strong confidence of good predictor. Refer to Table 5.

The co-integrating equation of the GP did indicate a stable equilibrium for the covid-19 crisis-terminal period

(1980-2020) and US financial crisis-terminal period (1980-2008). First, the covid-19 pandemic crisis period equation of GP (1.000) = GDP (coefficient -1.921, t = 4.8) + NTB (coefficient +0.037, t = 7.4) + INF (coefficient -0.817, t = 16.3) + ER (coefficient +3.870, t = 1935) indicated a greater confidence that all coefficients were good predictors, because all t-values were either at +2.0 or -2.0. There seemed to be a great confidence that the coefficient was a good predictor, because they were either greater than +2.000 or lesser than -2.000. Second, the US financial crisis-terminal period also showed an evidence of good predictor, because all t-values were either at +2.0 or -2.0 at the following equation: GP (1.000) = GDP (coefficient -5.944, t = 6.8) + NTB (coefficient +0.095, t = 7.9) + INF (coefficient +1.428, t = 12.9) + ER (coefficient +6.920, t = 1384).

Table 5: Hypothesized Equilibrium: Trace and Eigenvalue Statistics

H: n of CE*	COVID-19 PANDEMIC**			2008 US CRISIS***			1998 ASIAN CRISIS****		
	Statistic	Critical	p	Statistic	Critical	p	Statistic	Critical	p
<u>Trace</u>									
None	170.1	69.8	0.000	134.4	69.8	0.000	128.1	69.8	0.000
At most 1	87.1	47.9	0.000	66.5	47.9	0.000	70.0	47.9	0.000
2	36.9	29.8	0.000	n/a	n/a	n/a	37.7	29.8	0.005
3	18.3	15.5	0.000	n/a	n/a	n/a	11.4	15.5	0.186
4	5.7	3.8	0.000	n/a	n/a	n/a	2.1	3.8	0.146
<u>Eigenvalue</u>									
None	83.0	33.9	0.000	67.9	33.9	0.000	58.1	33.9	0.000
At most 1	50.2	27.6	0.000	41.5	27.6	0.000	32.3	27.6	0.011
2	n/a	n/a	n/a	n/a	n/a	n/a	26.3	21.1	0.009
3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4	5.7	3.8	0.017	n/a	n/a	n/a	n/a	n/a	n/a

*Number of cointegrating equation in the hypothesized equilibrium relationship
 **GP (1.000)=GDP(-1.921, t=4.8)+NTB(+0.037, t=7.4)+INF(+0.817, t=16.3)+ER(+3.870, t=1935.0)
 ***GP (1.000)=GDP(-5.944, t=-6.8)+NTB(+0.095, t=7.9)+INF(+1.428, t=12.9)+ER(+6.920, t=1384.0)
 **** GP (1.000)=GDP(+0.443, t=-7.4)+NTB(+0.007, t=-0.9)+INF(-1.200, t=-150.0)+ER(+4.500, t=1.3)

Research Question 2 – Granger-Causality Relationship

In order to create VAR models with (p + 1) lags and test the Granger-causality, Figure x shows the evidence that INF and GDP Granger-caused GP at both p = 0.003 and p = 0.001, respectively, under the crisis-terminal period. The ER didn't seem to Granger-cause GP, leading to an indication that the world gold price was no hedge at all to the Peso exchange rate (ER). Like the pandemic crisis, the US crisis revealed the evidence that inflation (INF) did Granger-cause GP at p = 0.013 under the US financial crisis. While the Granger-causality of NTB to GDP didn't indicate any direction on the behavior of how GP was affected by the INF and GDP.

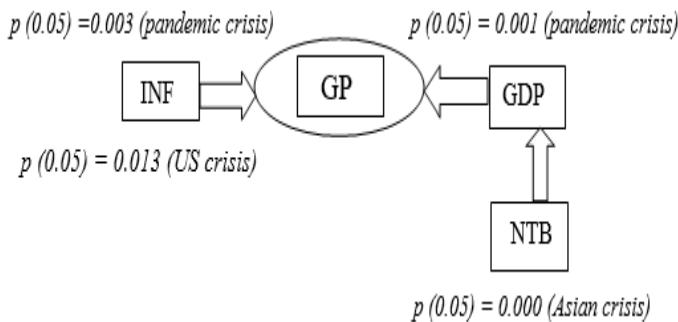


Figure 4. Granger-causality of GP and (INF and ER)

Of course, this finding on Granger-causality of the INF and GDP doesn't affect the structure of the hypothesized cointegrating equation of the future equilibrium of the world gold price in the future.

Table 6: Pair-wise Granger-causality Test Analysis Among the Three Crises

Null Hypothesis	Observation	F-value	p
Covid-19 pandemic crisis			
GDP doesn't Granger-cause GP	40	11.992	0.001
INF doesn't Granger-cause GP	40	10.475	0.003
US financial crisis			
INF doesn't Granger-cause GP	28	3.697	0.041
Asian financial crisis			
NTB doesn't Granger-cause GDP	18	15.858	0.000

The pair-wise Granger-causality test revealed a different size of F-value in the covid-19 pandemic crisis and the US financial crisis at F-value = 10.475 and F-value = 3.697, respectively. It tells us that the variances among group means have more units that what we see it by chance. Besides, the p value in the pandemic crisis is a stronger rejection of its H0 at p = 0.003, compared to the p = 0.041 under the US financial crisis time. The finding gives rise to the fact that the world gold price is indeed a hedge against inflation, but not Philippine Pesos to US\$ exchange rate, particularly in the covid-19 and US financial crisis-terminal periods. Refer to Table 6.

VII. SUMMARY OF INTERPRETATIVE FINDINGS AND CONCLUSION

The study came up with the summary of interpretative findings of the economic analysis of the world gold price as a hedge against inflation.

Interpretative Findings

The study presents the findings and their interpretation below. First, the unit root tests seemed to indicate that the time series variables all belonged to an integrated of order 1 or I (1). Second, the covid-19 pandemic crisis-terminal and US financial crisis-terminal periods seemed to indicate stronger cointegration. Third, the cointegrating equation of the covid-19 pandemic crisis-terminal period (1980-2020) and US financial crisis-terminal period (1980-2008), did indicate a stable equilibrium behavior: $GP(1.000) = GDP$ (coefficient -1.921, $t = 4.8$) + NTB (coefficient +0.037, $t = 7.4$) + INF (coefficient -0.817, $t = 16.3$) + ER (coefficient +3.870, $t = 1935$); and $GP(1.000) = GDP$ (coefficient -5.944, $t = 6.8$) + NTB (coefficient +0.095, $t = 7.9$) + INF (coefficient +1.428, $t = 12.9$) + ER (coefficient +6.920, $t = 1384$), respectively. There seemed to be a great confidence that the coefficients of the two crisis-terminal periods were good predictors for a long-term equilibrium. Fourth, specifically, world gold price or GP was proven to be a better hedge for Philippine inflation rate than that of its Peso exchange rate. Under the covid-19 pandemic crisis-terminal period, INF Granger-caused GP (F -value = 10.475, $p = 0.003$), and under the US financial crisis-terminal period, INF Granger-caused GP (F -value = 3.697, $p = 0.041$).

Conclusion

Based on the interpretative findings, the study concluded that there seemed to be a strong co-integration in all indicators with a special emphasis on the fact that the world gold price or GP is a strong hedge against INF or Philippine inflation rate, rather than the Philippine Pesos exchange rate. This strong cointegration specifically occurred during the covid-19 pandemic crisis-terminal period (1980-2020) and US financial crisis-terminal period (1980-2008), which all belonged to the integrated order at first difference or I (1).

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