Research

THE ROLE OF GOLD PRICES, EXCHANGE RATE AND INTEREST RATE ON THE CONTINUITY OF INFLATION IN PAKISTAN

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Abstract

In this paper we investigated the role of gold prices, interest rate and exchange rate against inflation in Pakistan both in the long and the short run, utilizing time series data over the period of 1975-2013 under the Johansen co-integration and vector error correction specifications. The results suggest that gold prices and interest rate are significantly positively related with inflation in the long run in the case of Pakistan, indicating that a rise in gold prices and interest will result in increase in inflation in Pakistan. Whereas exchange rate is found to be insignificant to impact inflation over the length of this study. However exchange rate is found to have significantly and negatively associated with inflation in the short run. That means that appreciation in rupee (PKR) will result in decrease in inflation and vice versa.

Keywords Inflation, gold prices, discount rate and exchange rate.
JEL Classification: Z000

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Introduction

Inflation is generally characterized by the increasing trend of price levels in an economy, that include escalation in the prices of all four factors of production like Capital, Labor, Land and Entrepreneurial abilities. In short, the basic notion is that inflation is the cause and effect relationship and is represented by the continuous escalation of price levels for the factors of production that are rent, wage, interest and profit. However the advantages or the adverse effect of inflation is still debatable that whether inflation is a good or a bad phenomenon for an economy? Nevertheless, many studies show that inflation, up to a threshold level is good or at least remains neutral, but adversely affects the economic activities if allowed to go beyond that threshold level. For example Hussain (2005) established that inflation level above a threshold point of 4-6% produced adverse effects on the economic growth in the case of Pakistan.

Bearing such heavy importance and drastic consequences as well, hence it is important to determine what causes inflation to increase or decrease—particularly the persistency in increasing behavior is more important to determine in the case of Pakistan. In this regards Cologni and Manera (2008) conclude that there are several factors which are evidenced as causing inflation like oil prices and fluctuation in price levels in commodity market such as gold prices, cotton, silver, rice and wheat. Or more classically, the study of Fama and French, (1987) concluded that fluctuation in prices in commodity market has significant effect on price level: raise in prices of gold, silver and wheat causes a significant rise in price level. Similarly Briere and Elliott (2000) determined the effect of natural disaster in this context and suggested that the occurrence of special events such as drought, floods earthquakes were the significant determinants in the case of cost push inflation.

Moreover, the fluctuation in currency exchange market also cause on inflation. In this regard, the econometric analysis based on

the study of Khan, Qasim and Ahmad (1996) evidenced the existence of significant influence of changes in Pakistani currency on inflation level in Pakistan. The study concluded that depreciation in PKR against USD caused hike in price level. On the same note Pakistan Economic Survey (2013-14) concludes in its seventh chapter that for ten months due to appreciation in PKR against USD, improvement in foreign reserves and average harvesting of wheat, the price level has remained lower than it was expected.

Besides the above rhetoric, relation of inflation with discount rate or the monetary policy rate has also been vastly experienced as significant. However, theoretically it is assumed that rise in interest rate adds to inflation because interest is a borrowing cost in financial market, but rising trend of inflation may be controlled by lowering the policy rate by a central Bank. The State Bank of Pakistan has also been trying to lower the inflation by lowering the policy rate, especially since 2008-09.

Hence keeping the above background information in mind, the main objective of this study is to find out the significant determinants or causes of inflation as the issue of inflation is very crucial for any economy, because it affects the prices of all four factors of production. Thus this study is aimed to investigate the main determinants or the causes of inflation in the economic context of Pakistan.

Review of Literature

Theoretical Perspectives:

Theoretically, numerous explanations have been put forward to explain the phenomenon of asset prices-to-inflation transmission mechanisms like the Marx's theory of money is one of the classical examples in this regards, which is an extended application of the labor theory of value and is practically considered a commodity theory of money and holds that disruptions in the intrinsic value of money

commodity (gold) may cause the general level of prices to rise (Tufail and Batool, 2013). This is more like a demand siders' view with the basic notion of the demand side of the economy as a catalyst. Similarly the proposed theory of Tobin's Q postulates that escalating asset prices poses marginal profitability effects and encourages more investment that in turn may lead to or translate into demand pull inflation (Mishkin, 1990). The basic idea behind this notion is stemmed in the 'wealth effect' of increasing prices that will lead to more private consumption and also enhanced capacity to borrow and hence resulting in inflation (Kent and Lowe, 1997).

However on the flip side, due to the turmoil in the global financial markets since 2007, the world has witnessed financial and economic volatility on a scale and magnitude that has not been seen since the great depression of 1930s. The recent crises left the world with a complex paradox of inflation-deflation and the performance of gold in these circumstances were found to be exceptionally well with more than doubling prices. This strong performance of gold during the period of turmoil has sparked a debate that the properties of gold needs to be reappraised as an investment vehicle and the hedging properties of gold needs to be reassessed as well. During the last couple of years, gold has even witnessed large and considerable physical movement to a level that is unprecedented in the history of the precious metal both within and across economies primarily due to the reasons that in the long run gold tends to hold its value in real terms and secondarily the hedging properties of gold in political and economic turmoil is beyond any doubt (Oxford Economics, 2011). As a store of value that is virtually believed to be immune to inflation, economic crises and credit defaults among other, for centuries gold has been found to protect wealth. However in the short run certain elements like economic volatility, financial crises, inflation, interest rates and exchange rate can affect gold to move away from its long run equilibrium (Harmston, 1998).

Likewise gold prices have attracted extensive research due to its potential ability to influence the behavior of inflation and is believed to serve as an important indicator of inflation. Numerous studies can be highlighted in this regard for example Stock and Watson

(199), Khalid (2005), Kemal (2006), Banerjee and Marcellino (2006), Rehman (2010) among others.

However factors like stock prices, money supply, interest rate and exchange rates among others are also deep rooted phenomena to explain the behavior of inflation and predict inflation both in the long and the short run. See for instance Andersen et al. (2007), Artigas (2010), Barnes et al. (199), Bilquees (1998), Dornbusch (1987), Hau and Rey (2006) among others.

Empirical Literature

Muhammad, Rasheed and Husain (2002) made a cross country study to determine relation between stock prices and inflation rates. The results of panel regression showed existence of fixed effect. The study concluded that there is positive effect of stock prices on the inflation in South Asian countries. Similarly the study of Ajayi and Mougoue (1996) analyzed correlation between inflation and exchange rate and concluded that exchange rate plays a vital role in determining inflation rate.

The multidimensional study of Kemal (2006) was designed to establish the relation of the stock prices and the actual dollar exchange rate with inflation rate. Utilizing co-integration analysis Kemal (2006) concluded that there is no long run relationship between the stock price and inflation rate. The study further concluded that exchange rate has positive effect on inflation rate. Similarly the study of Khan, Qasim and Ahmad (1996) was designed to establish the effect of exchange rate on inflation. The econometric analysis based study evidenced the existence of significant influence of changes in Pakistani currency on inflation level in Pakistan. The study concluded that depreciation in PKR against USD caused hike in price level. Similarly Padhan (2007) examined the relationship between foreign exchange rates on macroeconomic variables in India and concluded

that fluctuation in exchange rates bear negative effects on inflation in India.

Moreover Chishti, Hasan and Mahmud (1992) explored the factors that were affecting variability of inflation rate in Pakistan over the period of 1975-2010. The study considered discount rate and exchange rate as the determinant variables to investigate the variation in inflation rate in Pakistan. Chishti et al. (1992) concluded that rise in inflation occurred due to devaluation in exchange rates and discount rate. Exchange rate has a negative effect on inflation, whereas discount rate has positive impact on inflation. Furthermore the test result showed that in order to shorten the information and implementation gap between fiscal policy and monetary policy, effective fiscal and monetary policies should primarily comply and then should be linked with trade policy which will result in lower inflation and will help to have a healthier economy. Hence it is vital to shorten the gap between information and implementation of fiscal and monetary policies.

One of a promising conjecture, the study of Tufail and Batool (2013) was designed to determine the link between inflation and gold prices for Pakistan. Analyzing annual time series data for a relatively longer period of time that is 1960-2010, to determine the impact of gold prices against inflation and illustrate the hedging characteristics of gold and other assets like financial securities, foreign currency and real estate. They concluded that except foreign currencies, all other assets provide a hedge against inflation in the case of Pakistan whether expected or unexpected. Furthermore, hike in gold prices is found to have positive impact on inflation. However, unlike this, the study of Blose (2010) concluded that inflation could not be predicted via oil prices. On the other side, Worthington and Pahlavani (2007) concluded that the gold price has negative influence on in inflation both in short run as well as in the long run.

Similarly Anwar and Nguyen (2011) observed gold prices to predict future inflation for a sample of 14 countries from 1994-2005.

Using 6 to 24 months indicators of gold horizon and obtaining their standard deviations. The results indicated that inflation is more rapidly changed as compared to other indicators. Furthermore, gold was found to remain statistically significant in comparison to other variables like output gap. Likewise, Singh, Tripathi and Lalwani (2012) investigated the long and short run movements in inflation due to gold prices, using high frequency monthly data from 1976 to 1999.Utilizing co-integration technique, Singh et al. (2012) suggested that gold price has significant effect on inflation. Balassa (2013) is a comprehensive study to examine the effect of currency fluctuation and stock market price on inflation rate. The study concluded that currency changes had negative effect on inflation such as appreciation in currency caused decline in inflation, whereas changes in stock market has insignificant effect on inflation level.

Regarding gold prices, Chaudhry and Choudhary (2006) examined the relationship between gold prices and stock prices against inflation in Pakistan. Utilizing well known statistical techniques like co-integration analysis and Granger causality, for month end values of KSE 100 index and weighted average gold prices against inflation. The study documented positive relationship positive relationship between gold prices and inflation, whereas, negative relationship was found between inflation and KSE 100 Index. Similarly Choudhri and Khan (2002) was aimed to determine the influence of exchange rate on inflation in Pakistan, utilizing time series data for 35 years, the study concluded that exchange rate has negative effect on inflation.

Hypotheses of the Study

Initially, many determinants were under consideration. However, after reviewing literature and findings of several studies, in this study we finally select gold prices, discount rate and exchange rates as the major determinants of inflation in the context of Pakistan. Based on the objective of the study and following the literature, following hypotheses have been designed:

H1: Gold prices has significant impact on inflation

H2: Exchange rate has significant impact on inflation
H3: Discount rate has significant impact on inflation

Research Methodology

Data and Specification

In this study annual time series data for 35 years (1978 to 2013) for the variables in the model have been taken and are extracted from the Handbook of Statistics on Pakistan published by the State Bank of Pakistan and the economic survey of Pakistan 2013-14, whereas data for gold prices has been obtained from Kitco. The variables included in the model are based on well-established economic theory and long standing relationships and are supplemented into the following conceptual model. All the data is in natural log form.

$$\ln INF_t = f(\ln GP, \ln EXR, \ln DR) \quad (1)$$

Where;

*ln*INF: the natural log of Inflation, proxied by CPI index

*ln*GP: the natural log of Gold Prices, (the international bullion market rates per ounce)

*ln*DR: the natural log of Discount/Interest rate is the policy rate by the state bank of Pakistan.

*ln*EXR: the natural log of Exchange rate that is the official exchange rate (PKR per USD)

Tools and Methods

First the stationary or non-stationary behavior of the variables is examined by applying ADF (Augmented Dickey-Fuller) unit root test which is a common issue to be considered while dealing with time series analysis. If the variables are non-stationary then the ADF is tested at differenced series to finally determine the order of integration that whether the series can be said to be $I(0)$ or $I(1)$.

To determine the long run dynamic relation among the variables included in our model, Johnson and Juselius (1990) technique for co-integration is applied to find the long run co-integrating relation in the model. The relationship is established by investigating the number of co integrating equations (co-integrating vectors) whereas the short run dynamic linkages between the variables against Inflation can be determined by VECM (Vector Error Correction Mechanism).

The Johansen and Juselius (JJ) co-integration test has the benefit to identify multiple co-integrating relations in a single equation setting. In a simple manner it can be represented with a VAR of k lags as presented below;

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} \ldots A_k Y_{t-k} + \beta X_t + \varepsilon_t$$

Where $Y\text{-}_t$ is a k-vector of (n x 1) non-stationary series that are integrated of order one and $A\text{-}_i$ is an (n x n) matrix of deterministic parameters; whereas X_t is k-dimensional vector of exogenous regressors and e_t is a vector of innovations. Now with simple linear transformations the equation (2) can be re-parameterized as;

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \beta X_t + \varepsilon_t$$

And

$$\Pi = \sum_{i=1}^{p} A_i - I ; \Gamma_i = - \sum_{j=i+1}^{p} A_j$$

The Granger's representation theorem (Granger, 1969) governs that if the coefficient matrix $\prod$ is having reduced rank of $r < k$, then there is the possibility of $k \times r$ dimension matrices of α and β each with rank r such that = $\alpha\beta'$ or in other words; the long run coefficients and the co-integrating relations can be obtained by decomposing the matrix as $\alpha\beta'$ where each α and β are of dimensions $k \times r$. r is the number of cointegrating vectors and α is known as adjustment parameters (Hjalmarsson and Österholm, 2010).

However Johansen maximum likelihood test computes two statistics namely the Maximal Eigenvalues and the Trace Statistics. The Johansen likelihood test ratio, computed as the Trace statistics under the null hypothesis of r co-integrating vectors can be represented as;

$$Trace = -T \sum_{i=r+1}^{n} Log\ (1 - \hat{\lambda}_i)$$

And the maximum eigenvalue is given by;

$$\lambda_{\max} = -TLog\ (i - \hat{\lambda}_{r+1})$$

Assuming that Y_t is a non-stationary process integrated of order one *I(1)*, then the to identify the number of cointegrating vectors involves the estimation of the error correction representation as:

$$\Delta Y_t = A_0 + \prod Y_{t-p} + \sum_{i=1}^{p-1} A_i \Delta Y_{t-i} + \varepsilon_t \quad (7)$$

Where ΔY_t and ΔY_{t-1} represents the $I(1)$ parameters, governed by the Granger representation theorem.

Furthermore the efficiency and robustness of JJ co-integration results depend upon the lag length consideration, in this study we determine the lag length for our VAR specification by SIC

(Schwarz Bayesian Information Criteria) for its more consistent and parsimonious properties.

Finally when the long run dynamics have been established, to determine the short run dynamic linkages, the following VECM (Vector Error Correction Mechanism) has been specified, given a VAR(p) integrated of order *I(1)*, by re-parameterizing and transforming equation (2) as;

$$\Delta Y_t = \Pi Y_{t-k} + \sum_{i=1}^{k-i} \Gamma_1 \Delta Y_{t-1} + \varepsilon_t \quad (8)$$

Where Ï = $\alpha\beta'$ (Johansen 1991)

Empirical Results

While dealing with economic time series, unit root test is usually the starting point and one of most important to determine the stationary and non-stationary behavior of the variables under study to proceed further for co-integration and long run testing.

Table 1:
Unit root test results.

Variables	At Level	1st Difference	Conclusion
***ln* CPI**	-2.846787	-8.667713***	I(1)
***ln* GP**	-1.097704	-3.948337**	I(1)
***ln* EXR**	-1.922761	-3.591442**	I(1)
***ln* DR**	-2.243237	-4.671460***	I(1)
***ln* INF**	-2.475783	-6.404398***	I(1)

***, ** and * denotes significance at 1, 5 and 10% levels.

The results of Unit root test are provided in table 1,reveals that all the variables are non-stationary at level and becomes stationary at first difference hence it can be said that all the variables are integrated of order one or *I*(1). This fulfills the necessary conditions

to proceed with the JJ co-integration technique which requires that variables modeled should be integrated of the same order.

The results for JJ co-integration are presented in tables 2A and 2B for rank test (Trace) and Maximum Eigen values respectively. Both of the tests i.e. Trace statistic and Maximal Eigen value confirms the existence of one co-integrating equation. Thus this study utilizes one co-integrating vector to establish the long run relationship.

Table 2A:

Unrestricted Co-integration Rank Test (Trace)

	Trace Statistics			**Critical Value at 0.05**		
Null	v=0	v<=1	v<=2	v=0	v<=1	v<=2
Alternative	v=1	v=2	v=3	v=1	v=2	v=3
	53.36881	26.87155	7.108391	**47.85613**	29.79707	15.49471

Table 2B:

Unrestricted Co-integration Rank Test (Maximal Eigen Value)

	Max-Eigen Stats			**Critical Value at 0.05**		
Null	v=0	v<=1	v<=2	v=0	v<=1	v<=2
Alternative	v=1	v=2	v=3	v=1	v=2	v=3
	26.49726	7.015081	0.175444	**21.1316**	14.2646	3.841466

In order to make out the extent of the long run relationship among the variables, the long run coefficients were extracted by the process of normalization. The results of the long run normalized coefficients are presented in table 3 below;

Table 3:
Long run normalized coefficients.

Regressors	Long run Coefficient
***ln* GP**	0.097565*
***ln* EXR**	0.057599
***ln* DR**	0.144595*
C	-0.285156

***, ** and * denotes significance at 1, 5 and 10% levels.

From Table 3, the long run equation can be extracted as:

$$lnCPI = 0.098\ lnGP + 0.058\ lnEXR + 0.145\ lnDR - 0.285 \quad \ldots (9)$$

The long run normalized equation tells us that gold prices are significantly positively impacting the consumer price index in the long run that suggest that gold does not provide a hedge against inflation in the case of Pakistan. Similarly exchange rate is also having positive relationship with inflation and on average explains 5 % of variation in CPI inflation, however it is found to be statistically insignificant. Finally discount rate is having a significant and positive relationship with CPI inflation in the long run and affecting CPI for more than 14%.

Finally after capturing the long run relationship among the variables in our model, now we move towards assessing the short run dynamics of the model. For that purpose the VECM (Vector Error Correction Model) has been estimated with the results as follows;

Table 4:
VECM Results.

Variables	Δ ln CPI	Δ ln GP	Δ ln EXR	Δ ln DR
	-0.118160*	-1.437643***	0.492351***	-0.250414
VECM (-1)	(-1.60144)	(-2.75293)	(4.56905)	(-0.60646)
	-0.231175	0.408669	-0.400905	-0.784879
Δ ln CPI (-1)	(-1.06850)	(0.26688)	(-1.26878)	(-0.64825)
	0.023081	0.422476**	-0.218412***	-0.083529
Δ ln GP (-1)	(0.86315)	(2.23222)	(-5.59266)	(-0.55818)
	-0.246763*	0.964060	-0.478635**	-0.736032
Δ ln EXR (-1)	(-1.76944)	(0.97670)	(-2.35001)	(-0.94310)
	0.042129	0.153344	0.034076	0.180596
Δ ln DR (-1)	(1.10504)	(0.56829)	(0.61200)	(0.84647)
	0.024667	-0.029722	0.130918***	0.060974
C	(1.49647)	(-0.25476)	(5.43818)	(0.66099)
R^2	0.387901	0.464480	0.737359	0.410929
F-Statistic	1.549102	2.120176	6.862715	1.705216

***, ** and * denotes significance at 1, 5 and 10% levels.

The results for our VECM as reported in Table 4, shows that the error correction term in our model is significant with the expected negative sign, which shows the speed of adjustment towards long run equilibrium. We derive the short run behavioral equation for our model based on the results of the VECM as:

$$\Delta \ln CPI = 0.024 - 0.231\,\Delta \ln CPI(-1) - 0.023\Delta \ln GP(-1) - 0.246\,\Delta \ln EXR(-1) + 0.042\,\Delta \ln DR(-1) - 0.1181\,VECM(-1). \quad \ldots (10)$$

The coefficient of VECM in our model shows that CPI was adjusted on average for 11% in a year and it took approximately eight and a half years (1/0.1181 = 8.46) to eliminate the disequilibrium in the system that indicates quite a slow speed of adjustment towards the long run equilibrium. Arguably in the short run only the coefficient of exchange rate is found to be significant that means that only exchange rate and CPI is having a one to one relationship in the model in the short run.

Conclusions

In this paper we investigated the role of gold prices, interest rate and exchange rate against inflation in Pakistan both in the long

and the short run utilizing time series data over the period of 1975-2013 under the Johansen co-integration and vector error correction specifications. The results suggest that gold prices and interest rate are significantly positively related with inflation in the long run in the case of Pakistan, indicating that a rise in gold prices and interest will result in increase in inflation in Pakistan. Whereas exchange rate is found to be insignificant to impact inflation over the length of this study. However exchange rate is found to have significantly and negatively associated with inflation in the short run. That means that appreciation in rupee (PKR) will result in decrease in inflation and vice versa. Furthermore it was found that inflation is adjusted for about 11% a year and it took more than eight years to eliminate the short run disequilibrium in the system.

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