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Gold Prices and Financial Stability in India

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Abstract

There has been an almost sustained rise in the international gold prices since 2002, with just one deep correction in 2008. As gold is an integral part of savings of a large number of investors, this has raised apprehensions whether any correction in gold prices will have destabilising implications on the financial markets. In this backdrop, the paper makes an attempt to analyse the implications of the correction in gold prices on financial stability in India.

The paper covers empirical analysis on the inter-linkages between domestic and international gold prices and then it examines the nature of changes in the factors affecting international gold prices during the last two decades. While validating empirically the existence of complete inter-linkages between domestic and international gold prices, the paper goes on to conclude that there has been a structural shift in the factors affecting international gold prices in 2003. Short-run volatility in international gold prices used to be traditional factors such as international commodity prices, US dollar exchange rate and equity prices. However, since 2003, the same is largely due to the volatility in the US dollar exchange rate and mildly due to volatility in equity prices.

In conclusion, the findings of the paper show that domestic and international gold prices are closely interlinked. Based on empirical evidences, the paper also concludes that implications of correction in gold prices on the Indian financial markets are likely to be muted.

JEL classification: E44, G01, G10, G12

Key Words: Gold, Financial Stability, Financial Markets, Asset Price Bubble.

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Introduction

International gold prices have risen almost unabatedly in the last few years, though there was one large correction in 2008. From July 2011 the pace of increase in gold prices has, however, accelerated further and in the third quarter of 2011, gold prices rose much faster. The spurt in gold prices which occurred in 2011 took place in the background of worsening of financial and economic scenarios initially in the US, followed by the debt problems in the European Countries. As a result of these adverse global developments and “flight to quality”, gold is emerging as a “safe” asset for investment purposes.

The impact of the rise in international gold prices is reflected in its domestic prices as well. Despite the sharp recent price rise, in India, demand for gold has sustained, not only as a component of safe savings but also due to its social and cultural importance. Therefore, movements in gold prices in India are of keen interest to all segments of the society including investors. From the policy perspective, gold's price rise has raised a concern as to whether a future crash in gold prices would have financial stability implications. Given this background, the objective of the paper is to analyse the implications of the correction in gold prices on financial stability in India. The paper is covered in six sections. Section II provides a brief review of literature relating to gold with a particular focus on gold as a “safe haven”. Section III covers empirical analysis on the inter-linkages between domestic and international gold prices. Section IV covers empirical analysis on the factors affecting international gold prices. Theoretical and empirical analysis on the relevance of gold price rise to the financial stability is covered in Section V. Finally, broad conclusions are covered in section VI. References and technical results of regression analysis are appended at the end of the study.

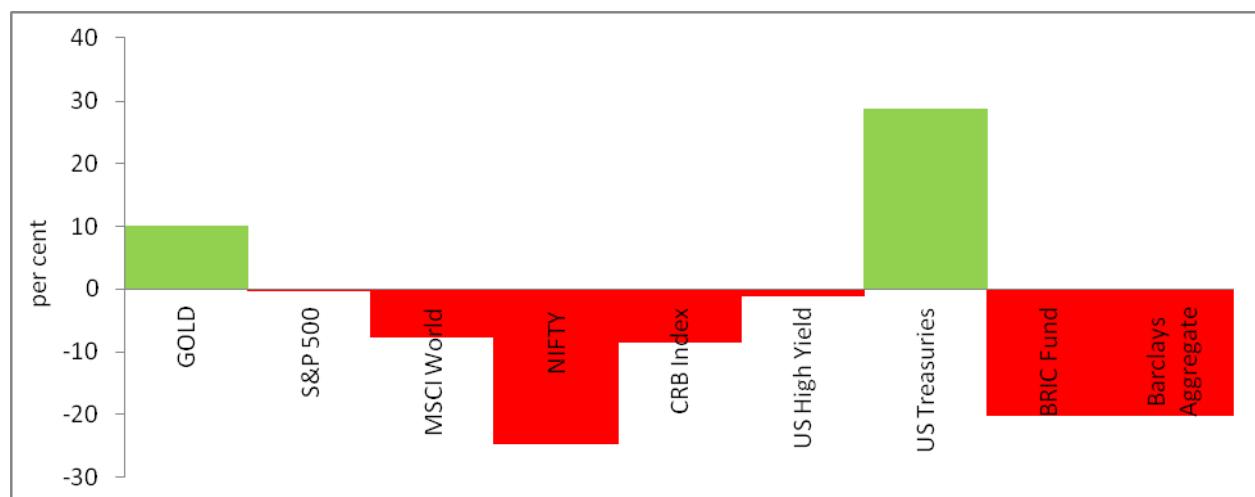
Section II Gold as a Safe Haven - A Review of Earlier Studies

Gold has been perceived as ‘safe haven’ especially during periods of financial and economic stress. A ‘safe haven’ can broadly be defined as an asset that protects investors’ wealth against financial turmoil. Therefore, an asset with a stable real value or, at least a stable nominal value is an uncontroversial safe haven, as it allows its holder to resell it without loss at any time (Coudert & Raymond, 2010). Viewed from this aspect, gold possess almost all characteristics essential to be classified as a safe haven. During the last decade, volatility of gold prices has been higher than that of sovereign bond markets but lower than riskier assets like equities and other commodities. There is some empirical evidence that gold could be a hedge even against stocks, though only in the short run (Baur and Lucey, 2010). The process of financialisation of commodities has led to a far greater interest in gold as an alternative asset. Investors take confidence from

high liquidity through daily trading in gold, which exceeds that of any sovereign's bond market with the exception of US treasuries. The rising share of Bars and Coins and ETFs in total demand is a sign of the financialisation of the commodity.

The spectacular rise in gold, which is reflected in its price rise, in the recent period can be attributed to several reasons. Firstly, during periods of geopolitical risks, the commodity has a great appeal as a haven. The unrest in Libya and Middle East provided the initial impetus for its rise in 2011. Secondly, measures like quantitative easing have weakened *fiat* money *vis-a-vis* commodities in general and gold in particular. With the US and European economy weakening again, there is speculation of a third round of quantitative easing and fears over further debasement of the US dollar in which gold is denominated. The US dollar is the reserve currency in which most countries hold their foreign exchange reserve assets. A country with a reserve currency has to run current account and fiscal deficits in order to provide enough reserves to meet the demand of the investing countries. Thirdly, it has come to represent a safe harbour in times of fall in risk appetite when sovereign debt sustainability on both sides of the Atlantic is being questioned. The political disagreement over how to address the large and growing sovereign debt and the resultant downgrade of US treasuries by S&P has quickened the pace of appreciation of gold. Some analysts and investors feel that in the current muddled political and economic scenario, gold is the only "hard currency" left. Lastly, short-term trend followers notice that a declining US dollar (in which gold is denominated) and negative real interest rates which reflects that gold price can only rise (may be till it reaches the psychological US\$ 2000 mark) have contributed to the feeling that it has emerged as the best performing asset in 2011 (Chart 1).

Chart 1: Returns on Major Asset Classes¹ in 2011 until November 30, 2011

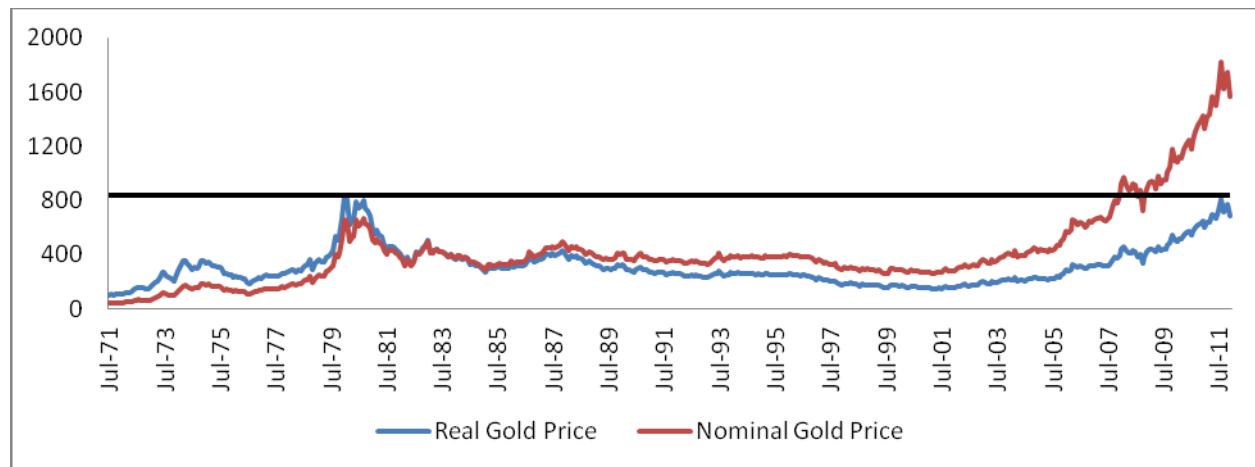


Source: Bloomberg

¹ US Treasuries, BRIC Fund and Barclays Aggregate are returns on ETF with these assets as underlying.

Despite the recent appreciation, however, real² value of gold lies below the peak of early-1980s (Chart 2).

Chart 2: Real and Nominal Price of International Gold



Source: Bloomberg

As regards India, there are various studies on gold especially on the demand and regulatory issues of gold. The study by Bhattacharya (2002) provides a comprehensive insight into the gold policy starting from the British era and until economic reforms in India. Bhattacharya has provided very useful suggestions regarding infrastructure and market development of gold in India and better protection to consumers by way of the widespread hallmarking of jewellery. Reddy (2002) in his address to the World Gold Council held at New Delhi outlined that from the policy perspective, gold has demand linkages with various macro aggregates and advocated further rationalisation of policy relating to import of gold, removal of restrictions on the export of gold jewellery, development of gold market in India, etc. The DRG study by the Reserve Bank of India titled "Gold Mobilisation Instrument as an External Adjustment" (1992) has listed five factors for their influence on demand for gold *viz.*, generation of large market surpluses in rural area as a result of all round increase in agricultural production, unaccounted income/wealth generated mainly in the service sector, comparative rate of return available on alternative financial assets like bank deposits, units of mutual funds, small savings schemes etc., price variation of gold and prices of other commodities. This study had an important conclusion that unaccounted money had great influence on the demand for gold in India.

A study by Kannan and Dall (2003) analysed the various factors of demand for gold in India and concluded that demand of gold has inverse relationship with its price and is positively related with income. They too concluded that financial wealth induced by medium term trends in equity prices has a positive impact on gold and that real yield on

² The nominal price of gold has been deflated using US CPI (Industrial Workers).

government bonds have inverse relationship with gold demand. A. Karunagaran (2011) has focused on the broader issue of central banks accumulating gold as a part of reserve management and has shown that central banks in most of the EMEs and advanced economies had either bought fresh stock of gold or stopped selling their existing stock of gold in the wake of the financial crisis of 2008. Moreover, the Reserve Bank's purchase of gold as foreign exchange reserve did not exacerbate the recent trend up for the commodity. Given this background, the present study differs from the earlier studies in term of its scope, coverage and objectives. Before taking up the analysis of the implications of the correction in the domestic gold prices on financial stability in India, it may be essential to examine the inter-linkages between domestic and international gold prices and in turn to examine factors affecting international gold prices, which forms the subject matter of section III and IV, respectively.

Section III Inter-linkage between Domestic and International Gold Prices

Indians have a yearning for gold since the inception of civilisation. Gold demand has not only remained high but has shown sharp rise in the recent period especially since 2001 as reflected in the increase in volume of imports. The demand has shown no signs of abating despite incessant price rise. Lord John Maynard Keynes famously commented that India's gold consumption reflects the 'ruinous love of a barbaric relic'. Incidentally, India's gold production continues to be minimal in nature. Almost all of India's demand for gold is met by imports. Before taking up a discussion on the inter-linkages between domestic and international gold prices, it would be appropriate to review the gold policy in India with a particular reference to the economic reforms in India.

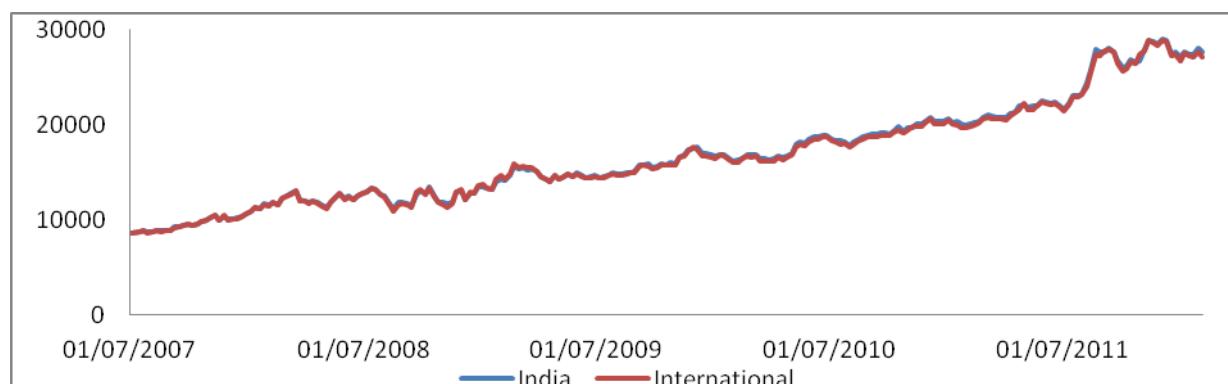
At the time of initiation of the economic reforms in 1991, one of the characteristic of gold was the prevalence of a large unofficial market for gold in India on account of restrictions in import of gold at the time. There was a considered view that unrestricted import of gold causes diversion of household savings from productive assets and the consequent diversion of precious foreign exchange resources. At that time, excess demand for gold was considered as one of the reasons for the then external constraint which hindered development and technical progress. This policy in turn led to a dual price for gold – one prevailing in the unofficial market and another one being the official gold price. The restrictive policy of gold resulted in smuggling of a large scale of gold into India.

The economic reform process initiated in 1991 influenced a shift in gold policy from "regulations" towards "deregulations". The major shift towards the deregulation of gold policy was reflected in the various recommendations of the Committee on Capital Account Convertibility (CCAC) in early 1997. The committee, *inter alia*, recommended the removal of restrictions on import of gold, which it hoped will curb smuggling and hoarding

of gold. The committee further recommended the development of gold-related financial instruments; developments of markets for physical and financial gold and encouragement of banks and non-banks to participate in the gold market. In line with these recommendations, the Reserve Bank authorised commercial banks to join the ranks of a few state enterprise like MMTC as nominated agencies for importing gold. As a result of these policy shifts, the import of gold through the official channel increased significantly. By 2011, almost entire import of gold has been taking place through the official channel leading to the integration of domestic gold prices with that of international gold prices.

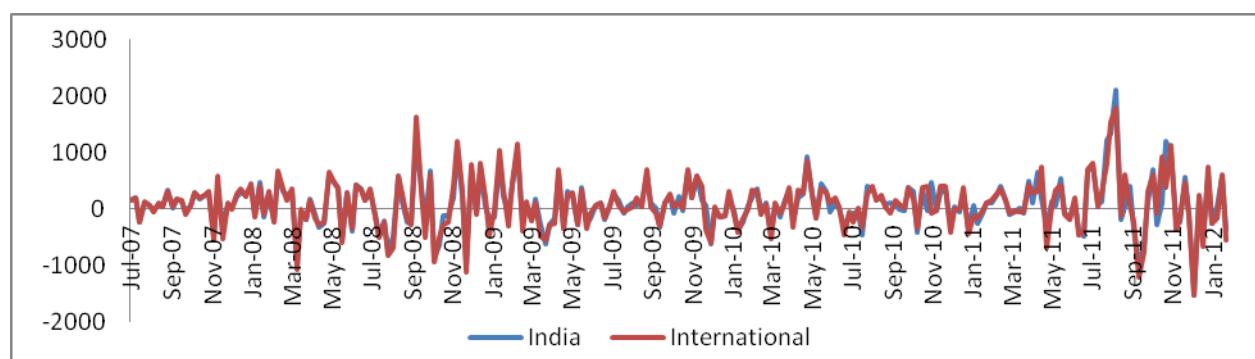
Domestic gold prices tend to swing with international gold prices. It is expected that on account of the liberalisation of gold, changes in domestic gold prices should be of almost the same magnitude as that of international gold prices adjusted for the exchange rate. With Rupee depreciation/appreciation, domestic gold prices should increase/decrease. Another factor which could have some impact on the domestic gold prices could be changes in domestic equity prices. In terms of its role as a "safe haven" during downturns in equity market, there could be increase in gold demand in the domestic market leading to a rise in domestic gold prices. However, in view of the liberalised environment, such an effect should be limited in magnitude as well as duration.

Chart 3: International and Domestic Price of Spot Gold (Rupees per 10 grams)



Source: Bloomberg

Chart 4: Changes in the International and Domestic Price of Spot Gold (Rupees per 10 grams)



Source: Bloomberg

Charts 3 and 4 visually suggest that the changes in the domestic gold prices take place completely in response to international gold prices. The same is tested econometrically both from long-run and short-run perspective.

For examining the long-run relationship between domestic and international gold prices, we have used monthly data on domestic gold prices as reflected on MCX commodity exchange (designated as MCX), international gold prices as reflected on Comex commodity exchange (CMX), Dollar-Rupee exchange rate (INR) and stock price index (NIFTY). Following econometric convention, all the variables are measured in their natural logarithm scale. Before estimating the long-run relationship, all the variables are tested for their unit root properties. After ensuring unit root properties, the long-run relationship between domestic gold prices, international gold prices, exchange rate and stock prices is tested estimating a simple OLS equation with domestic gold price as a dependent variable and international gold price, exchange rate and stock price index as the independent variables³. Empirical results of the equation confirmed *the existence of one-to-one relationship between domestic and international gold prices. Similarly, exchange rate also revealed expected impact on domestic gold prices*. Stock price index, however, did not show the desired impact and was dropped from the empirical analysis. The empirical results are furnished in Annex I.

The short-run relationship (i.e. month-over-month changes) between domestic gold prices and international gold prices is established through the ECM (Error Correction Modelling) framework. In this equation, change in the domestic gold prices is regressed on the changes in international gold prices, changes in the exchange rate and changes in the stock prices (all variables are in the logarithmic scale) and a lagged value of the residuals is obtained from their long-run relationship. These results confirm that *the relationship between domestic and international gold prices hold robustly even in the short-run*. The minor deviation, if any, gets corrected shortly as reflected through the high and significant coefficient of the error term. Thus, these results establish a strong linkage between domestic and international gold prices and exchange rate both in the long-run and short-run. These results are also given in Annex I.

Section IV Factors Affecting International Gold Prices

In this section, we confine our analysis to the factors affecting international gold prices both with a long-run and short-run perspective. At the outset, we analyse the long-run movements in nominal and real prices of gold prices (Chart 2). It may be seen that during 1979–1981 on account of oil crisis there was a steep rise in real price of gold from US\$ 400 to US\$ 800. It fell subsequently and is yet to regain that level.

³ Johansen's Test indicated the existence of Co-integrating vector for the variables under consideration.

The review of the earlier studies and the analysis as presented above suggests that international gold price is a complex phenomenon affected by economic and political environment. In the long-run, whereas international gold prices could move as a hedge against inflation, in the short-run there are large swings as a result of substitution of risky financial assets. Gold prices could also show wide variability during the episodes of financial stability/economic crises especially during the period of currency crises.

Accordingly, initially a simple relationship between international gold prices (GLD) is explained in relation to the world stock prices (SPX), Dollar index (DXY), IMF's World Price Index (Winf), US consumer price index (USACPI), Crude oil spot prices per barrel in US \$ terms (CRUD) and volatility index of stock prices (VIX). The details of the variables and their sources are given in the Annex II. For this part of the study, we have used quarterly data from the first quarter of 1991 to the second quarter of 2011. A graphical presentation of the international gold prices (Chart 5) revealed a mild downward trend from 1991 to 2001, though there have been strong swings. From 2001 onwards, international gold prices have revealed an almost unabated rise.

Chart 5: International Prices of Gold per Ounce in US dollars



Source : Bloomberg

In view of these observations, two set of equations were attempted. First set of equations covered the period from the first quarter of 1991 to the second quarter of 2003⁴ and, the second set contained regression equations in respect of the period from the first quarter of 2003 to the second quarter of 2011. All variables used in the study were tested for their unit root properties (and those results are omitted from the paper in order to keep the study brief). Initially, choice of the variables was made on the basis of theoretical

⁴ Chow test, Cusum and Cusum sum of square tests confirmed the structural shift in the relationship in 2003.

considerations followed by empirical experimentation of variables. Thereafter, long-run and ECM equations have been estimated and those results are presented in Annex II⁵.

Empirical results reveal that for the period 1991 to 2001, stock price, world price index and US\$ effective exchange rate turned out to be the most important factors affecting the long-run movements of the international gold prices. All these variables revealed desired and significant impact. In the long-run, gold acts as a hedge against inflation as the rise in world price level is accompanied by a rise in international gold prices. With the rise in stock price index, there is a fall in international gold prices. Similarly, with the strengthening of US dollar exchange rate (Dollar Index, DXY), there is a fall in international gold prices.

In the ECM framework, this relationship undergoes some changes - the stock prices and US dollar index are statistically significant determinants of the short-run changes in the international gold prices, whereas, the impact of world inflation rate, though of desired sign, is insignificant in nature.

When the similar relationships were estimated for the sample period 2003 to 2011, there was deterioration in the performance of the relationship especially in the ECM framework. In the long-run relationship, impact of only world price index turned out to be statistically significant and impact of the other variables turned out to be either having adverse sign or of much less relevance. In terms of ECM equation, however, impact of the US dollar index turned out to be statistically significant. Up to 2003, stock prices, world inflation rate and US dollar rate used to be major factors causing changes in the international gold prices. From 2003 onwards, world price level has impact on the international gold prices, and in the short-run only US dollar rate has a limited impact. Perhaps the unabated rise in the international gold prices since 2003 which have further gained pace in recent months are a result of "panic buying" which cannot be encompassed in these empirical analysis.

Section V Gold Price Bubble and Relevance for Financial Stability

With the price of gold surging to record highs - touching \$ 1900 per ounce in November 2011 - there are concerns in academic and policy forums as to whether gold is in a state of bubble and, if so, what could be its macroeconomic consequences in general and with reference to the financial system in particular. We take up this analysis in two stages. Initially, we provide theoretical background on the nature of asset bubbles and their financial implications using historical data and in the second stage, we provide empirical

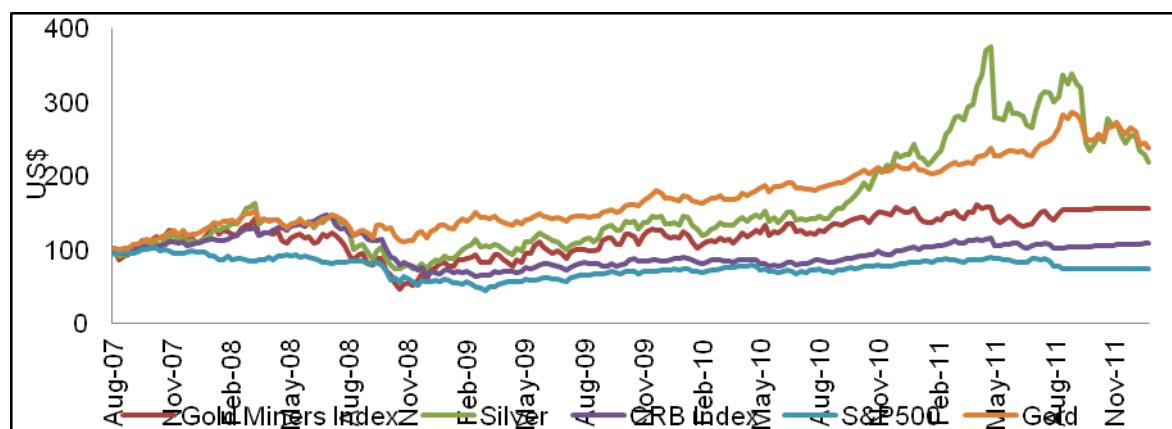
⁵ As before, co-integration tests were conducted and results showed the existence of co-integrated vector among the variables.

evidences on the impact of correction in gold prices on the financial stability indicators using Indian data.

We begin our analysis by providing a operational definition of bubble. The word “bubble” conjures up the image of an object growing steadily until it finally pops. Charles Kindleberger defined a bubble as ‘an upward price movement over an extended range that then explodes’ (Kindleberger, 1978). The definition of *bubble* most often used in Economics is that part of asset price movement that is unexplainable based on what we call fundamentals (Garber, 2000). A speculative bubble exists when the price of something exceeds by a big margin its market fundamentals for some period of time for reasons other than random shocks. Fundamental is usually argued to be a long-term equilibrium consistent with a general equilibrium (Rosser, 2000). It is well known that the price of an asset is the present value of all future *expected* cash flows. Ultimately this means that to define a bubble there must be an implications about the expectations of the cash flows of an asset.

In this context, it is analytically difficult to value the gold because unlike equity or fixed income securities, it does not have coupon or a dividend tied to it. There are no future cash flows that could be discounted using interest rates to arrive at a fair value as is done for financial assets. In fact, investing in gold requires some cash outflows in terms of rent for storage, insurance and other expenses. A number of unconventional indicators are, however, still used to arrive at its valuation. The US stock market, composite commodity index like Reuters – Jeffries CRB index, an index of stocks of gold producing mining companies (New York Stock Exchange’s Arca Gold Miners Index⁶) and crude oil have all fallen when measured in terms of gold rather than US dollars (Chart 6). Silver, also a precious metal, has risen even more than gold though. Thus, an assertion that gold is in a state of bubble can at best be a surmise.

Chart 6: Asset Prices in Terms of Gold



Source : Bloomberg

⁶ The New York Stock Exchange’s Arca Gold Miners Index is a modified market capitalization weighted index comprised of publicly traded companies involved primarily in the mining for gold and silver.

More important than the determination of gold as a bubble or not, from the financial stability point of view, it is the knowledge about the extent of macroeconomic and macro-financial damage a sharp correction in gold prices can cause that matters more.

In this section, we provide a brief discussion on the implications of an asset price bubble on real economic activity and financial stability. In general, the key channel through which asset price bubble impacts the real economy is through consumption and investment. In terms of economic paradigms, the fundamentals of any bubble are that the asset price bubble leads to the impression of creating wealth which through the wealth effect and other channels has negative effects on the macroeconomy when prices fall sharply. There may also be a major impact of asset price bubble, especially, in case of equity price, on corporate fixed investment. A steep fall in the equity prices may affect the net worth of the corporate sector and business houses, which in turn, impacts real economic activity having serious implications for stability of banking sector. An asset price bubble may pose problems to the stability of the banking system through variety of channels. As a result of asset price bubbles, banks may face credit risk, *i.e.* the risk of a severe reduction in collateral values and of increasing defaults of customers who have taken leveraged position. Banks may also encounter market risk, *i.e.* the risk banks incur as direct investors in the affected assets. Thus, the asset price bubble is likely to affect households through the consumption channel, corporate sector through the investment channel and the banking sector through the credit risk and market risk channels.

Asset bubbles burst and lead to contraction of the economy. But the impact of all types of bubbles has not been observed to be identical. Some asset price bubbles have devastating effect on the economy whereas impact of others is minimal. Reinhart and Rogoff (2008) have documented in detail, many episodes of boom-bust financial cycles but not all of them result in a costly economic contraction. Some boom-bust cycles, such as those in Japan and Scandinavian countries in the 1990s, and the sub-prime crisis of 2007-2009, led to banking crises and a severe recession. But on well known occasions such as 1987 stock market crash or the dot-com bubble of 1999-2000, the collapse of asset price did not result in any banking crisis.

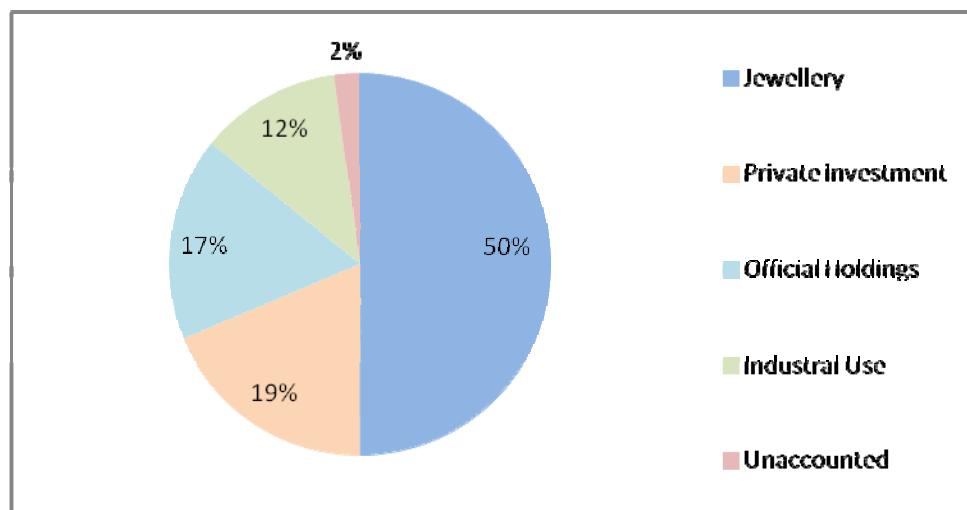
A pertinent question thus arises as to why some bubbles cause severe contraction of economic activities while others do not. Why did the dot-com bubble not lead to a serious banking crisis while the sub-prime bubble did? An additional policy dilemma from the financial stability angle, is whether policy makers should react to any sharp increase in asset prices or are there occasions when the market can be left safely to its own devices even when financial prices look to have departed from the fundamentals. Mishkin (2008, 2009) has argued that one should only worry about bubbles generated within the banking system. Literature on the subject suggests that an asset price boom is far more

likely to result in a costly output collapse when it is accompanied by a large increase in money, credit and bank leverage.

Kosuke and Nikolov(2011) have used a DSGE model to decipher the asymmetric effects of the various bubbles on the economic system. They have summarised their observation as: "...asset bubbles held by banks (some times referred as 'credit bubbles') are more dangerous than bubbles held by other investors who are less central in the credit allocation mechanism. When bank-held credit bubbles burst, banks become insolvent and need to be rescued by the government. The fall in their net worth causes a severe credit crunch and output collapse. In contrast, the effect of asset price busts on real economy are milder when savers directly hold bubbles. It is the savers who suffer from the capital loss. But because the net worth of savers is not central to the efficiency of financial intermediation, the cost of the bubble's collapse remain private rather than 'systemic'. Borrowers and other banks do not suffer as a result of saver's loss...."

With these theoretical backgrounds, we take a look at the ownership of gold by households, central governments and others and make a qualitative assessment of the gold price bust, if any, on the real activities. Chart 7 reveals that about 50 percent of the global gold holdings are meant for jewellery purposes which could be ascribed largely to the household sector. Another 12 percent global gold holdings are meant for industrial use whereas 17 percent are official holdings of the Central banks/other government bodies. Thus, a major part of the global gold holdings are not directly held by the banking/financial sector. Finally, there is a lack of leverage in purchasing of gold. Bubbles require large leverage and there is no evidence yet that investors are borrowing to invest in gold. Moreover, gold had been falling as a proportion of total global financial assets since 1968 from close to 5 per cent to less than 0.5 per cent in 2000 (CPM Gold Year Book, Bloomberg, March 2011).

Chart 7 : Composition of Gold Holdings (as at end-December 2010)



Source: World Gold Council

In the framework Kosuke and Nikolov (2011), gold price bubble, if at all, is likely to have a mild impact on the economic activities. Rather, gold price bust may have certain positive implications for economic activities. There is a general consensus that the present gold price spurt is taking place against the background of global uncertainties and gold is substituting other risky assets like equities in asset portfolios. This in turn could lead to the fall in the entrepreneur's networth having adverse impact on the economic activities. Fall in consumption expenditure by the household due to the wealth effect induced by fall in gold prices is likely to be minimal as the usage of gold as a collateral for obtaining financial assistance from the banks and non-banks is still limited in nature. Even if used as a collateral, there is considerable anecdotal evidence suggesting that financial institutions have raised margins fearing correction in gold prices.

Another related issue is the emerging role of Exchange Traded Funds (ETF) in gold. Sharma (2011) has pointed out that Financial Stability Board and Financial Services Authority have raised concerns regarding the emergence of synthetic ETFs which needs to be further examined.

The issue whether any sharp fall in the gold prices would have financial instability implications has also been empirically tested using Indian data. For this purpose we have evolved a financial market stability indicator⁷ (FMSI) which assesses the market conditions in terms of level/volatility of the various market indicators *viz.*, equity prices, volatility in the banks' equities, exchange rate, etc. An upward movement in the FMSI indicates that financial markets are encountering stress and are thus likely to encounter financial instability whereas its low level is indicative of stability in the financial markets. To empirically test the hypothesis that a sharp fall in gold prices is unlikely to add-up to the stress of the financial markets, we have estimated a regression equation considering FMSI as a dependent variable and changes (year-on-year) in the Indian gold prices and equity prices as independent variables using their monthly data. Results of this analysis, as given in Annex III, reflect that any correction in the gold prices would indeed result in a fall in the FMSI. Results of the same regression equation suggest that any sharp fall in the equity prices would have an adverse effect on the FMSI, *i.e.* would lead to a rise in the FMSI. These results are consistent with economic theory and also with the past episodes of financial crisis. These results provide support to the theoretical arguments that *any correction in the domestic gold prices is unlikely to cause any instability to the Indian markets.*

This analysis has also been supplemented by conducting an exercise in vector auto-regression (VAR) framework where FMSI, Indian gold prices and Indian equity prices formed a vector of the variables. These results are presented in Annex III. The impulse

⁷ For technical details, please see Financial Stability Report, Reserve Bank of India, December 2011. http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx?prid=25638

response functions of the VAR indicate that any correction in gold prices would lead to a fall in the FMSI whereas any correction in the equity prices would lead to a rise in FMSI⁸.

Based on the above qualitative and quantitative assessments, it could be reasonably inferred that *any sharp fall in the gold prices is unlikely to have destabilising effect on the Indian financial markets. Rather, any correction in gold prices may mitigate the financial stress, if any.* It may be mentioned that a fall in the gold prices is warranted in an environment when there is positive outlook in the real sector, financial, banking and equity markets and economic agents prefer investments in equities and currencies rather than gold.

Section VI Conclusions

One of the important findings of this study is that, presently, domestic gold prices and international gold prices are closely interlinked. Variations in the international gold prices find almost similar echo in the domestic gold prices.

Empirical analysis of the study also suggests that the factors affecting data generating process of the international gold prices has undergone a structural shift in 2003. In the pre-2003 period, macro fundamental such as international commodity prices, US exchange rate and equity prices used to be the most dominating factors affecting the international gold prices and their impact used to be identical both in the long-run and short-run. In the post 2003 period, however, this relationship has weakened in terms of its statistical and first and second order econometric properties.

Data generating process of international gold prices in the post 2003 period has gained complexities and exhibit non-linear characterization perhaps owing to the emergence of new economic centres such as China and India, which have a significant impact on the demand for gold. In the post 2003 period, variability in the international gold prices in the long-run horizon though continued to be affected by the international commodity prices but the same does not exhibit any influence in the short-run. During this period, short-run variability in the international gold prices is largely caused in response to the volatility in the US exchange rate and mildly by the volatility in the international equity prices. This leads to the inference that in the short-run, gold is “debasin” US dollar and equity, though investors still hold gold as a “hedge” against inflation with a long-term perspective.

⁸ The empirical results of methodology of VAR get affected on account of the ordering of the variables and, as a result, analysis of impact response function may not be highly robust. As VAR analysis is supported by the similar regression results, therefore, due to these limitations, implications of the overall analysis are unlikely to change. However, it would be appropriate to test the robustness of results by altering the ordering of the variables and resorting to the Structural VAR analysis.

Whether a deep correction in the gold prices as in 2008 has any financial instability implications to the Indian financial system depends on: (a) whether gold is in a state of bubble or not and (b) the nature and significance of gold in the overall financial architecture. Gold, unlike a financial asset, is not associated with cash inflows. This makes it somewhat difficult to judge on a historical basis whether it is in a state of bubble or not and thus to predict the nature of correction in gold prices in the immediate future. Theoretically, severity of a correction in any asset prices (including gold) on the financial system would depend upon the nature of the ownership of the asset. Specifically, if those assets are held by banks and financial institutions, (collectively financial intermediaries), either directly or indirectly through collateral, the severity of impact of a bursting of a bubble would be severe.

Viewed from this perspective, the likely financial stability implications of a correction in gold prices would be less severe on the financial system. Holding of gold among financial intermediaries is currently low though rising. It is bought mostly by the household sector as an alternative saving avenue and to meet social/cultural needs and not for speculative purposes. Even empirical analysis provides credence to the view that any deep correction in gold prices would not have any adverse implications for financial stability. In fact the empirical results of this study provide support to a contrarian view that any correction in gold prices would cause stabilising impact on the financial indicators of the Indian financial system.

It is important to note that the developments in gold market in 2011-12 are taking place against the backdrop of global and economic uncertainties caused by the downgrading of sovereign debts and the debt crisis in many of the European countries. The crisis has quickly spread to the banking sector in Europe. The scenario that would require gold to fall sharply would entail a turnaround in the global economy, subsiding of geopolitical tensions and a reversal of monetary accommodation. In that scenario, equity and other risky assets ought to recover as investors move money away from "safe haven" assets like gold and US treasuries. In other words, a sharp reversal in gold prices would in fact be reflective of improvement in global conditions, especially, those in the US. The substitution of gold for equity and other riskier assets would thus offset the systemic impact of gold prices, if any.

The measure of financial stability used in this study is based on the financial market indicators alone. There is a need to widen this definition including macro and other market indicators relevant to the financial stability in order to arrive at more robust empirical analysis. This could be a possible area for future research.

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Annex I : Description of the Variables and Technical Results

Inter-linkages between Domestic and International Gold Prices

Long-Run Equation

Dependent Variable: LMCX

Method: Least Squares

Sample: 2005:10 2011:09

Included observations: 72

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------------------|-------------|-----------------------|-------------|--------|
| C | -1.070006 | 0.073460 | -14.56589 | 0.0000 |
| LCMX | 0.995287 | 0.003846 | 258.7830 | 0.0000 |
| LINR | 0.993554 | 0.019450 | 51.08235 | 0.0000 |
| R-squared | 0.999114 | Mean dependent var | 9.479073 | |
| Adjusted R-squared | 0.999088 | S.D. dependent var | 0.349702 | |
| S.E. of regression | 0.010558 | Akaike info criterion | -6.223108 | |
| Sum squared residual | 0.007691 | Schwarz criterion | -6.128247 | |
| Log likelihood | 227.0319 | F-statistic | 38912.06 | |
| Durbin-Watson stat | 1.698508 | Prob(F-statistic) | 0.000000 | |

ECM Equation (Short-run)

Dependent Variable: DLMCX

Method: Least Squares

Sample(adjusted): 2005:11 2011:09

Included observations: 71 after adjusting endpoints

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------------------|-------------|-----------------------|-------------|--------|
| C | 0.096650 | 0.110708 | 0.873015 | 0.3858 |
| DLCMX | 0.920214 | 0.019278 | 47.73288 | 0.0000 |
| DLINR | 1.024211 | 0.045820 | 22.35281 | 0.0000 |
| RES(-1) | -0.8700 | 10.50857 | -8.344621 | 0.0000 |
| R-squared | 0.972374 | Mean dependent var | 1.847506 | |
| Adjusted R-squared | 0.971137 | S.D. dependent var | 5.190662 | |
| S.E. of regression | 0.881849 | Akaike info criterion | 2.641096 | |
| Sum squared residual | 52.10303 | Schwarz criterion | 2.768571 | |

INR : Dollar-Rupee exchange rate in spot markets

CMX: Spot price of gold in US dollars as quoted on Comex, US

RES : Residuals obtained from the long-run equation

DL stand for the difference of the log values of the variables.

Annex II: Factors Affecting International Gold Prices

Description of Variables and Technical Results

Long-run Relationship Between International Gold Prices and Stock Prices, US Dollar Rate and World Price Index

Dependent Variable: LGOLD

Method: Least Squares

Sample: 1991:1 2003:2

Included observations: 50

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------------------|-------------|-----------------------|-------------|--------|
| LSPX | -0.340181 | 0.034713 | -9.799950 | 0.0000 |
| LDXY | -0.460782 | 0.093747 | -4.915163 | 0.0000 |
| LINF | 0.272992 | 0.038384 | 7.112107 | 0.0000 |
| C | 9.030194 | 0.337520 | 26.75456 | 0.0000 |
| R-squared | 0.884289 | Mean dependent var | 5.802848 | |
| Adjusted R-squared | 0.876743 | S.D. dependent var | 0.130254 | |
| S.E. of regression | 0.045729 | Akaike info criterion | -3.255528 | |
| Sum squared residual | 0.096195 | Schwarz criterion | -3.102566 | |
| Log likelihood | 85.38820 | F-statistic | 117.1806 | |
| Durbin-Watson stat | 1.294199 | Prob(F-statistic) | 0.000000 | |

ECM Relationship between International Gold Prices and Stock Prices, US Dollar Rate and World Price Index

Method: Least Squares

Sample(adjusted): 1991:3 2003:2

Included observations: 48 after adjusting endpoints

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------------------|-------------|-----------------------|-------------|--------|
| C | -0.456525 | 0.985252 | -0.463358 | 0.6455 |
| DLSPX | -0.193126 | 0.075510 | -2.557608 | 0.0142 |
| DLDXY | -0.393909 | 0.128738 | -3.059767 | 0.0038 |
| DLINF | 0.264967 | 0.331519 | 0.799251 | 0.4286 |
| RESID91Q(-1) | -52.19892 | 14.49820 | -3.600372 | 0.0008 |
| DLGOLD(-1) | -0.191589 | 0.127665 | -1.500715 | 0.1409 |
| R-squared | 0.445223 | Mean dependent var | -0.127999 | |
| Adjusted R-squared | 0.379179 | S.D. dependent var | 5.090544 | |
| S.E. of regression | 4.010952 | Akaike info criterion | 5.732403 | |
| Sum squared residual | 675.6850 | Schwarz criterion | 5.966303 | |
| Log likelihood | -131.5777 | F-statistic | 6.741232 | |
| Durbin-Watson stat | 1.894607 | Prob (F-statistic) | 0.000108 | |

Long-run Relationship between International Gold Prices and Stock Prices, US Dollar Rate and World Price Index

Dependent Variable: LGOLD

Method: Least Squares

Sample: 2003:3 2011:2

Included observations: 32

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------------------|-------------|-----------------------|-------------|--------|
| C | -15.38456 | 2.433301 | -6.322507 | 0.0000 |
| LDXY | -0.143121 | 0.283353 | -0.505098 | 0.6174 |
| LSPX | 0.109614 | 0.091628 | 1.196291 | 0.2416 |
| LINF | 4.659678 | 0.207043 | 22.50585 | 0.0000 |
| R-squared | 0.977564 | Mean dependent var | 6.579850 | |
| Adjusted R-squared | 0.975160 | S.D. dependent var | 0.431610 | |
| S.E. of regression | 0.068025 | Akaike info criterion | -2.421421 | |
| Sum squared residual | 0.129566 | Schwarz criterion | -2.238204 | |
| Log likelihood | 42.74274 | F-statistic | 406.6626 | |
| Durbin-Watson stat | 0.818640 | Prob(F-statistic) | 0.000000 | |

ECM Relationship Between International Gold Prices and Stock Prices, US Dollar Rate and World Price Index

Dependent Variable: DLGOLD

Method: Least Squares

Sample(adjusted): 2003:4 2011:2

Included observations: 31 after adjusting endpoints

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------------------|-------------|-----------------------|-------------|--------|
| C | 2.452376 | 1.261116 | 1.944608 | 0.0627 |
| DLDXY | -0.580900 | 0.233928 | -2.483248 | 0.0198 |
| DLSPX | -0.085313 | 0.119183 | -0.715818 | 0.4805 |
| RES3Q(-1) | -40.13882 | 16.52977 | -2.428275 | 0.0224 |
| DLGOLD(-1) | 0.342887 | 0.205385 | 1.669482 | 0.1070 |
| R-squared | 0.303814 | Mean dependent var | 4.384844 | |
| Adjusted R-squared | 0.196708 | S.D. dependent var | 5.264137 | |
| S.E. of regression | 4.718065 | Akaike info criterion | 6.087364 | |
| Sum squared residual | 578.7635 | Schwarz criterion | 6.318653 | |
| Log likelihood | -89.35415 | F-statistic | 2.836581 | |
| Durbin-Watson stat | 2.196022 | Prob(F-statistic) | 0.044668 | |

DXY : US dollar index indicates the general international value of the US dollar. The US dollar index does this by averaging the exchange rates between the US dollar and the major world currencies.

INF : Data are presented in the interest rates section in the country tables and in the world tables on national and international interest rates. Prices, production, and labour cover domestic prices, production, and labour market indicators. The index series are compiled from reported versions of national indices and, for some production and labour series, from absolute data. The monthly series starts in January 1968.

GOLD : Spot gold price as per quotes on Comex commodity exchange, US.

SPX : Standard and Poor's 500 Index is a capitalization-weighted index of 500 large cap US stocks. The index is designed to measure performance of the broad domestic economy through changes in the aggregate market value of 500 stocks representing all major industries. The index was developed with a base level of 10 for the 1941- 43 base period.

RESID91Q(-1) and RES3Q(-1) : Residuals from the long-run relationship for the period 1991-2003 and **2003-2011** , respectively.

DL stand for the difference of the log values of the variables

Annex III: Gold Price Bubble and Relevance for Financial Stability

OLS Estimate: Dependent Variable: FMSI

Sample (adjusted): 2005M12 2011M10

Included observations: 71 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------------------|-------------|-----------------------|-------------|----------|
| FMSI(-1) | 0.819618 | 0.053387 | 15.35252 | 0.0000 |
| DLGOLD_IND(-1) | 1.557953 | 0.767612 | 2.029610 | 0.0464 |
| DLNIFTY(-1) | -1.835666 | 0.516004 | -3.557465 | 0.0007 |
| C | 0.050911 | 0.047039 | 1.082312 | 0.2830 |
| R-squared | 0.843018 | Mean dependent var | | 0.330482 |
| Adjusted R-squared | 0.835989 | S.D. dependent var | | 0.820546 |
| S.E. of regression | 0.332307 | Akaike info criterion | | 0.689172 |
| Sum squared residual | 7.398661 | Schwarz criterion | | 0.816647 |
| Log likelihood | -20.46562 | Hannan-Quinn criter. | | 0.739865 |
| F-statistic | 119.9338 | Durbin-Watson stat | | 1.674762 |
| Prob(F-statistic) | 0.000000 | | | |

Vector Autoregression Estimates

Sample (adjusted): 2006M01 2011M10

Included observations: 70 after adjustments

Standard errors in () & t-statistics in []

| | FMSI | DLGOLD_IND | DLNIFTY |
|----------------|--------------------------------------|--------------------------------------|--------------------------------------|
| FMSI(-1) | 1.071521 (0.15660) [6.84262] | -0.010376 (0.02436) [-0.42602] | -0.066696 (0.03959) [-1.68482] |
| FMSI(-2) | -0.194435 (0.13232) [-1.46940] | 0.018384 (0.02058) [0.89327] | 0.032851 (0.03345) [0.98208] |
| DLGOLD_IND(-1) | 1.784493 (0.80095) [2.22797] | -0.223793 (0.12458) [-1.79641] | -0.281263 (0.20248) [-1.38911] |
| DLGOLD_IND(-2) | -0.281697 (0.80815) [-0.34857] | -0.122066 (0.12570) [-0.97111] | 0.091396 (0.20430) [0.44737] |
| DLNIFTY(-1) | -1.261896 (0.62395) [-2.02244] | -0.034680 (0.09705) [-0.35735] | -0.105839 (0.15773) [-0.67101] |
| DLNIFTY(-2) | 0.904285 (0.58870) [1.53608] | 0.103310 (0.09156) [1.12827] | -0.197587 (0.14882) [-1.32768] |

| | | | |
|---|-------------------------------------|-------------------------------------|-------------------------------------|
| C | 0.019279 (0.05451) [0.35369] | 0.021135 (0.00848) [2.49281] | 0.026313 (0.01378) [1.90959] |
| R-squared | 0.851294 | 0.096386 | 0.095735 |
| Adj. R-squared | 0.837132 | 0.010328 | 0.009614 |
| Sum sq. resids | 7.004216 | 0.169446 | 0.447612 |
| S.E. equation | 0.333434 | 0.051862 | 0.084291 |
| F-statistic | 60.10918 | 1.120009 | 1.111636 |
| Log likelihood | -18.75629 | 111.5043 | 77.50566 |
| Akaike AIC | 0.735894 | -2.985836 | -2.014448 |
| Schwarz SC | 0.960744 | -2.760987 | -1.789598 |
| Mean dependent | 0.328042 | 0.018150 | 0.009002 |
| S.D. dependent | 0.826211 | 0.052132 | 0.084699 |
| Determinant resid covariance (dof adj.) | 1.35E-06 | | |
| Determinant resid covariance | 9.84E-07 | | |
| Log likelihood | 186.1296 | | |
| Akaike information criterion | -4.717990 | | |
| Schwarz criterion | -4.043441 | | |

NIFTY : Stock price index Nifty of National Stock Exchange

FMSI : Reserve Bank of India's Financial Markets Stability Indicator

GOLD_Ind : Spot gold price as per quotes on MCX commodity exchange of India

DL stands for the difference of the log values of the variables

Impact Response Function of VAR

Accumulated Response to Cholesky One S.D. Innovations ± 2 S.E.

