Lappeenranta University of Technology

Faculty of School of Business

Degree Programme in Strategic Finance

Prem Shah

Modelling Long-Run Relationship between Spot and Future Prices of Different Commodities

Examiners: Dr. Kashif Saleem

Professor Eero Pätäri

ABSTRACT

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The purpose of this study is to investigate whether there exists any kind of relationship between the spot and future prices of the different commodities or not. Commodities like cocoa, coffee, crude oil, gold, natural gas and silver are considered from January 3, 2000 to December 31, 2012. For this purpose, ADF test and KPSS test are used in testing the stationarity whereas Johansen Cointegration test is used in testing the long-run relationship. Johansen co-integration test exhibits that there at least 5 co-integrating pairs out of 6 except crude oil. Moreover, the result of Granger Causality supports the fact that if two or more than two time series tend to be co-integrated there exists either uni-directional or bi-directional relationship. However, our results reveled that although there exists the co-integration between the variable, one might not granger causes another .VAR model is also used to measure the proportion of effects. These findings will help the derivative market and arbitragers in developing the strategies to gain the maximum profit in the financial market.

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Finally, I would like to dedicate this thesis to my friend Late Mr. Nanda Kishor Shrestha. I wish he was here with me at this happiest moment of my life.

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LIST OF ABBREVIATIONS & SYMBOLS

AR	-	Autoregressive Process
ADF	-	Augmented Dickey-Fuller
KPSS	-	Kwiatkowski-Phillips-Schmidt-Shin
VAR	-	Vector Autoregressive
COS	-	Cocoa Spot Price
COF	-	Cocoa Future Price
CFS	-	Coffee Spot Price
CFF	-	Coffee Future
CROS	-	Crude Oil Spot Price
CROF	-	Crude Oil Future Price
GOS	-	Gold Spot Price
GOF	-	Gold Future Price
NGS	-	Natural Gas Spot Price
NGF	-	Natural Gas Future Price
SS	-	Silver Spot Price
SF	-	Silver Future Price
SP	-	Spot Price
FP	-	Future Price
D	-	First Differences

1. INTRODUCTION

The existence of market stability, market efficiency and price discovery related with the future and spot markets have been the topic to discuss since the beginning of future markets more than 100 years ago. Number of research papers have been published and examined the relationship between spot and future prices of different commodities and have come up with the different empirical results. To a large extent, recent papers on the relationship between spot and future prices have followed the two-step procedure i.e. the price series being non-stationary. In the initial phase, it is tested whether the data series are cointegrated or not so as to test the existence of long-run relationship between the spot and futures prices. If the initial step is successful (if there exists the long run relationship between spot and future prices) then lead lag (causality) can be tested to examine the discovery role of future prices. In contrast, if there exists no long-run relationship between these two prices then the investigation comes to an end since the two time series are generated independent (Quan J., 1992).

The future market has the high tendency of forecasting abilities which has created the huge buzz from the academic perspective in the last three decades. There are large number of studies which have explained and investigated on the lead-lag relationship between spot and future prices. However, Garbade & Silber (1983) were the first to look after the relationship between the spot and future prices and price discovery mechanism.

The advanced form of global liberalization and market integration in the financial markets has opened up with different new investment opportunities in regard with the increased risks which in turn requires the new instrument that can tackle these risks. The most prominent and wanted instrument that facilitate the financial markets to come up with these risks in the modern securities trading are known as derivatives. The main reason behind the use of derivative is that it helps in the reduction of risks by providing an additional way to invest with lesser trading cost and it facilitates the investors to extend their settlement through the future contracts (Seghal, Rajput & Dua, 2012).

The time-based relationship among stock and future markets have been and incessant to be of passionate interest to regulators, practioners, financial analyst and researchers. The root cause for examining this relationship is that in perfect ideally and efficiently organized future and stock markets, informed investors are indifferent among trading in either market as the new information disseminates in both markets at the same time. That means that changes in the logarithm of futures and stock price (future and spot returns) would be estimated to be perfectly contemporaneous correlated and non-cross-auto correlated (Stoll & Whaley, 1990).

In today's time, the importance of futures trading has been the topic to discuss since the impact of trading futures on the volatility of spot market is widely debated. Spot market can be over killed by the future market; this opinion is quite common in the financial market. Similarly, spot price tend to employ major influence on future prices for contracts with less than one year to maturity but future prices influence spot prices for contracts with less than one year to maturity (Ahma, Z & Shah, 2010).

The future market has provided with an opportunity to minimize the price risk to suppliers and producers of various commodities. Most importantly, future market facilitates market participants to hedge the risk of price volatility. Besides these, future market trading provides with a way to establish a form of price knowledge leading to continuous price discovery unlike the spot market. Future prices not only reflect the current cash prices but also the expectations of future prices and general economic factors. Similarly, in the contracts less than one year the spot price exert the significant influence on the future price whereas future price influence spot price with the contract more than a year. In comparison to the weekly and monthly market price there are no arbitrage opportunities for the daily market prices (Yohannes, 2011).

If the market is efficient, other things remaining the same then the changes in the spot price of a financial asset and its corresponding changes in the future price would be expected to be perfectly contemporaneously correlated and not to be cross-auto correlated (Brooks, C. 2008).

In other words, changes in the spot prices and future prices respectively are expected to occur at the same time if:

a. The existing change in the futures price is expected not to be related to preceding changes in the spot price and vice-versa.
b. The changes in the log of the spot and future prices are known as the spot and futures return.

Most of the past researches on the spot and future commodities respectively focused mainly on the agricultural products Koontz, Garcia, & Hudson (1990), Oellermann, Brorsen & Farris (1989), Schroeder & Goodwin (1991) and oil products Schwarz & Szamary (1994); Foster (1996), Silvapulle & Moosa (1999), Moosa, I (2002).

Large number of theoretical models have been developed explaining why we should anticipate a relationship between the spot and future prices. The specific relationship between these two prices depend on the nature of the commodity (i.e. storable and non-storable), seasonal factors, market expectations, its relative importance in the world economy and the random realization of the news in the market. In order to be linked, both the spot and future prices should have the existence of the spot-future parity. Spot-future parity explains that constant arbitrage opportunities based on the spot-futures relationship aren’t possible (Maslyuk & Smith, 2009).

Looking at the global market, today more than hundreds of the commodities are traded out of which 50 are actively traded. Commodities include metals, bullion, energy products and agricultural products. Bullion which involves gold, silver and platinum embraces around 42%, agricultural products with 23% are traded of the total trade value (Jackline & Deo, 2001).

1.1 Purpose and Motivation of the Study

The main reason behind carrying out this research is to test whether there exists the long run relationship among the spot and future prices of the different commodities or not, find out to what extent both the spot and future price granger cause each other, which way (direction) the relationship among the variables flow and the proportion of effects among the variables. Although many researches have been carried out concerning this issue but very few researches have taken into account the more number of commodities and they have considered the variables from the same category. Most of the researches have focused mainly on either two or three variables from the same category to find out the problems and solution to this issue. This is from where I got the motivation and discuss more considering as more commodities as possible to address this issue and come up with some innovative results. In this paper, I have taken different variables from the energy, agriculture and precious metals categories.

1.2 Structure of the Study

The present study discusses about the long run relationship between the spot and future prices of different commodities. Review the previous literatures on subject matter. In the third part the hypotheses for the paper is listed whereas in the section four the data is presented. Section five deals with the methodologies applied to carry out our empirical analysis. Section six explains about the empirical results followed by the conclusions, practical implications, references and appendices respectively.

2. LITERATURE REVIEW

Large numbers of papers have examined the relationship between the spot and future prices of various commodities as well as financial assets (Khan 2006, Asche & Guttormen 2002). Till the date, these papers have provided with the mixed empirical evidences despite majority of the studies have exhibited that future markets have a price discovery role. The issue of the lead-lag relationship in the volatility and returns in developed currency, equity and commodities has been the focus point and has been researched since long time. Very few researches have taken into account the commodities from different categories. In this paper, commodities from energy, precious metals and agriculture are considered so as to test how the spot price reacts when the future prices changes and vice-versa.

John M. Keynes in his Treaties on Money (1930) explained that the future market is an insurance scheme where the speculators bear the risk and are awarded with the risk premium at the end. Similarly, hedgers who think of assuring a certain price for their goods pay this premium to the speculators. This process is termed as the “normal backwardation” stating that the future prices are the unbiased estimators of spot prices of different commodities.

It’s believed that there exists the long-run relationship between spot and future prices rather than a short-run which can be verified by inspecting whether the spot and future prices are cointegrated. There exist the immense literatures highlighting the long-run relationship between spot and future prices of commodities among others, (Martin & Garcia 1981, Hokkio & Rush, 1989, Wahab & Lashgari 1993, Giot 2003, Garcia & Leuthold, 2004, Hernandez & Torero, 2010) but there are very few research papers that examine the time dynamic of such relationship meaning the continuation of a possible structural break in the cointegration vector (Dawson; Sanjuan & White 2010, Maslyuk & Symth 2009).

Market consists of different new information and news about the prices of the commodities which is termed as the price discovery function. The study of the causal connection between the spot and future prices is functional to the analysis of the “price discovery” role of spot and future markets, defined as the lead-lag relationship between spot and future markets (Schroeder & Goodwin 1991, Yang, Bessler & Leatham 2001, Brooks; Rew & Ritson, 2001). Yang et al (2001) finalized that future market play an essential role in the price discovery process for the storable commodities. In fact, the importance of price discovery highly depends on the relationship between the spot and future prices. The causal relation investigates whether the spot prices lead the future prices or future prices lead spot prices or there exist the bi-directional relationship between them.

Due to the market inefficiency some economists failed to detect the superior forecast power of the future prices (Leuthold, 1974, Martin and Garcia 1981). However, there are other two explanations which state that there may be nothing for the future markets to forecast meaning if the current price equals the true expectation of the future spot price then the future market can’t provide a better forecast. Similarly, the second one explains about the future market forecasting which may be unnoticed by the unpredicted factor of the realized spot price is unobservable; one must approximate this expectation with the actual future spot price.

Regarding the relationship between the spot and future prices of commodity there exist the two main views (Fama & French, 1987). The first theory deals with the cost and convenience of holding inventories and the second with the risk premium to derive a model for explaining the relationship between the long-term and short-term prices. Inventory is one of the important factors in the price formation for the storable commodities in the market (Pindyck, 2001) which explains the difference between spot and future prices in terms of interest foregone in storing the commodity, a convenience yield on inventory and warehousing costs. Thus, in order to meet the unexpected demand the convenience yield is considered as the liquidity premium and denotes the freedom of holding a unit of inventory. Pindyck (2001) has derived the following formula to explain the future prices assuming the absence of possibilities for arbitrage between the spot and future market.

$$F_{t,T}=S_t e^{rt} + \psi_T - K_T \qquad (1)$$

$F_{t,T}$ = future price at time t for the delivery at time t+T

St= spot price of the commodity at time t

rT= risk-free interest rate for the period T

ψ_T= convenience yield

K_T= cost of physical storage over the holding cost

Similarly, the second theory explains about the price of a future contract on the basis of the expected future spot price ($E_t(S_{t+T})$) and a corresponding risk premium , PT= - (r_T-i_T), for the commodity.

Ft, T = (E_T (S_{t+T})) e (r_T-i_T)

= (E_T (S_{t+T}) e-p_T

i_T= discount rate

r_T= risk free interest rate

Chinn et al (2005) had studied the relationship between spot price and future prices for energy commodities (crude oil, heating oil, natural gas and gasoline) whose main idea was to examine whether future prices were the perfect predictors and unbiased estimator of spot prices or not at different periods of time. This study came up with the conclusion that the future prices for the gasoline, heating oil and crude oil were the predictor of spot price but not in the context of natural gas. Future prices only explain about the small proportion of the variation in underlying commodity price movements. Similarly, study conducted by Silvapulle & Moosa (1999) examined the relationship between the WTI crude oil spot and future prices using the daily data where they found out that linear causality test exhibited future prices leading spot prices but non-linearity exposed the bi-directional relationship. These kinds of results suggest us that as per the change in the information in the market the relationship between the spot and future prices simultaneously react.

Similarly, Fortenbery and Zapata (1993) carried out the study on the long term relationship between the agricultural commodities taking the spot and future prices of corn and soybean using the cointegration technique. In this research, they have used the future contracts and two cash markets for each commodity from the Chicago board of Trade (CBOT) for the time period 1980-1991 using the daily data. Their result exhibited that markets are inefficient and transport rates and carrying charges were at the stationary phase. They recommended that bivariate cointegration models are not so much powerful enough in recognizing the different kinds of market relationship in commodity markets as they are in exchange markets. Moreover, Zapata and Fortenbery (1996) analyzed the price discovery process by introducing the interest rates as an argument in the cointegration model. They concluded that interest rate was emerged as one of the important factor in explaining the price discovery relation between the spot and future prices of storable commodities.

Bekiros et al (2008) investigated the linear and non-linear causal relationship between the daily spot and future prices for the maturities period of one, two , three and four months of WTI crude oil for the time period October 1991-October 1999 and November 1999- October 2007 using the econometric techniques like VECM and GARCH-BEKK models. They concluded there was the presence of causality between the spot and future prices in both the periods and not only the future prices but also the spot prices play an important role in the price discovery process.

Since, there exist some kind of causal relationship between the spot and future prices but it is essential to correctly understand the actual and true meaning of it. Sometimes the idea about the price discovery is randomly and inappropriately used in the evaluation of the hypothesis about the role of speculation in commodities price increase or decrease. For instance, if there is any kind of price changes that occur first in the future market then the speculation may be an important determinant. In contrast, if changes firstly appear in the spot market then they are the results of the changes in market fundamentals which affect the demand-supply balance for the commodity (Kaufmann & Ullman, 2009).

Literatures for each and every commodity have been also described individually so as to have the easy access in the upcoming sections.

Crude oil

There is large number of studies that explains whether the spot and future prices for oil are connected to each other or not in a long-run relationship. From the theoretical perspective, both spot and future prices expose the same cumulative value of an underlying asset and considering that instantaneous arbitrage are possible; future should neither lag nor lead the spot price. However, the empirical evidence is different from this notion, most of the studies indicate that future influence spot prices but not vice versa. With reference to the oil market, in comparison to spot price, future price reacts more quickly if there is new information in the market because of lower transaction cost and flexibility of short selling. Since, spot purchases require more initial outlay and longer time to implement in comparison to future prices, both speculators and hedgers interested in the physical commodity responds to the new information preferring the futures rather than spot transactions.

Spot transactions can't be implemented so quickly since the spot prices reacts with a lag (Silvapulle & Moosa, 1999).

Garbade & Silber (1983) supports the hypothesis that future prices lead spot prices through the price discovery mechanism theory. Their study of seven commodity market exhibited that future prices lead to the spot prices but not vice-versa. Similarly, future trading helps in the allocation of consumption over time and production by providing the market scheme in inventory holdings (Houthakker; Newman; Milgate & Eatwell, 1992). Future markets provide with the opportunities for market manipulation by providing the better information and in the expense of other market participants. For instance the OPEC can make the huge profits by dominating the future market to impact the production decisions of its competitors in the spot markets (Newberry; Newman; Milgate & Eatwell, 1992).

Quan, J (1992) inspected the price discovery function in the field of the crude oil market and came up with the conclusion that the future prices doesn't play so much essential role in the price discovery process. However, Schwarz & Szakmary, (1994) argued with the Quan's conclusion stating that why future markets continue to influence if they don't have such impact on one of the essential "tenants for their existence" based on the price discovery function. Their research concluded that crude oil future markets tend to dominate the spot markets in the price discovery.

Some of the earlier studies found the evidence that the future prices were precise out-of-sample forecasters of the future spot price of oil. Future price outperform no-change as well as other simple time-series model's forecast in out-of-sample estimating exercise Ma, (1989). Similarly, Kumar (1992) came up with the same conclusion that future prices facilitates with more accurate estimates than of other obtained from alternative time-series models along with the random-walk model. Chinn; M & Coibion (2005) came up with the conclusion that future prices of oil is the unbiased estimator of the spot price and they accomplish better than the random-walk forecast on the basis of the mean-squared prediction error. However, when Coibion & M (2009) updated their results from their earlier paper they discovered that future prices don't methodically outperform the random-walk forecast despite they are superior to estimate generated by other types of time-series models.

In contrast, there are also other empirical evidences that explain the spot prices lead future prices. Studies by Moosa; McAleer; Miller & Leong (1996) explain that the spot price change generates action from all kinds of market participants which ultimately changes the future prices. In one hand, arbitrageurs react to the violation of the cost-of-carry condition and in another hand speculator look over their anticipation of the spot price and then retort to the disparity between the expected spot and future prices. Likewise, in the expectation of the future prices speculators responds to the disparity between the current and expected future prices. Besides these, some of the studies highlight the relationship between the spot and future prices to be bi-directional. Kawaller; Koch & Koch (1998) highlighted on the principles that both the spot and future prices are affected by the current market information and their past history. As per the new market information the potential lead-lag patterns drastically change which may cause the phenomenon of one price causing another. However, the hypothesis explaining future prices lead spot prices is very strong from the empirical evidence perspective.

In the case of energy markets, the long-run relationship between the spot and future oil prices has been proven. Some of the studies follow the conventional linear cointegration as methods of Engle and Granger (1987) and Johansen (1998) to examine the long-run equilibrium between the spot and future oil prices (For example, Quan, 1992, Schwartz and Szakmary, 1994, Silvapulle and Moosa 1999, McAleer and Sequeira 2004.). Similarly, some of the recent research papers have examined the lead-lag relationship between the spot and future prices of oil where they have compared the difference between the results of the non-linear and linear methods. For example Silvapulle & Moosa, (1999) exhibited that linear causality testing shows that future prices lead spot prices. However non-linear causality testing shows a bi-directional relationship. The pair-wise vector error-correction models (VECM) put forward a strong bi-directional Granger causality between spot and future oil prices however, under the non-linear methods a uni-directional causality is shown under some restricted conditions Bekiros & Diks (2008).

Thus, from the above discussions it can be concluded that some justification and empirical evidence for the hypothesis that future prices lead spot price and vice-versa. However, the first hypothesis carries stronger weight than of first one. Thus, furthermore empirical testing is required to solve this issue based on the crude oil market.

Natural Gas

In today's economy the role of natural gas, one of the most actively traded commodities with relatively high levels of volatility and liquidity is vital which is supposed to continue in the coming days. It's essential enough to study how the natural gas functions, its efficiency and the ways of using it efficiently. Moreover, in the recent time the market for the natural gas has become more volatile and complex resulting in the difficulties to predict the future prices for the market participants exposing to price risk. Thus, to minimize this risk a new market for natural gas i.e. financial gas market was developed.

As stated earlier, the future market for the natural gas started in the 1990 is still trending high since then. During the period of high volatility and liquidity the market participants actively engage themselves in the hedging so as to gain the maximum profit. However, there are only few researches and empirical evidences regarding the examination of Granger causality test that explain the relationship between the spot and future prices thoroughly. Looking at the numerous literatures, most of the studies concluded that the future markets has the strong influencing behavior than of the spot market meaning the future prices are the efficient estimators of spot prices. In one of the earliest studies conducted by Gebre-Mariam, (2011) emphasizing on the Northwest US natural gas markets covering the time period 1999-2004, tested on the spot and future prices where they found that spot prices Granger-causes the future prices with the maturity period less than one year.

Quan (1992) was the first one to test and explain about the lead-lag relationship between the spot and future prices series combining the cointegration and causality test which exhibited that only spot price causes the future prices.

Reviewing at the number of researches and empirical evidences the relationship between the natural gas spot and future prices is mixed stating which direction it goes. Thus, furthermore researches are required considering the non-linear characteristics of the market structure since the previous studies have not considered this issue.

Gold

Viewing the earlier literatures, it is quite surprising to see that very few research has been carried out on information transmission to the gold market although it hugely impacts the overall economic scenario of the whole world.

Gold is categorized as one of the most precious metal which is also classed as a monetary asset and a commodity. Since the centuries it has been acting as a multifaceted metal consisting the similar features as the money; acts as a store of wealth, a unit of value and medium of exchange (Goodman 1956, Solt & Swanson 1981).

Blose, (2009) came up with the surprising result that Consumer Price Index (CPI) doesn't affect the gold spot price. Furthermore, gold price doesn't determine market inflation expectations. In contrast to Blose, (2009) David;

Chaudary & Koch, (2000) found out that gold price strongly reacts to the release of CPI, gross domestic product and unemployment rates. Since, the world gold market is dominated by the U.S. dollar bloc, thus depreciations and appreciations of the dollar highly impact on the prices of the gold in other currencies that are used in trading Sjaastad (2008).

Cocoa

Most of the researches on the long-run relationship between the spot and future prices for the commodities have been carried out on the agricultural products focusing on the major commodities like wheat, corn, rice and soybeans. Hernandez & Torero (2010) carried out their research on the spot and future prices for corn, soybean and wheat came up with the evidence that future prices Granger-cause spot prices for corn and wheat but not reverse. Similarly, they found out the causal relationship which was extraordinarily stronger than in the past offering the result to an increment importance of electronic trading of future contracts resulting in the more transparent and widely accessible prices. However, other studies have different idea suggesting that the spot prices lead future prices (Quan, J 1992, Kuiper, Pennings & Meulenberg 2002, Mohan & Love 2004).

For the agricultural products like cocoa there are very few researches that have been carried out. Thus, it would be great to know through this paper what kinds of relationships do they have in the long run. Are the relationship between the spot and future prices for cocoa is the same as for the other agricultural commodities or is it different than that?

Coffee

The coffee market is an interesting commodity market for various reasons and one of them is that the market is successfully regulated by the International coffee Agreement (ICA) with the aim of keeping the price of the coffee above some minimum price level so that the coffee producers could be benefited from different sorts of price risks problems.

In the context of developing market, after petroleum coffee is the world's second largest biggest trading commodity with 80% of total output exported to other parts of the world. Coffee is produced by the small producers in the developing countries which have the high price risk because of its volatility and their inability to diversify the risk exposure or hedge (Oxgam, 2001).

Very few studies have focused on the importance of the future market as an option to stabilize export earning in spite of the problem caused due to the instability of export revenue on the economy of the Least Developed Countries (LDCs). There is a lack of evidence in justifying actually on which way the direction of causality runs; from spot price to future price or vice-versa (Bigman et al., 1983).

Likewise, studies by Rajaraman (1983) and Kofi (1973) came up with the evidence that the future market for coffee is efficient in providing a good forecast of future spot prices. However, these studies are unable to highlight on the evidence on the risk neutrality and efficiency in the coffee future markets

For the short-term contract, coffee future prices can be used as the indicator of spot market prices. There might be the consequences of having the misallocation of resources and welfare loss through the short-term adjustment of available stock and by the use of storage facilities, planning-longer-term input and marketing decisions on the basis of future-market price (Kebede, 1993).

Mohan and Love (2004) came up with the evidence that the coffee future market isn't efficient to predict the subsequent spot prices: the contention that coffee future market is agency for rational price formation or expectation can't be accepted. On the basis of the coffee future forecast, it is difficult to predict that coffee producers could reduce their price risk exposure.

From the perspective of macroeconomic level, accurate information related to the future coffee prices can help policymakers to measure the impact of such price fluctuations on the economy.

Silver

As gold, silver is also one of the most significant and widespread investments in the precious metals investment market which are widely and actively traded in the commodity trading centers. Looking back at the history it is clearly shown that silver had been in used as the form of payment for thousand years before the silver standard has ended less than 100 years ago.

Since, gold is used as the primary commodities in the commodity trading center, there are very few researches that have focused on the long-run relationship between the silver spot and future prices individually. Most of the researches have linked it with the other precious metals especially gold and explained the relationship. Thus, it would be interesting to know what kind of long-run relationship does the silver spot and future prices have with each other.

3. HYPOTHESES

Reviewing the previous researches and on the basis of the objective of the study we have developed three hypotheses. It's believed that there exist the relationship between the spot and future prices of the commodities on the long-run. Moreover, the causal relation among the spot and future prices of the variables help us in investigating whether there exist the uni-directional or bi-directional relationship. Garbade & Silber (1983) supports the hypothesis that future prices lead the spot price in the market through the price discovery mechanism theory but not the vice-versa. Ahmad et al. (2010) in their research paper concluded that there exists no long-term relationship among the variables when the Johansen co-integration test was applied. Similarly, on the basis of VAR model we tend to test our third hypothesis that whether changes in the price of one variable tends to change another variable or not in the presence of the error terms. Three hypotheses for our study are listed below:

i) There exists the long-run relationship between the spot prices and future prices of the commodities.
ii) Spot price granger causes the future price and vice-versa.
iii) Changes in the price of one variable affect the price of another variable.

4. DATA

The data used in this thesis comprises of both qualitative and quantitative which are collected from the reliable and recognized data providers, articles, research paper published on different financial and economic databases. Data are collected from the DataStream from the stock exchanges like New York Mercantile Exchange and ICE Futures U.S. The dataset consists the spot and future prices of 9 variables (crude oil, gold, cocoa, silver, natural gas, copper, soybeans, coffee and Eurodollar) from January 22, 1988 to January 23, 2013 on the daily basis; 5 days per week. Due to the large number of observations and missing values at the end only 6 variables (cocoa, coffee, crude oil, gold, natural gas and silver) were considered. Similarly, the data was then limited to 2012 from 2000. Altogether 3391 observations are considered. The data used in this paper is of time-series nature, thus there are the presence of non-stationary which give rises to the problem of exaggerated results and spurious regression if are regressed (Granger & Newbold, 1974). Thus, it is important to test for the stationarity before the regression analysis is done.

5. EMPIRICAL METHODOLOGY

5.1 Graphical Analysis

Before carrying out the formal tests of stationarity, line graphs of both spot and future prices of all the commodities are plotted so as to see the nature of time series since time series data usually have a trend which has to be eliminated before undertaking any kind of estimation and this is done so by taking the first difference of each series (Hendry & Juselius, 1999).

5.2 Tests for Stationarity

As for other economic time series data the spot and future prices of the commodities (cocoa, crude oil, coffee, gold, natural gas and silver) are believed to demonstrate the non-stationarity. It is necessary to test for this kind of characteristics of prices before we perform any kind of tests because it is believed that most conventional statistical tests assume that time dependent variables exhibit stationary behavior. Thus, it is important to implement modeling and testing procedures for unit roots to discover the nature of movements or the long-run relationship between the spot and future prices. It is widely recognized that most of the economic time series data exhibits a monotonically rising trend meaning the error terms underlying the distribution of these series may not be stationary. Thus, in the statistical analysis if these kinds of non-stationary data are not eliminated then we get the “spurious “regression. It is important to test for this kind of data before we perform the cointegration and causality test since the asymptotic distributions of causality tests are sensitive to the presence of unit roots and trends. Furthermore, this study has revealed that the both spot and future prices of the commodities are stationary at first difference.

For instance, let us take an autoregressive process of order 1 (AR (1)):

$$Y_t = \mu + \varphi y_{t-1} + \mu \qquad (2)$$

Where μt is a white noise disturbance term which is assumed to be independently and identically distributed with zero mean and equal variance and $\varphi > 1$. If $-1 < \varphi < 1$, the process is said to be stationary. If $\varphi=1$, the equation represents a process that is a random walk with a drift. This process characterizes most economic time series data. Therefore, the appropriate statistical test for random walk process is $\varphi=1$. This constitutes a test for unit-root and determines whether the series is non-stationary or not.

The study will employ the Augmented Dickey-Fuller test in order to check whether the price series of the different commodities demonstrate stationary or not. Besides the Augmented Dickey–Fuller test, Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test has been also used so as to be sure enough whether we tend to achieve the same conclusion as of ADF test or not. Standard unit root tests were carried out for each time series variable, first on the level and then first differences. KPSS test results strongly reject I (0) null at 95% confidence level. In the meantime, KPSS statistics support this conclusion by failing to reject the null hypothesis at the usual confidence level. After taking the first difference, the ADF statistics reject the unit root null in support of stationarity. Thus, these unit root tests conclude with the idea that all the variables are non-stationary in level but stationary in first difference.

5.3 Tests for Cointegration

Engle and Granger (1987) stated that if a linear combination of two or more than two non-stationary series can become stationary, then the stationary linear combination is termed as cointegration equation and may be inferred as a long-run equilibrium relationship among the variables. Similarly, according to the notion forwarded by Engle and Granger 1987, despite the time-series variables are non-stationary there may still exist a linear combination among the variables such that their stochastic trends can be cancelled out. Following equation is used to check the staionarity of the term μt in the following regression.

$$\text{InSPt} = \alpha + \beta \text{InFPt} + \mu t \qquad (3)$$

Here, α is a constant term that helps in capturing the differences in the levels of the prices whereas β explains the relationship between these prices. If β=0, then there is no any existence of the relationship between the prices whereas if β=1, then the spreads are constant and two are the perfect substitutes. Moreover, β≠0 and β≠1 then there exists the relationship between the prices. However, the relative price isn't constant.

5.4 Pair-wise Granger Causality Tests

The granger causality (linear) test exhibits whether the past values of the first variable explains the present value of the second variable based on the past values of the second variable. Similarly, it explains whether the past values of the first variable consists any additional information on the current value of the second variable which is not included in the past values of the latter. (Hernandez & Torero, Examining the dynamic relationship between spot and future prices of agricultural commodities. , 2010). Moreover, causality tests helps in examining whether the spot price leads in the changes of future price or vice-versa or both. In this paper, we examine whether the future price Granger-causes spot price or spot price Granger-causes future price or both. The order of integration of both spot and future prices for the commodities were examined using the Augmented Dickey-Fuller (ADF) unit root test after the first difference. The dynamic relation between the spot and future prices is given by the pair-wise Granger Causality tests (Granger C, 1986). Following equations helps in testing the causality between the two stationary series X_t and Y_t.

$$X_t = \alpha_0 + \sum^{k}_{j=1} y_j x_{t-j} + \sum^{k}_{j=1} \beta_j y_{t-j} + \mu_{xt} \qquad (4)$$

$$\mathbf{y_t = \alpha_0 + \sum^{k}_{j=1} \; y_j\, x_{t-j} + \sum^{k}_{j=1} \; \beta_j y_{t-j} + \mu_{yt}} \qquad \mathbf{(5)}$$

Here k is the suitably chosen integer, y_j and B_j, j=0, 1….k parameters, α is a constant whereas U_t is an error term with zero means and finite variance. The null hypothesis that Y_t doesn't granger cause X_t is not accepted if βj s, j>0 as in equation 1, are jointly different from zero using a standard test. Similarly, X_t Granger causes Y_t, if y_j are j>0, coefficients in equation 2 are jointly different form zero.

Alpha (α) =0.05

Decision rule= reject Ho if P-value < 0.05

Looking at the F-statistic value and probability value, the conclusion can be drawn that there were uni-directional, bi-directional and no causality relations between the selected spot and future prices of the commodities. It was found that the spot price series causes future prices and vice-versa as well as no granger-cause causality between the selected spot and future prices.

5.5 Vector Autoregressive Model (VAR)

A VAR is a system regression model that can be considered as the hybrid between the simultaneous equation model and univariate time series model. It helps in capturing the evolution and interdependencies between the multiple time series. Since, univariate and bivarite models can't measure the co-movements VARs performs this work involving the current and lagged values of the multiple time series. Besides these, VAR model is used in the data description and forecasting along with the policy analysis. For the VAR model, it is not necessary to hold up the exogeneity since, it treats all the variables initially as the endogenous one and the VAR models are inertial as each of the dependent variable in the system is the function of lags of all the variables. It's not compulsory for the estimated coefficients to be negative, positive or even statistically significant in the VAR model. The main idea is to figure out all the interactions in a statistically clear sense (Dan H). Variables in the model have some kind of complex interactions and feedback with each other which makes the interpretations more complex. Thus, impulse response functions and variance decomposition are used in overcoming these problems. In addition to these, causal impacts of unexpected shocks on the variables are usually described with the impulse response functions and forecast error variance decompositions. Impulse responses explain the responsiveness of the dependent variable to the shocks to each of the variable whereas variance decomposition measures proportion of the movements in the dependent variables which are caused due to its own shocks versus shocks to other variables.

The vector autoregression model can be expressed as:

$$\mathbf{Y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \ldots. + A_p y_{t-p} + e_t} \qquad \textbf{(6)}$$

- k variables over sample period (t=1,… ,T)
- Y_t is a k x 1vector
- C is a k x 1 vector of constants
- A_i is a k x k matrix (here for every i=1, …., p)
- e_t is an error term

Vector autoregressions are used in macroeconomic in forecasting, describing and organizing data.

6. EMPIRICAL RESULTS

6.1 Descriptive Analysis

6.1.1Presentations of the variables

Most of the research papers have included either the agricultural commodities or energy products so as to answer the questions related to the relationship between spot and future prices. However, in this paper variables from different fields are included which are shown in the following table.

Table 1. The presentation of variables

Agriculture	Energy	Precious Metals
➢ Cocoa ➢ Coffee	➢ Natural Gas ➢ Crude Oil	➢ Gold ➢ Silver

6.1.2 Descriptive Statistics

Data transformation is a method used in statistics for modifying the variables either to correct violations of the statistical assumptions or improve the relationship between the variables (Hair;Anderson;Tatham;& Black, 1988). In order to achieve the normality, homoscedasticity and linearity of the variables data transformations is done. The objective of the data transformation is to test the variables and find out whether the desired remedy is achieved or not. Logarithms transformations have been used in the paper where the log of the original price of the commodity is taken in account.

Table 2 shows the descriptive statistics of both the spot and future prices of all the commodities after the log transformation. As shown in the table, mean returns for the cocoa spot, cocoa future, coffee spot, coffee future, crude oil spot, crude oil future, gold spot, gold future, natural gas spot, natural gas future, silver spot and silver future are 7.534804, 7.501740, -0.017346, 0.066006, 3.967145, 3.977713, 6.419240, 6.429468, 4.985174, 7.742489, 2.340105 and 2.340287 respectively. Comparatively, median were found to be bigger than that of mean.

Natural gas spot price (9.622781) and future price (9.643875) respectively have the maximum return in comparison to others. On the other hand, the minimum limit of returns for the spot and future prices of the commodities were 6.654449, 6.570883, -1.049822, -0.755023, 2.813611, 2.881443, 5.545177, 5.544396, 0.593327, 0.732368, 1.401183 and 1.393766 respectively for the cocoa spot, cocoa future, coffee spot, coffee future, crude oil spot, crude oil future, gold spot, gold future, natural gas spot, natural gas future, silver spot and silver future.

Skewness and kurtosis determines whether the distributions are normal or not for both the spot and future prices. As shown in the table, the skewness of both the spot and future prices of all the commodities are either greater than zero or less than zero despite taking the logarithms of the related prices. However, after the log transformation the data are more close to normal than of the original one. Cocoa spot price (-0.312873), cocoa future price (-0.381785), crude oil future price (-0.224572), crude oil spot price (-0.106324) and natural gas future price (-2.281526) are negatively skewed meaning the distribution has a long left tail inspite of the small skewness statistics. Moreover, the negative skewness demonstrates that the return distribution of the commodities have the higher probability of having negative returns whereas coffee future price (0.269092), gold spot price (0.232550), gold future price (0.213155), silver spot price (0.330559) and silver future price (0.329450) are positively skewed stating that the skewness is close enough from the symmetrical.

Similarly, when we look at the kurtosis of the spot and future prices we find that the values are either greater than 3 or less than 3 concluding that the distribution are leptokurtic (sharper than a normal distribution with values concentrated around the mean and thicker tails; this means high probability for extreme values) and platykurtic (flatter than a normal distribution with a wider peak) respectively. Among all the commodities prices, coffee future price (2.629206) seems to be close to 3 with the mesokurtic distribution feature meaning normal distribution. However, the spot and future prices of other commodities are with the leptokurtic and platykurtic characteristics.

Following table shows the descriptive statistics of spot and future prices for all the commodities. It includes the mean, maximum value, median, standard deviation, minimum value, kurtosis, skewness and Jarque-Bera respectively.

Table 2. Descriptive statistics

Prices	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
Lcocoa_spot	7.534804	7.533405	8.2242	6.6544	0.383943	-0.312873	2.325972	119.5146
Lcocoa_fut	7.50174	7.493317	8.225	6.5709	0.391009	-0.381785	2.393701	134.3174
Lcoffee_spot	-0.017346	0.04879	1.0886	-1.05	0.500918	-0.031383	2.330109	63.9618
Lcoffee_fut	0.066006	0.122218	1.1378	-0.755	0.430127	0.269092	2.629206	55.70499
Lcrude_oil_spot	3.967145	4.065259	4.9703	2.8136	0.56275	-0.106324	1.693621	247.521
Lcrude_oil_fut	3.977713	4.107096	4.9826	2.8814	0.512155	-0.224572	1.733778	255.0382
Lgold_spot	6.41924	6.412311	7.5487	5.5452	0.623152	0.23255	1.69663	270.5865
Lgold_fut	6.429468	6.428913	7.5438	5.5444	0.621115	0.213155	1.696432	262.4819
Lnat_gas_spot	4.985174	2.571084	9.6228	0.5933	3.479679	0.028441	1.059291	532.6111
Lnat_gas_fut	7.742489	8.452548	9.6439	0.7324	2.251201	-2.281526	6.518965	4691.527
Lsilver_spot	2.340105	2.373975	3.8857	1.4012	0.703372	0.330559	1.856187	246.6082
Lsilver_fut	2.340287	2.372111	3.8832	1.3938	0.703307	0.32949	1.857737	245.709

6.2 Graphical Analysis (Line Graphs)

Cocoa

As shown in the figure 1 and 3, the spot price and future prices respectively of cocoa seems to be fluctuating at different periods of time indicating to be non-stationary but after the first differencing series revolve around the constant mean exhibiting the series to be stationary. There is a sharp rise of prices in the year 2002 and a downfall in the beginning of the year 2008 in both the cases (spot and future prices). Both the spot and future prices follow the similar pattern.

Coffee

One of the key characteristics of world coffee market is that there is a substantial short-term fluctuations in prices. As of cocoa, both the spot and future prices are stationary after the first differencing which have the slight downfall in prices at the mid of year 2001 whereas there is a huge rise in prices in the beginning of the year 2010. Since, there is an increment in the liquidity and trading volume of the coffee market over the time there is an improvement in the price-forecasting performances of futures over time in comparison to previous years of studies.

Crude oil

Crude oil, one of the highly traded commodities in the trading commodity market has quite different pattern of rise and fall of prices. Both the prices keeps on rising from the year 2001 to 2008 which might be the consequences of 9/11/2001 (New York World Trade Centre attack) and Iraq war and from the beginning of year 2008 there is a huge downfall in prices which again keeps on rising after the mid-2008. After the World Trade Center attack there was a drastic change in the prices of crude oil till 2008 because of which it became more volatile. When we look at the graph, we find the upward trend initiated by these shocks. Similarly, due to the reopening (17.09.2001) of New York Stock Exchange and NYMEX for the first time after the World Trade Center attack (11.09.2001) there was a downward trend in both spot and future prices.

Gold

As crude oil, gold is also one of the highly traded commodities. The price fluctuation pattern of gold is completely different. As we have considered the data sample period from the year 2000-2012, there is a rise in both spot and future prices from 2000 to 2012 despite the slight downfall in the mid-2008. Gold spot and future prices (figure 13 and 15) keep on rising despite the 2002 South American and 2008 global crisis. As Tully & Lucey (2007) concluded that exchange rate is the main macroeconomic variable that influences the volatility of gold whereas other macroeconomic variables have less impact on it.

Natural gas

Natural gas among all the taken sample variables is one of the most and highly traded commodity. Although, Walls (1995), Chinn et al., (2001), Cuddington & Wang (2006) stated that as of other commodities the time series data for the natural gas is also non-statioanry. However, unlike other variables, both the spot and future prices of natural gas were at the stationary position before doing the first differencing. The graph of natural gas looks completely different than of other variables. There was a frequent price movement. The effects of global events like U.S. natural gas storage reaches all-time lows; the dot-com bust, U.S. recession and the global financial crisis were the causes for this phenomenon. Similarly, there is a high demand and huge consumption of natural gas due to the comparatively cutthroat market and environmental standards that encourage increased use or combustion of “cleaner” fuels (Yohannes, 2011). Over the years, the market for the natural gas has become more volatile and complex ultimately which has made quite difficult to predict the future price of the natural gas. Because of these, the market participants are exposed to price risks. Natural gas is hugely affected by the transmission, production, distribution, storage, prices of competing fuels, market risk, weather and demand (Bruce;Sloan;& Leon, 2003).

Silver

As compared to gold, silver is not so much commonly traded precious metal but due to the huge benefits of it in different fields, it’s trading has tremendously increased. Regarding the graphical representation of spot and future prices of it, both the prices rises from the year 2000 till 2000 and in the mid-2000 there is a slight downfall. However, after that the prices rise at the tremendous rate. There is a close relationship of silver with the gold. As the gold prices become strong market participants switch their demand towards the silver and bid it up rapidly. Likewise, as gold prices weaken then they quickly return to gold leaving the bid for the silver.

Figure 1.

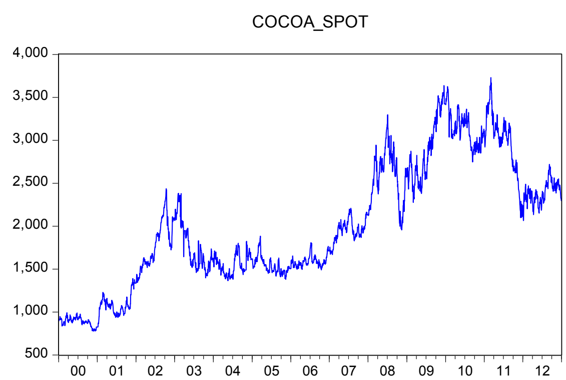
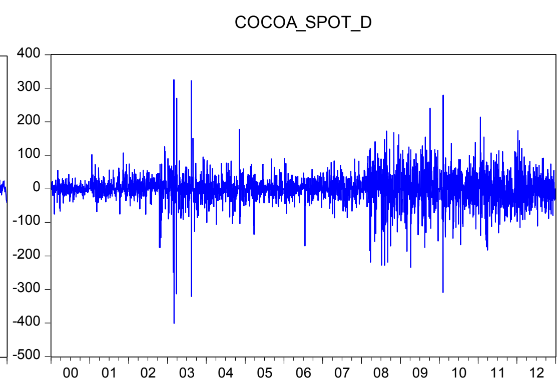


Figure 2.



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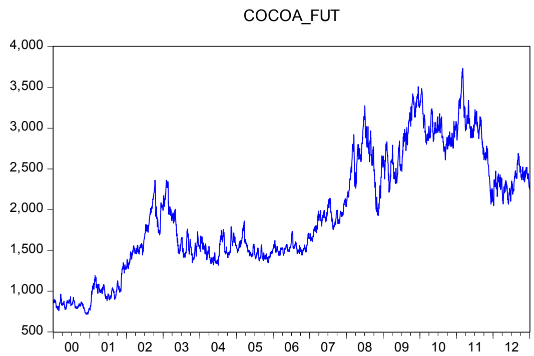

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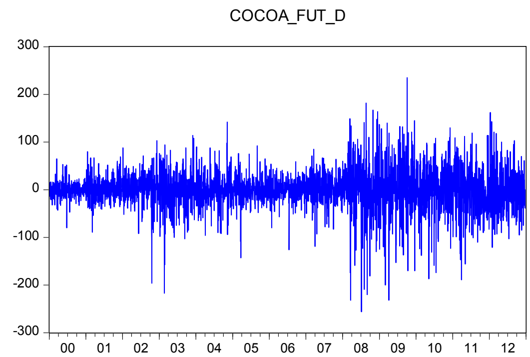

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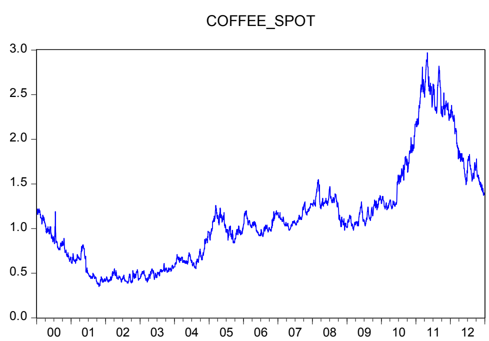

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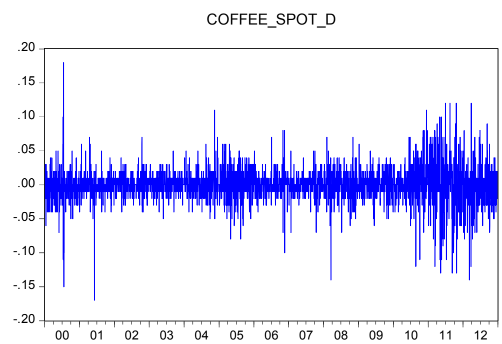

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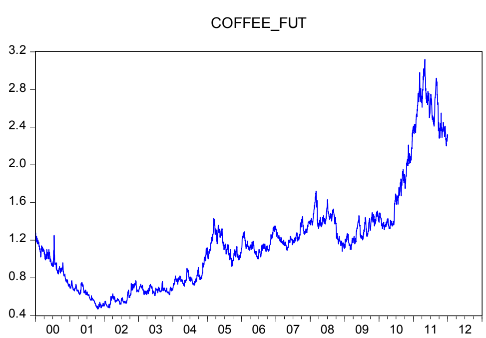

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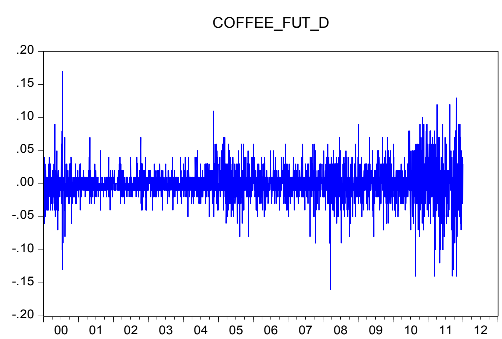

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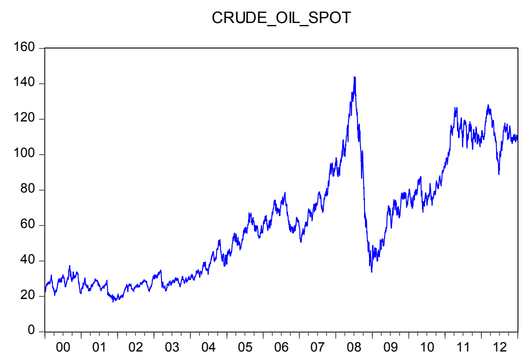

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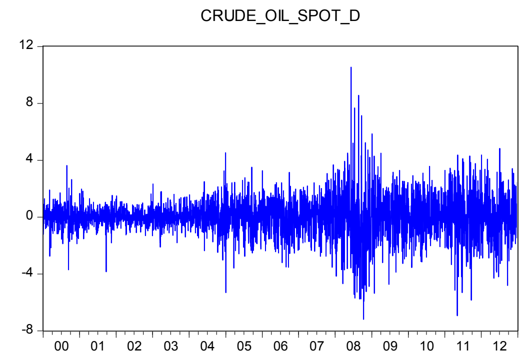

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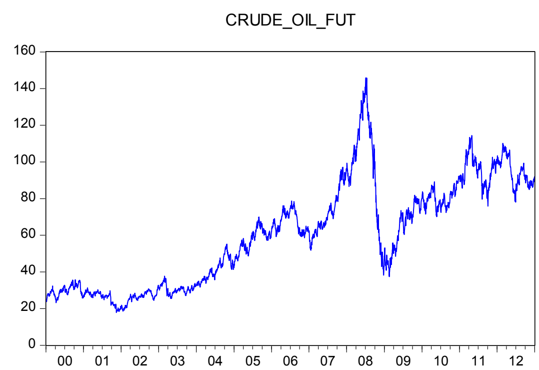

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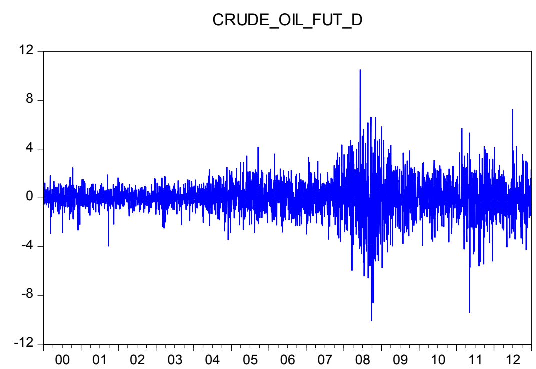

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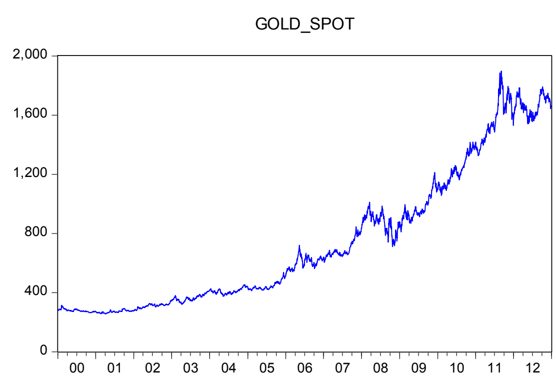

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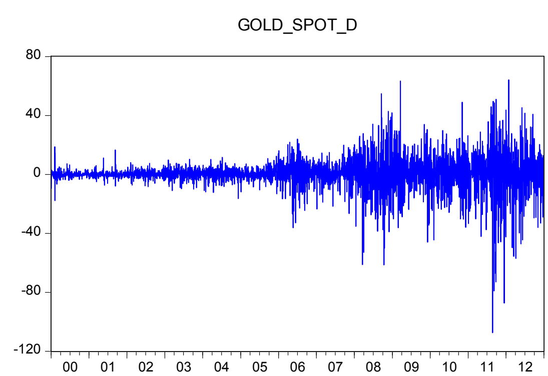

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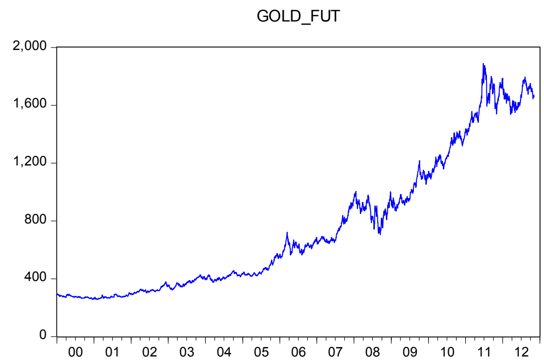

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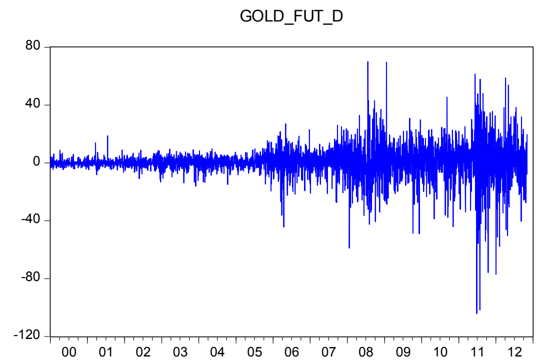

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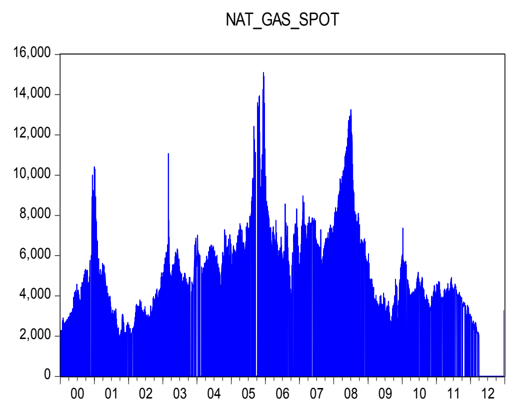
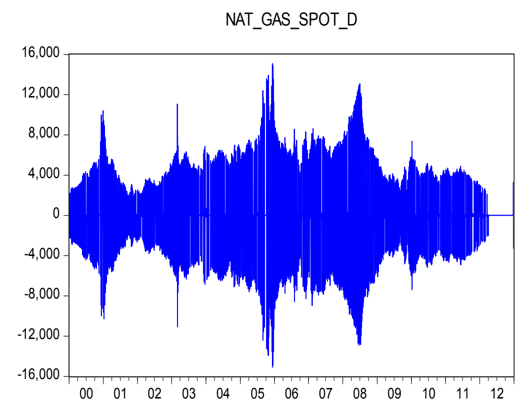


Figure 18



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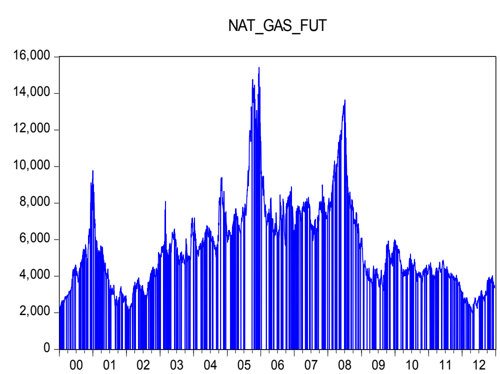

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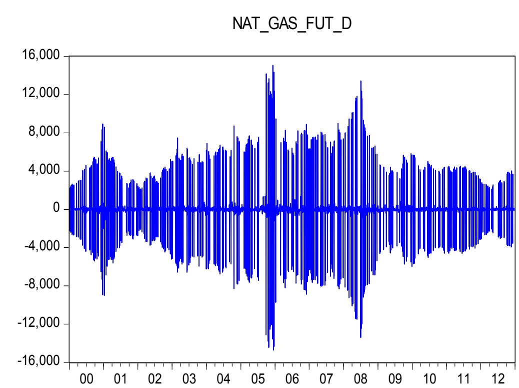

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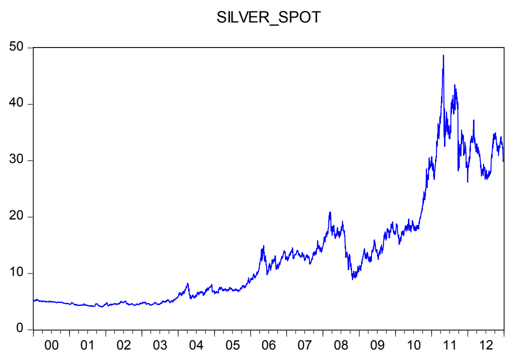

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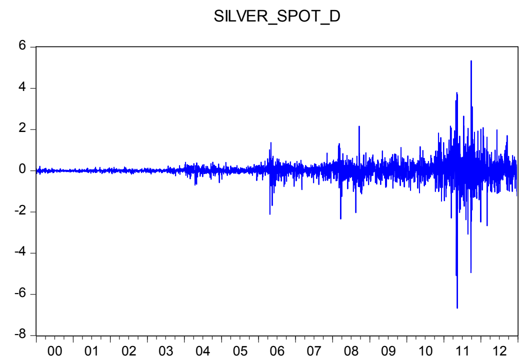

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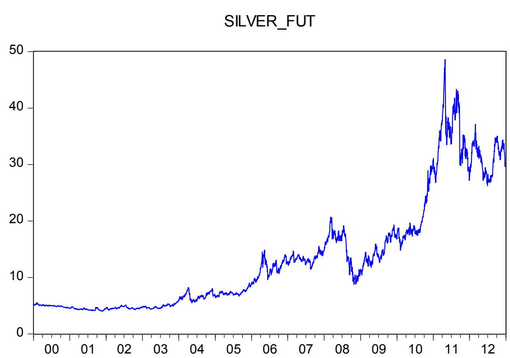

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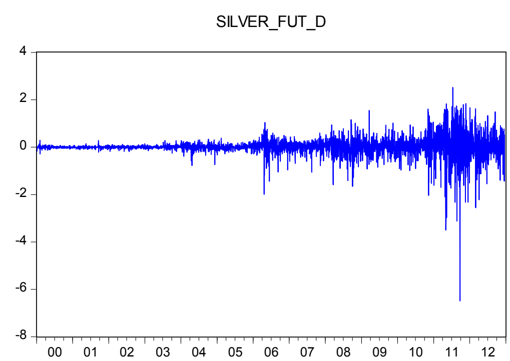

6.3 Testing for a Unit Root

6.3.1 The Augmented Dickey-Fuller Test

Hypothesis for unit root test:

a. Null hypothesis H_0= variable is not stationary
b. Alternative H_1= variable is stationary

Similarly, in the unit root test we have three models:

a. Model 1: only intercept
b. Model 2: trend and intercept
c. Model 3: no trend, no intercept

For any econometric analysis, the most important aspect we need to check whether the data is stationary or not. Unit root tests can be used to determine if trending data should be first differenced or regressed on deterministic functions of time to render the data stationary. In order to test the cointegration pre-testing for unit root tests is often carried out first. We will be using ADF test statistic to check whether the data is stationary or non-stationary. As shown in the appendix (1) most of the series; both spot and future prices of the commodities while testing with the ADF test-statistic at the “level” with all the three models were found to be non-stationary resulting in the unit root problem concluding to the result we can’t reject null hypothesis (Ho). If the absolute test statistic (there is no negative signs) is more than the critical values (absolute) then we reject null hypothesis and accept alternative hypothesis. But if the absolute test statistic is less than critical values we can’t reject null hypothesis, we accept null hypothesis. For instance, we can take the example of cocoa spot price (see appendix 1 (a)). The computed ADF test-statistic (-1.912965) is less than the critical values (-3.432092, -2.862195, -2.567163 at 1%, 5% and 10% significant level respectively). Therefore, we can’t reject the null hypothesis and the null hypothesis states that cocoa spot index has a unit root which means this spot index is not stationary. We look at the absolute values and ignore the negative signs and normally we compare the test statistics with the critical values at 5% significant level. It means the cocoa series has a unit root problem and is a non- stationary series. Looking at the probability at interval we have a chance of 32.65% of making mistakes. At the same time the coefficient of lag of variable (cocoa_spot) should be also negative which is (-0.001911). This states that this model is viable. Similarly, cocoa future price (see appendix 1 (g)) also has the ADF test-statistic absolute value (-1.974183) less than the absolute critical value (-2.862195 at 5% significant level).

Thus, in order to transform the time series data from non-stationary to stationary we used difference-stationary process. In this process we just changed the chosen items to “1st difference” instead of “level”. When the variables are converted to first difference then we check whether still unit root exists or not. When we choose 1st difference, variables will be automatically converted to 1st difference.

As shown in the appendix 2 (a) the absolute computed ADF test-statistic of cocoa spot price (-63.32229) is greater than the absolute critical value -2.862195 at 5% significant level. Thus, we can reject the Ho. This means the 1st difference of "cocoa" becomes stationary. When we checked the all three models at "first differenced" it was found that the variables were stationary.

Same goes with the other variables. Therefore, we can conclude that the variables (crude oil, gold, cocoa, silver, and coffee) series were non-stationary series, but after taking the 1st difference we generated the stationary.

In contrast to other variables, natural gas was only the commodity that was a stationary series. Its computed ADF test-statistic absolute value (see appendix 1 (e)) -8.622396 was greater than the absolute critical values -2.862198 at 5% concluding that we can reject the null hypothesis.

In totality, variables at "level" don't have unit root but when the variables are converted to "first differenced" then the first differenced is stationary. For furthermore analysis, we can use the differenced variables in time series model since they don't have any more unit root.

Table3. Unit root test statistics for the commodities

Commodities	ADF Statistics		
	Prices	Level	1st Differences
cocoa	SP	-1.912965	-63.32229*
	FP	-1.974183	-57.72074*
coffee	SP	-1.186958	-43.37054*
	FP	-0.421087	-57.33761*
Crude oil	SP	-0.994072	-55.60527*
	FP	-1.484526	-60.33349*
Gold	SP	0.397134	-58.25397*
	FP	0.411909	-57.52904*
Natural gas	SP	-8.622396	-22.75005*

	FP	-4.829502	-24.02430*
Silver	SP	-0.885676	-20.47202*
	FP	-0.736461	-57.15672*

* Denotes significant at 1% level
Test critical values:
1% -3.432092
5% -2.862195
10% -2.567163

6.3.2 Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Test

In econometrics, KPSS test which are projected to complement unit root tests, such as Dickey-Fuller test is used in testing the null hypothesis that an observable time series is stationary around a deterministic trend. The series is expressed as the sum of stationary error, random walk, deterministic trend and is the Lagrange multiplier test of the hypothesis indicating that the random walk has the zero variance. The hypotheses for the KPSS test are as follows:

a) H_0= variable is stationary.
b) H_1= variable isn't stationary.

As shown in the appendix 3, all the spot and future prices of the variables have the stationary after the KPSS test. For instance, when we look at the test statistic of cocoa spot price at 5% level it was found out to be 0.463000, greater than of the critical value 0.070132 stating that we reject the alternative hypothesis and accept the null one. The same procedure goes with rest of the variables. As shown in the following table 3, all the KPSS test statistics are less than the critical value concluding we reject the alternative hypothesis and accept the null hypothesis. Thus, concluding KPSS test matches with the results determined by the Augmented Dickey-Fuller Test.

Table 4. KPSS test statistic for the commodities

Commodities	KPSS Statistics	
	Prices	1st Differences
cocoa	SP_D	0.070132*

	FP_D	0.061035*
coffee	SP_D	0.149388*
	FP_D	0.275278*
Crude oil	SP_D	0.047520*
	FP_D	0.038808*
Gold	SP_D	0.229830*
	FP_D	0.227187*
Natural gas	SP_D	0.038800*
	FP_D	0.048448*
Silver	SP_D	0.072666*
	FP_D	0.075295*

* Denotes significant at 1% level
Test critical values:
1% 0.739000
5% 0.463000
10% 0.347000

6.4 Testing for Cointegration

6.4.1 Johansen Cointegration Method

Since the price series are all non-stationarity and integrated of the same order, cointegration analysis is the appropriate tool for investing the relationship between prices. We proceed by testing for cointegration in the system containing the both spot and future prices for six commodities. The lag length was again chosen to whiten the error term and as tests for autocorrelation lagrange multiplier (LM) for the presence of autocorrelation up to the 12th order. The two tests to determine the rank of the coefficient matrix i.e. the trace and eigenvalue tests are also reported. The maximum eigenvalue test as well as the trace test suggests that there are three cointegration vectors presented in the system, and for that reason only one stochastic trend. The conclusion must therefore be that spot and future prices with different time to expiration are cointegrated and hence there is a long run relationship between the prices. In the Johansen testing, we have applied both the trace statistics and the maximum Eigen value statistics to find the cointegration test between the spot and future prices of different commodities in the long-run.

The trace statistic test is used in testing the null hypothesis: “there is at most r cointegrating relation” against the alternative of m cointegrating relations” (meaning the availability of the series being stationary), r=0, 1… m-1.

The maximum eigenvalue statistic test is used in testing the null hypothesis: “there are r cointegrating relations” against the alternative: “there are r+1 cointegrating relations.”

Tests on long run relationships between spot and future prices are mostly carried out in a two-step Engle and Granger approach. However, this approach has several limitations. Particularly, valid tests for lead lag relationships can only be carried out in a system structure. Furthermore, it is not possible to test hypothesis with respect to the parameters in the long run relationship on the basis to the Engle and Granger framework. Finally, one cannot take into account that there for most commodities are several contracts. Thus, in this paper it is shown that all these problems can be avoided with the use of Johansen procedure (Asche & Guttormsen, 2002).

For testing whether there is a long run relationship between the spot and future prices of the variables or not we use the Johansen Cointegration Test. We assume that all the used variables are non-stationary. As stated earlier, when we convert them to first difference then they become stationary. However, in Johansen cointegration test we take the initial (original) data which are non-stationary and the variables are at the level form. Data or variable must be integrated of same order. There are two types of test in the Johansen cointegration test to explain our results that whether there is any long run relationship among the variables or not; trace test and maximum-Eigen test.

Johansen Cointegration Test has the following hypotheses:

a) H_0: spot and future price are cointegrated
b) H_1: spot and future price aren’t cointegrated

Trace test

No. of CE (s): Number of cointegrated equation or null hypothesis.

On the first hypothesis at none for the cocoa spot and future prices, when we look at the probability, it is less than 5% (see table 5) so we can't reject the null hypothesis. This means that the variables are cointegrated meaning variables have long run relationships. Similarly, when we look at the at most 1, the probability (0.0560) is more than 5% thus we reject null hypothesis. Another way of checking whether there is cointegration or not is to compare the trace statistic and critical value. If the trace statistic is greater than critical value then there is the presence of the cointegration. For instance, when we can look at the trace statistic and critical value at none, the trace statistic 116.3306 is greater than of critical value 15.49471 highlighting on the fact that there is a long run relationship between the prices of cocoa. In contrast, at at most 1, the maximum-eigen statistic 3.651525 is less than the critical value 3.841466 meaning there is no any long-run relationship between the spot and future prices of cocoa.

Table 6 exhibits the cointegration test for the coffee spot and future prices. Here the trace statistic 25.54423 is greater than the critical value 15.49471 including the probability less than 0.05 i.e. 0.0011. Similarly, at most 1 the trace statistic 0.087995 is less than 3.841466 and the probability of 0.7667 greater than 0.05. This scenario results in the existence of the long-run relationship between the coffee spot and future prices.

As suggested by Svetlana, Maslyuk, Russell (2009) the spot and future prices are determined by the same factors like macroeconomic variables, interest rates and oil reserves since the future prices represent the expectations of the future spot prices of the physical commodity. For this reason, the expectation of the long-run relationship between the spot and future prices are expected. However, when we look at the table 7, we find that the trace statistic 9.821370 is less than the critical value 15.49471at none with the probability more than 5% i.e. 29.47% meaning that there exists no cointegration between the crude oil spot and future prices. Thus, the result exhibited by the Svetlana, Maslyuk, Russell (2009) is challenged here. However, Quan (1992) supports our result. The reason behind the absence of long-run relationship might be the dramatic price movement in the recent period since crude oil is the worldwide traded energy commodity. Similarly, due to the new information indicating the rise in oil prices the market participants and speculators either tend to buy future or spot. Since, spot requires more initial outlay and longer time in the implementation speculators prefer future transactions as soon as possible with less amount of cash. Thus, speculators react to the new information choosing futures instead of spot transactions (Silvapulle & Moosa, 1999).

Table 8 also explains the results of the existence of the long-run relationship between the gold spot and future prices. As shown in the table, the trace statistic 61.59684 at none is greater than the critical value 15.49471. The probability (0.000) is also less than 0.05. However at most 1, the probability is greater than 5% i.e. 23.48% and the trace statistic 1.411425 is also less than 3.841466 stating that there is the presence of cointegration in the long-run.

Moreover, table 9 represents the results of cointegration test for the natural gas spot and future prices which shows the presence of long-run relationship both at the none and at most 1. Here, the trace statistic at none 619.1959 and at at most 1, 84.10770 are greater than the critical value 15.4971 and 3.841466 respectively. Similarly, the probabilities are also less than 0.05 both at the none and at most 1 respectively. Moreover, when we look at the maximum eigen value (see table 13) the result is same as this meaning there is a cointegration.

Table 10 shows the cointegration test for the silver and future prices. This table too highlights on the fact that there exist the cointegration between the spot and future prices in the long-run. As shown in the table, the trace statistic

73.6749 is greater than the critical value 15.4971 at none with the probability of 0.0001 whereas the trace statistic at at most 1 0.59243 is less than the critical value 3.841466 with the probability higher than 0.05 i.e. 0.4415.

Maximum Eigen Test

As stated earlier, this is another way of explaining whether there exists the long-run relationship between the spot and future prices of the commodities or not. For instance, when we consider the maximum Eigen statistic at none, the probability i.e 0.0001 is less than 0.05 stating that there is a cointegrated equation (see table11). We accept the null hypothesis. In other words, when we look at the maximum Eigen statistic 112.6791, it is more than that of the critical value 14.26460 at 5% significant level stating we can't reject the null hypothesis. Moreover, at most 1, the probability is more than 5% i.e. 5.60% and even the maximum Eigen statistic 3.651525 is less than the critical value 3.841466 meaning there is no presence of long-run relationship.

Similarly, when we have a glance at table 12, the maximum-eigen statistic 25.45623 is more than the critical value 14.2640 at none with the probability less than 5% exhibiting the presence of cointegration. However, at most 1, the trace statistic 0.087995 is less than the critical value 3.841466 with the probability of 76.67% at 5% significant level with no long-run relationship.

Table 14 explains the results of cointegration test for the gold spot and future prices on the basis of maximum eigenvalue. Here at none, the maximum eigen-statistic 60.18542 is more than the critical value 14.26460 at 5% significant level with the probability of 0.0000 stating there is the presence of cointegration in the long-run. However, at none there exists no cointegration.

At table 16, the maximum Eigen statistic 763.0824 is greater than 14.2640 with the probability less than 0.05 at none. However, at the most 1, the maximum eigen-statistic is less than the critical value along with the higher probability at 5% significant level.

In totality, the Johansen Cointegration Test using both trace statistics and maximum Eigen value statistics indicate that there exists the long-run relationship between the spot and future prices of the commodities except for the crude oil. Our results on the cointegration between the spot and future prices support the findings of Martin & Garcia 1981, Hokkio & Rush, 1989, Wahab & Lashgari 1993, Giot 2003, Garcia & Leuthold, 2004, Hernandez & Torero, 2010.

Following tables show the unrestricted cointegration rank test between the commodities on the basis of trace test and maximum-eigen value respectively.

Table 5: Unrestricted cointegration rank test between cocoa spot price and cocoa future price (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace statistic	Critical value	Probability
None* At most 1	0.032730 0.001078	116.3306 3.651525	15.49471 3.841466	0.0001 0.0560

Table 6: Unrestricted cointegration rank test between coffee spot price and coffee future price (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace statistic	Critical value	Probability
None* At most 1	0.008113 2.82E-05	25.54423 0.087995	15.49471 3.841466	0.0011 0.7667

Table 7: Unrestricted cointegration rank test between crude oil spot price and crude oil future price (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace statistic	Critical value	Probability
None At most 1	0.002642 0.000255	9.821370 0.862816	15.49471 3.841466	0.2947 0.3530

Table 8: Unrestricted cointegration rank test between gold spot price and gold future price (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace statistic	Critical value	Probability
None*	0.017837	61.59684	15.49471	0.0000
At most 1	0.000422	1.411425	3.841466	0.2348

Table 9: Unrestricted cointegration rank test between natural gas spot price and natural gas future price (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace statistic	Critical value	Probability
None*	0.146175	619.1959	15.49471	0.0001
At most 1	0.024534	84.10770	3.841466	0.0000

Table 10: Unrestricted cointegration rank test between silver spot price and silver future price (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace statistic	Critical value	Probability
None*	0.201774	763.6749	15.49471	0.0001
At most 1	0.000175	0.592493	3.841466	0.4415

Table 11: Unrestricted cointegration rank test between cocoa spot price and cocoa future price (maximum eigenvalue)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen statistic	Critical value	Probability
None*	0.032730	112.6791	14.26460	0.0001
At most 1	0.001078	3.651525	3.841466	0.0560

Table 12: Unrestricted cointegration rank test between coffee spot price and coffee future price (maximum eigenvalue)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen statistic	Critical value	Probability
None*	0.008113	25.45623	14.26460	0.0006
At most 1	2.82E-05	0.087995	3.841466	0.7667

Table 13: Unrestricted cointegration rank test between crude oil spot price and crude oil future price (maximum eigenvalue)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen statistic	Critical value	Probability
None At most 1	0.002642 0.000255	8.958555 0.862816	14.26460 3.841466	0.2896 0.3530

Table 14: Unrestricted cointegration rank test between gold spot price and gold future price (maximum eigenvalue)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen statistic	Critical value	Probability
None* At most 1	0.017837 0.000422	60.18542 1.411425	14.26460 3.841466	0.0000 0.2348

Table 15: Unrestricted cointegration rank test between natural gas spot price and natural gas future price (maximum eigenvalue)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen statistic	Critical value	Probability
None* At most 1	0.146175 0.024534	535.0882 84.10770	14.26460 3.841466	0.0001 0.0000

Table 16: Unrestricted cointegration rank test between silver spot price and silver future price (maximum eigenvalue)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen statistic	Critical value	Probability
None* At most 1	0.201774 0.000175	763.0824 0.592493	14.26460 3.841466	0.0001 0.4415

6.5 Granger Causality Analysis

Granger causality is one of the most primitive methods developed to formally analyze the dynamic relationship between the spot and future prices from the time series observation, linear and nonlinear (nonparametric).This test is based on the notion that the cause occurs prior to its effect. This test is used in investigating whether changes in the spot price leads in the change of future price or not or vice-versa or both. Due to the simplicity, extendibility and robustness this test is quite dominant and successful in comparison to other tests. Importantly, granger causality test is based on the two principles:

i. The cause happens prior to the effect.
ii. The causal series contains unique information about the effect series that is not available otherwise.

Through the granger causality test, this paper attempts to explain whether the spot and future prices of different commodities cause-effect each other or not. The granger causality tests for some variables are very sensitive to the selected number of lags in the analysis so we should be careful enough. For the monthly data the suitable lag terms can be from 1-12 or 24; for the quarterly data 1-4 or 12 and for the annual data the reasonable lag terms should be less.

In this test, the stationary prices of the commodities are considered thus the original prices of the commodities are first difference and then further used for this test. Granger causality is used to determine if the variable in time series is useful in forecasting another or not.

Following is the null hypotheses for the Granger-Causality test:

H_0: X does not granger-cause Y.

H_1: X does granger-cause Y.

Table 17: Results of testing causality between the spot and future prices of different commodities, 2000-2012

Direction of causality	Probability	Type for causality	Direction of causality	Probability	Type for causality
COS → COF	0.0002*	Bi-directional causality	GOS → COS	1. E-10*	Uni-directional causality
COS → CFS	0.0125*	Bi-directional causality	GOS → COF	0.1853	No causality
COS → CFF	0.3202	No causality	GOS → CFS	3. E-09*	Bi-directional causality
COS → CROS	0.0082*	Bi-directional causality	GOS → CFF	0.2131	No causality
COS → CROF	0.3058	No causality	GOS → CROS	0.0450*	Uni-directional causality
COS → GOS	0.3040	No causality	GOS → CROF	0.0005*	Bi-directional causality
COS → GOF	0.9408	No causality	GOS → GOF	0.0311*	Bi-directional causality
COS → NGS	0.5192	No causality	GOS → NGS	0.3074	No causality
COS → NGF	0.0819	No causality	GOS → NGF	0.3792	No causality
COS → SS	0.4152	No causality	GOS → SS	4. E-92*	Bi-directional causality
COS → SF	0.9253	No causality	GOS → SF	0.0024*	Bi-directional causality
COF → COS	0.000*	Bi-directional causality	GOF → COS	0.6783	No causality

COF →CFS	4.E-18*	Uni-directional causality	GOF →COF	0.4590	No causality
COF →CFF	0.2542	No causality	GOF →CFS	0.0191*	Bi-directional causality
COF →CROS	0.4633	No causality	GOF →CFF	0.4517	No causality
COF →CROF	0.7751	No causality	GOF →CROS	0.14039	No causality
COF →GOS	0.5205	No causality	GOF →CROF	0.0146*	Bi-directional causality
COF →GOF	0.4161	No causality	GOF →GOS	0.0157*	Bi-directional causality
COF →NGS	0.2127	No causality	GOF →NGS	0.5446	No causality
COF →NGF	0.2228	No causality	GOF →NGF	0.8976	No causality
COF →SS	5.E-10*	Uni-directional causality	GOF →SS	0.5270	No causality
COF →SF	0.7793	No causality	GOF →SF	0.0352*	Uni-directional causality
CFS →COS	0.0022*	Bi-directional causality	NGS →COS	0.8175	No causality
CFS →COF	0.3162	No causality	NGS →COF	0.2444	No causality

CFS → CFF	0.0190*	Bi-directional causality	NGS → CFS	0.4496	No causality
CFS → CROS	0.0652	No causality	NGS → CFF	0.6620	No causality
CFS → CROF	0.00558*	Bi-directional causality	NGS → CROS	0.1425	No causality
CFS → GOS	0.0006*	Bi-directional causality	NGS → CROF	0.0785	No causality
CFS → GOF	0.3456	No causality	NGS → GOS	0.5526	No causality
CFS → NGS	0.6382	No causality	NGS → GOF	0.6676	No causality
CFS → NGF	0.6974	No causality	NGS → NGF	0.0004*	Uni-directional causality
CFS → SS	9.E-09*	Bi-directional causality	NGS → SS	0.1747	No causality
CFS → SF	0.0001*	Bi-directional causality	NGS → SF	0.0994	No causality
CFF → COS	5.E-20*	Uni-directional causality	NGF → COS	0.0809	No causality
CFF → COF	0.0004*	Uni-directional causality	NGF → COF	0.6213	No causality
CFF → CFS	0.0000*	Bi-directional causality	NGF → CFS	0.8581	No causality

CFF →CROS	0.0013*	Bi-directional causality	NGF →CFF	0.931	No causality
CFF →CROF	0.0398*	Uni-directional causality	NGF →CROS	0.2634	No causality
CFF →GOS	2.E-07*	Uni-directional causality	NGF →CROF	0.5224	No causality
CFF →GOF	0.0995	No causality	NGF →GOS	0.8934	No causality
CFF →NGS	0.6261	No causality	NGF →GOF	0.9185	No causality
CFF →NGF	0.3159	No causality	NGF →NGS	0.2212	No causality
CFF →SS	5.E-32*	Uni-directional causality	NGF →SS	0.6324	No causality
CFF →SF	1.E-05*	Uni-directional causality	NGF →SF	0.5344	No causality
CROS →COS	1.E-19*	Bi-directional causality	SS →COS	5. E-06*	Uni-directional causality
CROS →COF	0.2226	No causality	SS →COF	0.1862	No causality
CROS →CFS	6.E-18*	Uni-directional causality	SS →CFS	3. E-06*	Bi-directional causality
CROS →CFF	0.0092*	Bi-directional causality	SS →CFF	0.2117	No causality

CROS →CROF	0.0203*	Bi-directional causality	SS →CROS	0.2899	No causality
CROS →GOS	0.5200	No causality	SS →CROF	0.0001*	Bi-directional causality
CROS →GOF	0.0790	No causality	SS →GOS	0.0226*	Bi-directional causality
CROS →NGS	0.5286	No causality	SS →GOF	4. E-05*	Uni-directional causality
CROS →NGF	0.2140	No causality	SS →NGS	0.8837	No causality
CROS →SS	7.E-25*	Uni-directional causality	SS →SF	0.7332	No causality
CROS →SF	7.E-05*	Uni-directional causality	SS →SF	0.0056*	Bi-directional causality
CROF →COS	4. E-24*	Uni-directional causality	SF →COS	1. E-09*	Uni-directional causality
CROF →COF	0.0519	No causality	SF →COF	0.0028*	Bi-directional causality
CROF →CFS	5. E-21*	Uni-directional causality	SF →CFS	3. E-21*	Bi-directional causality
CROF →CFF	0.0964	No causality	SF →CFF	0.2228	No causality
CROF →CROS	3. E-76*	Bi-directional causality	SF →CROS	0.0006*	Bi-directional causality

CROF →GOS	2. E-08*	Bi-directional causality	SF →CROF	0.0003*	Bi-directional causality
CROF →GOF	0.0246*	Bi-directional causality	SF →GOS	2. E-38*	Bi-directional causality
CROF →NGS	0.5424	No causality	SF →GOF	0.1635	No causality
CROF →NGF	0.1533	No causality	SF →NGS	0.8913	No causality
CROF →SS	1. E-57*	Bi-directional causality	SF →NGF	0.8281	No causality
CROF →SF	5. E-06*	Bi-directional causality	SF →SS	0.000*	Uni-directional causality

*: Significant at 5% level.

Looking at the result, it is quite different with other previous studies and suggests that not only future price leads to the determination of spot price for the commodities but also spot price determines the future prices in return. At certain point of time due to the arrival of new information in the market spot price may lead the future price and future price may lead the spot price as market participants filter the available information relevant to their positions. Most of the researches have concluded that future prices lead the spot prices. Among them Asche & Guttormsen (2002), Moosa & Al-Loughani (1995) are some of them. However, Sivapulle & Moosa (1999); Quan (1992); Moosa (1996); defended this one and concluded that spot prices lead future price. Similarly, Garbade and Silber (1983) examined the price discovery role taking in account the spot and future prices of seven commodities and concluded that not only the future market dominate the spot market rather spot market too play an important role in the price discovery.

We find the bi-directional causal relationship between the spot and future prices for the agricultural commodities (cocoa and coffee). For instance, the spot and future prices of cocoa and coffee granger cause each other respectively. Bigman et al., (1983) had stated that it is difficult to justify on which way does the direction of causality flow; is it the spot to future or future to spot. Here, we have solved this problem and come with the conclusion that the direction of causality runs both from spot to future and future to spot respectively. However, we have a kind of mixed results with the precious metals and energy commodities. Gold and crude oil have the bi-directional relationship too. Quan (1992) had concluded that crude oil spot market always dominate the future market .However, in this case both crude oil spot and future prices move together and causes each other rather than playing dominant role. In case of the natural gas, the significant role of spot price in the price discovery role is observed. It’s surprising that the spot and future prices of other commodities are not affected by the future price of natural gas at all. It acts as an independent. The reason behind this might be that natural gas is regarded as the secondary product of crude oil exploration. Similarly, due to the rise of the alternative source of energy shale gas, the demand for the natural gas has declined. Because of this, it is difficult to analyze the leading role of natural gas future price in the price discovery process in the spot market in the long-run. In contrast, Yohannes & Gebre (2001) stated that in the long-run future price plays a dominant role and exert higher impact on the spot prices. As Brajesh & Ajay (2011) suggested in their research that in case of the non-agricultural commodities mostly future prices lead the spot prices in the long-run. However, our result came up with the conclusion that not only future prices lead the spot prices rather spot prices too lead the future prices in the long-run which can be proved by the relationship of spot prices of natural gas, gold and crude oil with the future prices.

More distinctively, we can see the following uni-directional causality that exists between some of the selected variables: cocoa future causes coffee spot, coffee future causes silver spot, coffee future causes cocoa spot, coffee future causes crude oil future, coffee future causes gold spot, coffee future causes silver spot, coffee future causes silver future, crude oil spot causes coffee spot, crude oil spot causes silver spot, crude oil spot causes silver future, crude oil future causes cocoa spot, crude oil future causes coffee spot, gold spot causes cocoa spot, gold spot causes crude oil spot, gold future causes silver future, natural gas spot causes natural gas future, silver spot causes cocoa spot, silver spot causes gold future and silver future causes cocoa spot.

No causality exists between cocoa spot and coffee future, cocoa spot and crude oil future, cocoa spot and gold spot, cocoa spot and gold future, cocoa spot and natural gas spot, cocoa spot and natural gas future, cocoa spot and silver spot, cocoa spot and silver future, gold spot and cocoa future, gold spot and coffee future, gold spot and natural gas spot, gold spot and natural gas future, gold future and cocoa spot, gold future and cocoa future, cocoa future and coffee future, cocoa future and crude oil spot, cocoa future and crude oil future, cocoa future and gold spot, cocoa future and gold future, cocoa future and natural gas spot, cocoa future and natural gas future, cocoa future and silver future, gold future and coffee future, gold future and crude oil spot, gold future and natural gas spot, gold future and natural gas future, gold future and silver spot, natural gas spot and cocoa spot, natural gas and cocoa future, natural gas and coffee spot, coffee spot and crude oil spot, coffee spot and gold future, coffee spot and natural gas spot, coffee spot and natural gas future, natural gas spot and coffee future, natural gas spot and crude oil spot, natural gas spot and crude oil future, natural gas spot and gold spot, natural gas spot and gold future, natural gas spot and silver spot, natural gas spot and silver future, natural gas future and the spot and future prices of all the other commodities respectively, silver spot and cocoa future, silver spot and coffee future, silver spot and crude oil spot, silver spot and natural gas spot, silver spot and silver future, silver future and coffee future, crude oil spot and gold spot, crude oil spot and gold future, crude oil and natural gas spot, crude oil and natural gas future, crude oil future and cocoa future, crude oil future and coffee future, crude oil future and natural gas spot, crude oil future and natural gas future, silver future and gold future, silver future and natural gas spot and silver future and natural gas future.

Following table shows the spot and future price of commodities that have the bi-directional relationship with each other.

Table 18: Spot price and future prices with bi-directional relationship

Direction of causality
1. COS↔CROS
2. COS↔CFS
3. COS↔COF
4. CFS↔CFF

5. CFS↔CROF
6. CFS↔GOS
7. CFS↔SS
8. CFS↔SF
9. CFF↔CROS
10. CROS↔GOS
11. CROS↔CROF
12. CROF↔GOF
13. CROF↔SS
14. CROF↔SF
15. GOS↔GOF
16. GOS↔SS
17. GOS↔SF
18. GOF↔CROF
19. SS↔SF
20. SF↔COF
21. SF↔CROS

As shown in the table16 spot and future prices of all the commodities except natural gas and silver have the bi-directional relationship. Cocoa spot price has the bi-directional relationship with crude oil spot price and coffee spot price. Coffee spot has the bi-directional relationship with crude oil future price, gold spot price, silver spot price and silver future price respectively. Similarly, coffee future price has the bi-directional relationship with crude oil spot price. Crude oil spot price has the bi-directional relationship with the gold spot price. Crude oil future price has the bi-directional relationship with the gold future price, silver spot price and silver future price respectively. Gold spot price has the bi-directional relationship with the silver spot and future price respectively. Gold future price has the bi-directional relationship with the crude oil future price. Similarly, gold future has the bi-directional relationship with the cocoa spot price and crude oil spot price respectively.

6.6 VAR model

In the VAR model, all the 1st differences spot and future prices of the commodities are taken as the endogenous variables. As shown in the table 19, all the dependent variables have their individual independent variables with lag 1 and 2 shown on the left hand side column. In the VAR model, we tend to check whether the independent variables influence the dependent variable or not and to what proportion do they change. For this purpose, we check the corresponding p-value. If the p-value is less than 0.05 then the independent variable significantly affects the dependent variable. Altogether, there are 300 coefficients in the VAR model. Out of 300, we have just 68 significant relationships (see appendix 6). For instance, the first number 0.102893 is the coefficient of silver future price lag 1, second number placed in the small bracket i.e. (0.02633) is the standard error and the third number put in the big bracket [3.90745] is the t-statistics. When we look at the silver future price (SF_D) which is the dependent variable and silver future price lag 1 represented as SF_D(-1) is an independent variable. In order to check whether the independent variable can explain dependent variable or not we check the probability (see appendix 6) where the p-value of SF_D (-1) is 0.001 indicating the significant relationship. However, SF_D (-2), independent variable has the probability of 0.9856 signaling no effect at all. Similarly, when we look at the silver spot price lag 1 whether influences the silver future price (dependent variable) or not we tend to find the probability being 0.0685 indicating no significant relationship. Moreover, some of the following independent variables have the significant relationship with the dependent variables. Natural gas lag 1, coffee future price lag 1, coffee spot prices lag 1, crude oil future price lag 2, gold spot price lag and gold spot price lag 2 have the significant relationship with the silver future. Similarly, silver future lag 1, silver future lag 2, silver spot lag 1, silver spot lag 2, natural gas lag 1, coffee spot lag 1, crude oil future lag 2, crude oil spot lag 2 and gold spot price lag 2 significant influences the silver spot price. Silver future lag 1, silver future lag 2, silver spot lag 1, natural gas spot lag 1, natural gas spot lag 2, natural gas future lag 1, and cocoa future lag 2, coffee future lag 2 influences natural gas spot prices. Natural gas future lag 1, natural gas future lag 2 and cocoa spot lag 1 influences natural gas future prices. Cocoa spot lag 1, cocoa spot lag 2 and coffee future lag 1 influences coffee future prices.

Besides these, in order to check whether the two independent variables jointly influence dependent variable or not we tend to check the Wald coefficient test.
H_0: c (1) =c (2) = 0 (accept the null hypothesis)

H_1: c (1) ≠ c (2) ≠ 0 (reject the H_1)

Since we had large number of coefficients thus, we picked up some random variables and performed the test.

Table 19. Probability distribution for the coeffecients

H_0	Probability	Decisions
c(1)= c(2)=0	0.0002	reject H_0
c(25)=c(26)=0	0.0000	accept H_0
c(49)=c(50)=0	0.9839	reject H_0
c(75)=c(76)=0	0.3867	reject H_0
c(175)=c(176)=0	0.0274	rejectH_0

As shown in the table, coefficient 1 and coefficient 2 (i.e. silver future lag 1 and silver future lag 2) jointly can't influence the dependent variable (silver future). Similarly, coefficient 49 and 50, coefficient 75 and 76, and coefficient 175 and 176 jointly have no effect on the respective variable. However, coefficient 25 and 26 jointly can influence the respective dependent variable.

Impulse Responses Functions

The impulse response function is innovation/shock/impulses to the VAR system. It helps in identifying the reaction of the variable when a positive shock of one standard deviation is given to the error terms and to know in what manner the variables react with each other. The regression model is shown in the appendix 7 for each variable.

Looking at the whole impulse response functions (see appendix 8) the result can be drawn out as that most of the impulse response of the error terms are due own shocks or the opposite commodities' (i.e. spot vs. future or future vs. spot) prices rather than with other different commodities prices.

For instance, when we look at the graphs (see appendix 8) how cocoa future price reacts to the cocoa future price when one shock of standard deviation is given we find the response being decreased from the 1st day to 2nd day and then at a steady position after the period 2. Due to the increment of uncertainty, the precautionary demand for the oil prices tend to rise causing the direct rise in the spot prices at no time. Here, crude oil future prices have the strong advantage in predicting the spot price. Similarly, when the shock is given to the cocoa spot price, the cocoa future reacts in a steady position after the 4th period although it responses in a positive decreasing manner from the 1st period till the 3rd period. Regarding the cocoa spot prices reaction on cocoa future prices when the shock is given we find cocoa spot prices responding in a highly positive manner from the initial period to period 2 and then completely drops negatively till it reaches period 5 and then slightly moves in a positive manner with the stable position after the period 6. Moreover, coffee spot price rises positively from the period 1 to 2 and then completely drops out in a negative manner till the period 5 and rises steadily positively from the period 6. Similarly, when a shock is given to the coffee spot price, the coffee spot price responses negatively from the period 1 to 3 and rises from the period 4 in a stable manner along the x-axis. Crude oil future and crude oil spot prices react in a same manner as the shock is given to the crude oil future prices. Silver spot price reacts in a different manner as the shock is given to the silver spot and silver future prices. Silver spot price drops from the beginning of the period till the period 2 and then slightly rises resulting in the decrement from the period 3 to 5. Silver spot prices react differently to the silver future price. In the initial period the prices rise till the period 2. However, from the period 2, it reacts sharply negatively till the period 4 and again rising from then along the X-axis in a steady manner. Natural gas spot and natural gas future prices response in the same manner as the shock is given to the natural gas spot and natural gas future prices respectively.

Variance Decomposition

Variance decomposition provides us with different way of examining the VAR system dynamics which gives the information of the proportion of the movement in the dependent variables that are caused due to their own shocks versus shocks to other variables. Information related to the relative importance of each random shock in affecting the variation of the variables in the VAR model is provided by the variance decomposition. In addition to these, practically it is observed that the shocks in the own time series explain most of the error variance of the series in a VAR (Chris B, 2008). Variance decomposition in the VAR model provides us with the clear view of the starting point from where the interactions between the variables are felt.

Looking at the result (see appendix 9), it can be concluded that the percentage of errors that are credited to own shocks is somewhat similar in all the cases. For instance, when we look at the cocoa future price, gold future price, natural gas spot price and natural gas future price (see appendix 9), they have shocks of 100%. In the meantime, in case of cocoa spot price, the shocks fall from 100% to 50% which remains stable then after. Similarly, the percentage of errors attributed to own shocks is 95% for the coffee future price, 90% in case of crude oil future price, and 45% in case of silver future price. However, in case of coffee spot price the shock is of 85% which decreases to 55% after the 2nd period, crude oil spot price has the shock of 45% which slightly increases from 42% after the 1st period. Similarly, gold spot price has 90% of shock which decreases to 80% after the 1st period and remains constant then after. Silver spot price has the shock of 80% which declines to 35% from the period 1 and remains constant. Besides these, for the cocoa spot price, cocoa future price explains around 50% of the variation in returns, coffee future price explains around 40% which rises from 15% from the period 1, and crude oil future price explains around 45% for crude oil spot price.

Thus, from the above explanation and results we can conclude that mainly the price of respective commodities has the high percentage of the errors that is attributed to own shocks. Very few other commodities explain the variation in returns of each other.

In totality, VAR model concludes with the notion that the shocks of own its variable (spot price vs. spot price & future price & future price) highly changes the movement of its own. However, the spot price of the variable has an impact on the future price of the respective variable also and vice-versa. Moreover, the shocks in other variables too change the movement of another variable but with the very low effects.

Table 20. VAR model for the spot and future prices of the commodities.

Commodities	SF_D	SP_D	NGS_D	NGF_D	COF_D	COS_D	CFF_D	CFS_D	CROF_D	CROS_D	GF_D	GS_D
SF_D(-1)	0.102893	1.055448	42.48697	-15.43286	6.635473	-7.600443	0.000674	-0.000836	0.098372	0.098458	0.079125	9.390512
	(0.02633)	(0.02051)	(232.881)	(160.601)	(2.72167)	(1.95983)	(0.00170)	(0.00125)	(0.09488)	(0.08525)	(0.70501)	(0.67520)
	[3.90745]	[51.4533]	[0.18244]	[-0.09609]	[2.43801]	[-3.87810]	[0.39678]	[-0.66875]	[1.03679]	[1.15488]	[0.11223]	[13.9078]
SF_D(-2)	0.000105	0.360587	188.2924	-109.3987	1.642481	1.312820	-0.002029	-0.005110	0.290319	0.220861	-1.206091	3.087520
	(0.03503)	(0.02729)	(309.774)	(213.629)	(3.62032)	(2.60694)	(0.00226)	(0.00166)	(0.12621)	(0.11340)	(0.93779)	(0.89813)
	[0.00301]	[13.2152]	[0.60784]	[-0.51210]	[0.45368]	[0.50359]	[-0.89776]	[-3.07285]	[2.30030]	[1.94756]	[-1.28610]	[3.43771]
SS_D(-1)	-0.051982	-0.760586	24.96081	88.72275	-3.846536	-4.221891	0.001770	0.002452	-0.142143	-0.098775	0.590280	-4.500081
	(0.02834)	(0.02207)	(250.605)	(172.825)	(2.92882)	(2.10900)	(0.00183)	(0.00135)	(0.10210)	(0.09174)	(0.75867)	(0.72658)
	[-1.83443]	[-34.4562]	[0.09960]	[0.51337]	[-1.31334]	[-2.00185]	[0.96818]	[1.82220]	[-1.39216]	[-1.07665]	[0.77805]	[-6.19347]
SS_D(-2)	-0.016585	-0.228397	-72.83645	-23.87687	-1.460055	-0.687334	0.002648	0.002367	-0.026783	-0.034346	1.362286	-2.287711
	(0.02282)	(0.01778)	(201.812)	(139.175)	(2.35857)	(1.69837)	(0.00147)	(0.00108)	(0.08222)	(0.07388)	(0.61095)	(0.58512)
	[-0.72679]	[-12.8485]	[-0.36091]	[-0.17156]	[-0.61904]	[-0.40470]	[1.79900]	[2.18485]	[-0.32574]	[-0.46489]	[2.22978]	[-3.90984]
NGS_D(-1)	-2.56E-06	-3.60E-06	-0.635829	0.005565	0.000296	3.60E-05	1.36E-07	-1.64E-07	-4.65E-06	-7.77E-06	-3.40E-05	-3.66E-05
	(1.9E-06)	(1.5E-06)	(0.01717)	(0.01184)	(0.00020)	(0.00014)	(1.3E-07)	(9.2E-08)	(7.0E-06)	(6.3E-06)	(5.2E-05)	(5.0E-05)
	[-1.31590]	[-2.37705]	[-37.0232]	[0.46987]	[1.47375]	[0.24888]	[1.08185]	[-1.77417]	[-0.66479]	[-1.23592]	[-0.65356]	[-0.73484]
NGS_D(-2)	-4.49E-06	-2.76E-06	-0.292950	0.012825	-0.000105	1.99E-05	8.46E-09	-7.39E-08	-7.05E-06	-2.92E-06	-3.99E-06	-8.63E-05
	(1.9E-06)	(1.5E-06)	(0.01719)	(0.01185)	(0.00020)	(0.00014)	(1.3E-07)	(9.2E-08)	(7.0E-06)	(6.3E-06)	(5.2E-05)	(5.0E-05)
	[-2.31189]	[-1.82382]	[-17.0434]	[1.08192]	[-0.52398]	[0.13788]	[0.06744]	[-0.80073]	[-1.00690]	[-0.46391]	[-0.07659]	[-1.73126]
NGF_D(-1)	3.76E-06	5.91E-07	-0.064703	-0.639723	3.51E-05	3.23E-05	-1.52E-09	3.11E-08	-4.76E-06	3.19E-06	-2.73E-05	9.34E-05
	(2.8E-06)	(2.2E-06)	(0.02471)	(0.01704)	(0.00029)	(0.00021)	(1.8E-07)	(1.3E-07)	(1.0E-05)	(9.0E-06)	(7.5E-05)	(7.2E-05)

	[1.34424]	[0.27171]	[-2.61891]	[-37.5469]	[0.12140]	[0.15534]	[-0.00845]	[0.23461]	[-0.47251]	[0.35267]	[-0.36446]	[1.30364]
NGF_D(-2)	-1.62E-06	-1.61E-06	-0.035870	-0.321886	-0.000255	-5.97E-06	-4.29E-09	2.27E-09	-1.32E-05	-8.59E-06	-3.04E-05	3.46E-06
	(2.8E-06)	(2.2E-06)	(0.02472)	(0.01704)	(0.00029)	(0.00021)	(1.8E-07)	(1.3E-07)	(1.0E-05)	(9.0E-06)	(7.5E-05)	(7.2E-05)
	[-0.58111]	[-0.73945]	[-1.45128]	[-18.8848]	[-0.88354]	[-0.02869]	[-0.02379]	[0.01710]	[-1.31424]	[-0.94898]	[-0.40667]	[0.04832]
COF_D(-1)	-6.42E-05	-7.27E-05	-0.016677	1.236476	-0.030218	0.741779	-3.99E-06	9.87E-06	-0.000486	-0.000870	-0.005782	-0.005383
	(0.00018)	(0.00014)	(1.62789)	(1.12264)	(0.01903)	(0.01370)	(1.2E-05)	(8.7E-06)	(0.00066)	(0.00060)	(0.00493)	(0.00472)
	[-0.34893]	[-0.50726]	[-0.01024]	[1.10140]	[-1.58834]	[54.1457]	[-0.33612]	[1.12947]	[-0.73352]	[-1.45948]	[-1.17316]	[-1.14051]
COF_D(-2)	-0.000168	-0.000163	4.407558	-1.470812	-0.045999	0.357654	-4.36E-06	3.45E-06	-0.000526	-0.000832	0.001848	-0.001704
	(0.00025)	(0.00019)	(2.19540)	(1.51401)	(0.02566)	(0.01848)	(1.6E-05)	(1.2E-05)	(0.00089)	(0.00080)	(0.00665)	(0.00637)
	[-0.67704]	[-0.84398]	[2.00764]	[-0.97147]	[-1.79279]	[19.3582]	[-0.27197]	[0.29270]	[-0.58777]	[-1.03524]	[0.27807]	[-0.26769]
COS_D(-1)	-4.59E-05	0.000122	-0.814783	2.758375	0.082166	-0.353762	2.22E-05	1.70E-05	0.000684	0.000995	-0.005516	0.004653
	(0.00023)	(0.00018)	(2.01906)	(1.39240)	(0.02360)	(0.01699)	(1.5E-05)	(1.1E-05)	(0.00082)	(0.00074)	(0.00611)	(0.00585)
	[-0.20108]	[0.68720]	[-0.40355]	[1.98102]	[3.48209]	[-20.8198]	[1.50935]	[1.57128]	[0.83179]	[1.34569]	[-0.90237]	[0.79479]
COS_D(-2)	-7.72E-05	3.40E-05	0.404153	-0.982894	0.042791	-0.062876	3.08E-06	1.89E-05	0.000201	0.000716	-7.33E-05	0.002498
	(0.00017)	(0.00013)	(1.47717)	(1.01870)	(0.01726)	(0.01243)	(1.1E-05)	(7.9E-06)	(0.00060)	(0.00054)	(0.00447)	(0.00428)
	[-0.46220]	[0.26098]	[0.27360]	[-0.96485]	[2.47870]	[-5.05793]	[0.28609]	[2.37883]	[0.33431]	[1.32326]	[-0.01639]	[0.58320]
CFF_D(-1)	1.111625	0.468441	-859.2069	-430.8805	87.67110	13.07261	-0.042680	0.589659	2.963231	1.913267	-3.564206	14.37709
	(0.31698)	(0.24692)	(2803.30)	(1933.23)	(32.7620)	(23.5914)	(0.02045)	(0.01505)	(1.14213)	(1.02625)	(8.48650)	(8.12764)
	[3.50697]	[1.89713]	[-0.30650]	[-0.22288]	[2.67600]	[0.55413]	[-2.08709]	[39.1792]	[2.59448]	[1.86434]	[-0.41999]	[1.76891]
CFF_D(-2)	0.021929	0.495707	-6531.848	2144.870	-3.521037	-10.89031	-0.069777	0.272294	-0.753212	-0.241514	5.855386	10.68528
	(0.37219)	(0.28993)	(3291.63)	(2270.00)	(38.4691)	(27.7010)	(0.02401)	(0.01767)	(1.34109)	(1.20502)	(9.96484)	(9.54347)
	[0.05892]	[1.70972]	[-1.98438]	[0.94488]	[-0.09153]	[-0.39314]	[-2.90595]	[15.4081]	[-0.56164]	[-0.20042]	[0.58760]	[1.11964]

CFS_D(-1)	0.964409	0.666396	2372.896	-1917.936	29.07451	17.95819	0.059799	-0.331730	0.521824	0.425371	-10.80785	16.67337
	(0.39181)	(0.30522)	(3465.12)	(2389.64)	(40.4967)	(29.1611)	(0.02528)	(0.01860)	(1.41177)	(1.26853)	(10.4901)	(10.0465)
	[2.46142]	[2.18336]	[0.68480]	[-0.80260]	[0.71795]	[0.61583]	[2.36572]	[-17.8316]	[0.36962]	[0.33533]	[-1.03029]	[1.65962]
CFS_D(-2)	0.373629	0.454334	2377.615	-280.1587	-1.492786	9.067339	-0.025545	-0.155338	-1.159203	-0.669303	-6.684537	6.368035
	(0.32424)	(0.25258)	(2867.51)	(1977.51)	(33.5125)	(24.1318)	(0.02092)	(0.01540)	(1.16829)	(1.04975)	(8.68089)	(8.31381)
	[1.15233]	[1.79879]	[0.82916]	[-0.14167]	[-0.04454]	[0.37574]	[-1.22120]	[-10.0902]	[-0.99222]	[-0.63758]	[-0.77003]	[0.76596]
CROF_D(-1)	0.008712	0.019101	67.49548	50.57711	-0.020203	1.219002	-0.000134	9.09E-06	-0.071721	0.422793	0.171807	0.439809
	(0.00715)	(0.00557)	(63.2268)	(43.6030)	(0.73893)	(0.53209)	(0.00046)	(0.00034)	(0.02576)	(0.02315)	(0.19141)	(0.18331)
	[1.21855]	[3.42970]	[1.06751]	[1.15994]	[-0.02734]	[2.29096]	[-0.29047]	[0.02678]	[-2.78420]	[18.2660]	[0.89759]	[2.39920]
CROF_D(-2)	-0.022138	0.001733	-51.65762	20.33236	-0.943166	-0.446376	-0.000521	-0.000558	-0.072225	0.147078	-0.213336	-0.531265
	(0.00752)	(0.00586)	(66.5149)	(45.8705)	(0.77736)	(0.55976)	(0.00049)	(0.00036)	(0.02710)	(0.02435)	(0.20136)	(0.19285)
	[-2.94342]	[0.29577]	[-0.77663]	[0.44326]	[-1.21330]	[-0.79744]	[-1.07368]	[-1.56396]	[-2.66515]	[6.04012]	[-1.05946]	[-2.75485]
CROS_D(-1)	0.002657	-0.010496	-100.2772	11.22079	0.990224	0.436241	0.000217	0.000688	0.059387	-0.274132	-0.135406	-0.329130
	(0.00786)	(0.00613)	(69.5417)	(47.9579)	(0.81273)	(0.58524)	(0.00051)	(0.00037)	(0.02833)	(0.02546)	(0.21053)	(0.20162)
	[0.33792]	[-1.71353]	[-1.44197]	[0.23397]	[1.21839]	[0.74541]	[0.42834]	[1.84279]	[2.09603]	[-10.7679]	[-0.64318]	[-1.63240]
CROS_D(-2)	0.002853	-0.011850	-30.40111	25.23552	-0.093761	-0.118742	0.000931	0.000495	0.018811	-0.124526	0.057706	0.231008
	(0.00735)	(0.00572)	(64.9620)	(44.7997)	(0.75921)	(0.54670)	(0.00047)	(0.00035)	(0.02647)	(0.02378)	(0.19666)	(0.18835)
	[0.38836]	[-2.07087]	[-0.46798]	[0.56330]	[-0.12350]	[-0.21720]	[1.96499]	[1.42070]	[0.71071]	[-5.23621]	[0.29343]	[1.22651]
GF_D(-1)	-0.001128	-0.000887	-5.732733	-2.459822	-0.020852	0.014013	4.06E-05	6.90E-05	-0.003241	-0.002796	0.038616	-0.035323
	(0.00067)	(0.00052)	(5.95259)	(4.10508)	(0.06957)	(0.05009)	(4.3E-05)	(3.2E-05)	(0.00243)	(0.00218)	(0.01802)	(0.01726)
	[-1.67659]	[-1.69183]	[-0.96306]	[-0.59921]	[-0.29974]	[0.27972]	[0.93434]	[2.15926]	[-1.33642]	[-1.28303]	[2.14289]	[-2.04672]
GF_D(-2)	0.000992	0.000232	6.404292	1.515727	-0.081898	0.023387	-4.64E-05	8.80E-06	0.008314	0.003106	-0.026332	0.001890
	(0.00067)	(0.00052)	(5.94724)	(4.10139)	(0.06951)	(0.05005)	(4.3E-05)	(3.2E-05)	(0.00242)	(0.00218)	(0.01800)	(0.01724)

	[1.47577]	[0.44195]	[1.07685]	[0.36956]	[-1.17831]	[0.46727]	[-1.07054]	[0.27574]	[3.43115]	[1.42677]	[-1.46256]	[0.10960]
GS_D(-1)	-0.002282	-0.000851	13.72095	-1.928010	-0.011904	0.144397	-7.53E-05	-1.25E-05	-0.001874	-0.005453	-0.063533	-0.140072
	(0.00087)	(0.00068)	(7.73715)	(5.33576)	(0.09042)	(0.06511)	(5.6E-05)	(4.2E-05)	(0.00315)	(0.00283)	(0.02342)	(0.02243)
	[-2.60878]	[-1.24801]	[1.77338]	[-0.36134]	[-0.13164]	[2.21764]	[-1.33344]	[-0.30181]	[-0.59433]	[-1.92532]	[-2.71242]	[-6.24415]
GS_D(-2)	0.002454	0.002126	0.330614	-0.059729	0.157251	0.054717	2.42E-05	0.000105	0.006195	0.003332	0.024704	0.019262
	(0.00088)	(0.00068)	(7.74791)	(5.34318)	(0.09055)	(0.06520)	(5.7E-05)	(4.2E-05)	(0.00316)	(0.00284)	(0.02346)	(0.02246)
	[2.80157]	[3.11560]	[0.04267]	[-0.01118]	[1.73663]	[0.83917]	[0.42881]	[2.53314]	[1.96240]	[1.17471]	[1.05325]	[0.85746]
C	0.006453	0.003395	-3.985767	-0.819125	0.318037	0.056423	0.000351	0.000105	0.019054	0.022472	0.493892	0.426009
	(0.00692)	(0.00539)	(61.1925)	(42.2001)	(0.71516)	(0.51497)	(0.00045)	(0.00033)	(0.02493)	(0.02240)	(0.18525)	(0.17742)
	[0.93266]	[0.62996]	[-0.06513]	[-0.01941]	[0.44471]	[0.10957]	[0.78616]	[0.32047]	[0.76428]	[1.00314]	[2.66608]	[2.40118]
R-squared	0.034696	0.565778	0.314284	0.316400	0.018488	0.547494	0.011079	0.378845	0.019362	0.115842	0.011815	0.088880
Adj. R-squared	0.027228	0.562419	0.308979	0.311111	0.010894	0.543993	0.003427	0.374039	0.011774	0.109001	0.004170	0.081831
Sum sq. resids	460.7191	279.5767	3.60E+10	1.71E+10	4921812.	2552069.	1.917545	1.038663	5981.542	4829.323	330248.5	302909.2
S.E. equation	0.385387	0.300213	3408.316	2350.471	39.83287	28.68305	0.024863	0.018299	1.388627	1.247735	10.31810	9.881783
F-statistic	4.645658	168.4090	59.23910	59.82243	2.434539	156.3813	1.447940	78.83003	2.551895	16.93425	1.545377	12.60842
Log likelihood	-1442.854	-661.8679	-29859.41	-28697.40	-15946.50	-14919.64	7127.850	8086.450	-5451.114	-5116.568	-11722.57	-11587.47
Akaike AIC	0.938826	0.439314	19.11379	18.37058	10.21522	9.558453	-4.542917	-5.156028	3.502471	3.288499	7.513638	7.427226
Schwarz SC	0.987178	0.487666	19.16214	18.41893	10.26358	9.606804	-4.494565	-5.107676	3.550823	3.336851	7.561990	7.475577
Mean dependent	0.007259	0.007323	0.255197	0.260633	0.407739	0.394650	0.000345	0.000336	0.023898	0.026713	0.478734	0.413838
S.D. dependent	0.390743	0.453837	4100.096	2831.915	40.05163	42.47559	0.024906	0.023128	1.396875	1.321854	10.33967	10.31274

DETERMINANT RESID COVARIANCE(DOF ADJ)	7.72E+14
DETERMINANT RESID COVRIANCE	7.01E+14
LOG LIKELIHOOD	-106691.3
AKAIKE INFORMATION CRITERION	68.43061
SCHWARZ CRITERION	69.01083

7. CONCLUSION

The empirical results indicate that the spot and future prices of used commodities are stationary after the first differencing but the spot and future price of natural gas had the stationarity even before doing the first differencing. The major findings of the study are as follows:

The Johansen cointegration test exhibits that that there exist the long run relationship between the spot and future prices of the agricultural, energy and precious metals (commodities) except the crude oil spot and future prices. Thus, the first hypothesis is fulfilled.

The granger causality test exhibits the bi-directional, uni-directional and no causality relationship between the selected spot-future, future-spot, spot-spot and future-future prices of the commodities. In the case of agricultural commodities (cocoa and coffee), energy (crude oil) and precious metal (gold) bi-directional relationship was found whereas at the same time natural gas spot and silver future have the uni-directional relationship with the natural gas future price and silver spot price respectively. Thus, it is safely concluded that although in the theories future prices play a crucial role in the price discovery process, the spot price too play an equal role in this respect. In this way, the second hypothesis is also explained and fulfilled with the notion that prices of one variable granger causes the price of another variable.

Finally, the VAR model explained the interrelationship among the prices of the variables in the system when the shocks are given. It highlights the fact that the movement in the dependent variable occurs which is caused due to its own shock. Moreover, the VAR model results the proportion of effect is high in the case of the respective spot and future of the commodities rather than among the prices of the commodities meaning the changes of movement is seen between the spot vs. spot, future vs. future, spot vs. future or future vs. spot prices of the same commodity. Here, the third hypothesis is also satisfied.

From the above results, it is found out that the differences in the relative importance of the spot and future prices in the price discovery role in the financial markets for the energy and agricultural commodities including precious metals. Moreover, it is important to understand and investigate the price discovery process of both the spot and future markets so as to guide and help the policy makers and market participants to formulate the efficient policies and improve the efficiencies of both markets. Moreover, the commodities like crude oil, natural gas, gold and silver have an important role in the spot and future market since they are the globally traded commodities with high risks thus raising the importance of the use of derivatives. Likewise, price fluctuations of the commodities directly impact on the personal life of everyone plays a vital role in the economy of the country should be realized.

Masih and Masih (2002) suggested that in the presence of either a non-stationary risk premium or a non-stationary convenience yield there exists no cointegration of commodity markets. Thus, from this point of view we can explain that for all the commodities (cocoa, coffee, natural gas, gold and silver) except crude oil there is the presence of the properties of the convenience yield and risk premium.

Similarly, the idea can also be generated that geopolitical plays a vital role in the spot and future markets which can completely twirled out the market scenario in a blink.

In addition, this study could be furthermore extended to observe the situation of spot and future prices of other major commodities focusing on the emerging markets since, these markets hugely affect the global business and comprise the huge space in the global market.

This paper will facilitate the academician, researchers, policy makers, financial analyst, and market players to know the actual value and forecast the outcomes of introduction the options in the global financial market. Moreover, as Batra (2004) highlighted the fact that estimations of market volatility will help in this matter as it is considered as the barometer of the susceptibility of financial risks. Similarly, this paper will help portfolio managers in identifying the risks and hedge them by making efficient portfolios along with the portfolio diversification and creating arbitrage opportunities. If the company or an individual wants to utilize the new information on the movement of the future prices to enter in the hedging process, it is thus suggested to clearly overview the price movements or the relationships between the prices. Besides these, future contract is considered as one of the most important hedging instruments in a hedging contract since it highly reduces the business failure rates with making the availability of wide range of products in the financial markets. It has helped the companies to invest in resourceful but valuable production technologies and relocation of risks to those who are willing to bear and handle them (Culp, 2009). So as to reduce the spot price volatility future prices can be used in the financial market since the future market increases the overall market depth and in formativeness which are important for price discovery and transfer the risks.

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APPENDICES

APPENDIX 1.

UNIT ROOT TEST BEFORE FIRST DIFFERENCES

I. Spot Prices

a. cocoa_spot

Null Hypothesis: COCOA_SPOT has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.912965	0.3265
Test critical values:	1% level	-3.432092	
	5% level	-2.862195	
	10%level	-2.567163	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COCOA_SPOT)
Method: Least Squares
Date: 01/28/13 Time: 15:29
Sample (adjusted): 3/03/2000 2/27/2013
Included observations: 3389 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COCOA_SPOT(-1)	-0.001911	0.000999	-1.912965	0.0558
D(COCOA_SPOT(-1))	-0.083416	0.017120	-4.872477	0.0000
C	4.286249	2.134546	2.008038	0.0447

R-squared	0.008160	Mean dependenvar	0.412842
Adjusted R squared	0.007574	S.D. dependent var	42.53885
S.E. of regression	42.37744	Akaike info criterion	10.33199
Sum squared resid	6080740.	Schwarz criterion	10.33742
Log likelihood	-17504.56	Hannan-Quincriter.	10.33393
F-statistic	13.92856	Durbin-Watson stat	1.998874
Prob(F-statistic)	0.000001		

b. coffee_spot

Null Hypothesis: COFFEE_SPOT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.186958	0.6823
Test critical values:	1% level	-3.432091	
	5% level	-2.862195	
	10% level	-2.567162	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COFFEE_SPOT)
Method: Least Squares
Date: 01/28/13 Time: 15:32
Sample (adjusted): 3/02/2000 2/27/2013
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COFFEE_SPOT(-1)	-0.000863	0.000727	-1.186958	0.2353
C	0.001024	0.000905	1.130621	0.2583

R-squared	0.000416	Mean dependent var	6.49E-05
AdjustedRsquared	0.000121	S.D. dependent var	0.023817
S.E. of regression	0.023815	Akaike info criterion	-4.636377
Sum squared resid	1.921587	Schwarz criterion	-4.632761
Log likelihood	7860.659	HannanQuinncriter.	-4.635084
F-statistic	1.408869	Durbin-Watson stat	1.964024
Prob(F-statistic)	0.235328		

c. crude_oil_spot

Null Hypothesis: CRUDE_OIL_SPOT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-0.994072	0.7575

Test critical values:	1% level	-3.432091
	5% level	-2.862195
	10% level	-2.567162

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CRUDE_OIL_SPOT)
Method: Least Squares
Date: 01/28/13 Time: 15:33
Sample (adjusted): 3/02/2000 2/27/2013
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRUDE_OIL_SPOT(1)	-0.000707	0.000711	-0.994072	0.3203
C	0.068410	0.049353	1.386121	0.1658

R-squared	0.000292	Mean dependent var	0.025006
Adjusted R-squared	-0.000003	S.D. dependent var	1.339555
S.E. of regression	1.339557	Akaike info criterion	3.423145
Sum squared resid	6079.474	Schwarz criterion	3.426761
Log likelihood	-5800.231	Hannan-Quinn criter.	3.424438
F-statistic	0.988179	Durbin-Watson stat	1.907600
Prob(F-statistic)	0.320259		

d. gold_spot

Null Hypothesis: GOLD_SPOT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.397134	0.9829
Test critical values:	1% level	-3.432091	
	5% level	-2.862195	
	10%level	-2.567162	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GOLD_SPOT)
Method: Least Squares
Date: 01/28/13 Time: 15:34

Sample (adjusted): 3/02/2000 2/27/2013
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GOLD_SPOT(-1)	0.000157	0.000395	0.397134	0.6913
C	0.287616	0.348348	0.825657	0.4091

R-squared	0.000047	Mean dependent var	0.404546
Adjusted R-squared	-0.000249	S.D. dependent var	10.83741
S.E. of regression	10.83876	Akaike info criterion	7.604724
Sum squared resid	398017.9	Schwarz criterion	7.608340
Log likelihood	-12888.01	HannanQuinncriter.	7.606017
F-statistic	0.157715	Durbin-Watson stat	2.001814
Prob(F-statistic)	0.691294		

e. nat_gas_spot

Null Hypothesis: NAT_GAS_SPOT has a unit root
Exogenous: Constant
Lag Length: 13 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.622396	0.0000
Test critical values:	1% level	-3.432099	
	5% level	-2.862198	
	10% level	-2.567164	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(NAT_GAS_SPOT)
Method: Least Squares
Date: 01/28/13 Time: 15:34
Sample (adjusted): 3/21/2000 2/27/2013
Included observations: 3377 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NAT_GAS_SPOT(-1)	-0.308991	0.035836	-8.622396	0.0000
D(NAT_GAS_SPOT(-1))	-0.593655	0.037200	-15.95860	0.0000
D(NAT_GAS_SPOT(-2))	-0.514714	0.037896	-13.58220	0.0000

D(NAT_GAS_SPOT(-3))	-0.488060	0.038149	-12.79342	0.0000
D(NAT_GAS_SPOT(-4))	-0.460970	0.038167	-12.07786	0.0000
D(NAT_GAS_SPOT(-5))	-0.415108	0.037890	-10.95568	0.0000
D(NAT_GAS_SPOT(-6))	-0.366177	0.037297	-9.817898	0.0000
D(NAT_GAS_SPOT(-7))	-0.312400	0.036282	-8.610424	0.0000
D(NAT_GAS_SPOT(-8))	-0.260931	0.034780	-7.502397	0.0000
D(NAT_GAS_SPOT(-9))	-0.224427	0.032764	-6.849788	0.0000
D(NAT_GAS_SPOT(-10))	-0.174850	0.030193	-5.790992	0.0000
D(NAT_GAS_SPOT(-11))	-0.140264	0.027044	-5.186504	0.0000
D(NAT_GAS_SPOT(-12))	-0.114786	0.023132	-4.962177	0.0000
D(NAT_GAS_SPOT(-13))	-0.070513	0.017210	-4.097171	0.0000
C	810.0819	106.5830	7.600477	0.0000

R-squared	0.451412	Mean dependentvar	1.007243
Adjusted R-squared	0.449127	S.D. dependent var	3949.608
S.E. of regression	2931.430	Akaike info criterion	18.80880
Sum squared resid	2.89E+10	Schwarz criterion	18.83601
Log likelihood	-31743.66	Hannan-Quincriter.	18.81853
F-statistic	197.6043	Durbin-Watson stat	2.003141
Prob(F-statistic)	0.000000		

f. silver_spot

Null Hypothesis: SILVER_SPOT has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.885676	0.7933
Test critical values:	1% level	-3.432095	
	5% level	-2.862197	
	10% level	-2.567163	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SILVER_SPOT)
Method: Least Squares
Date: 01/28/13 Time: 15:35
Sample (adjusted): 3/13/2000 2/27/2013
Included observations: 3383 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

SILVER_SPOT(-1)	-0.000699	0.000789	-0.885676	0.3759
D(SILVER_SPOT(-1))	-0.110491	0.017094	-6.463843	0.0000
D(SILVER_SPOT(-2))	-0.007372	0.017194	-0.428770	0.6681
D(SILVER_SPOT(-3))	-0.036938	0.017196	-2.148074	0.0318
D(SILVER_SPOT(-4))	0.028862	0.017202	1.677840	0.0935
D(SILVER_SPOT(-5))	-0.007806	0.017196	-0.453965	0.6499
D(SILVER_SPOT(-6))	-0.024747	0.017196	-1.439122	0.1502
D(SILVER_SPOT(-7))	0.123727	0.017112	7.230581	0.0000
C	0.016909	0.013144	1.286422	0.1984

R-squared	0.032045	Mean dependent var	0.007334
Adjusted R-squared	0.029750	S.D. dependent var	0.463550
S.E. of regression	0.456603	Akaike info criterion	1.272650
Sum squared resid	703.4313	Schwarz criterion	1.288949
Log likelihood	-2143.687	Hannan-Quinn criter.	1.278477
F-statistic	13.96238	Durbin-Watson stat	1.997734
Prob(F-statistic)	0.000000		

ii. Future Prices

g. cocoa_fut

Null Hypothesis: COCOA_FUT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.974183	0.2985
Test critical values:	1% level	-3.432091	
	5% level	-2.862195	
	10% level	-2.567162	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COCOA_FUT)
Method: Least Squares
Date: 01/28/13 Time: 15:37
Sample (adjusted): 1/04/2000 12/31/2012
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COCOA_FUT(-1)	-0.001913	0.000969	-1.974183	0.0484
C	4.138859	2.011678	2.057416	0.0397

R-squared	0.001149	Mean dependent var	0.411209
Adjusted R-squared	0.000854	S.D. dependent var	40.42110
S.E. of regression	40.40384	Akaike info criterion	10.23632
Sum squared resid	5530808.	Schwarz criterion	10.23993
Log likelihood	-17348.56	Hannan-Quinn criter.	10.23761
F-statistic	3.897398	Durbin-Watson stat	1.981994
Prob(F-statistic)	0.048442		

h. coffee_fut

Null Hypothesis: COFFEE_FUT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.421087	0.9033
Test critical values:	1% level	-3.432251	
	5% level	-2.862265	
	10% level	-2.567200	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COFFEE_FUT)
Method: Least Squares
Date: 01/28/13 Time: 15:37
Sample (adjusted): 1/04/2000 12/30/2011
Included observations: 3129 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COFFEE_FUT(-1)	-0.000343	0.000814	-0.421087	0.6737
C	0.000735	0.001055	0.696785	0.4860

R-squared	0.000057	Mean dependent var	0.000332
Adjusted R-squared	-0.000263	S.D. dependent var	0.024924
S.E. of regression	0.024927	Akaike info criterion	-4.545109
Sum squared resid	1.942944	Schwarz criterion	-4.541243

Log likelihood	7112.823	Hannan Quinn criter.	-4.543721
F-statistic	0.177314	Durbin-Watson stat	2.046038
Prob(F-statistic)	0.673720		

i. crude_oil_fut

Null Hypothesis: CRUDE_OIL_FUT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.484526	0.5416
Test critical values:	1% level	-3.432091	
	5% level	-2.862195	
	10% level	-2.567162	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CRUDE_OIL_FUT)
Method: Least Squares
Date: 01/28/13 Time: 15:37
Sample (adjusted): 1/04/2000 12/31/2012
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRUDE_OIL_FUT(-1)	-0.001256	0.000846	-1.484526	0.1378
C	0.095656	0.056454	1.694401	0.0903

R-squared	0.000650	Mean dependent var	0.019844
Adjusted R-squared	0.000355	S.D. dependent var	1.401366
S.E. of regression	1.401117	Akaike info criterion	3.513006
Sum squared resid	6651.080	Schwarz criterion	3.516622
Log likelihood	-5952.546	Hannan Quinn criter.	3.514299
F-statistic	2.203818	Durbin-Watson stat	2.070770
Prob(F-statistic)	0.137762		

j. gold_fut

Null Hypothesis: GOLD_FUT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.411909	0.9835
Test critical values:	1% level	-3.432115	
	5% level	-2.862205	
	10% level	-2.567168	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GOLD_FUT)
Method: Least Squares
Date: 01/28/13 Time: 15:38
Sample (adjusted): 1/04/2000 11/01/2012
Included observations: 3348 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GOLD_FUT(-1)	0.000165	0.000399	0.411909	0.6804
C	0.288978	0.354371	0.815469	0.4149

R-squared	0.000051	Mean dependent var	0.412634
Adjusted R-squared	-0.000248	S.D. dependent var	10.89414
S.E. of regression	10.89549	Akaike info criterion	7.615172
Sum squared resid	397209.4	Schwarz criterion	7.618826
Log likelihood	-12745.80	HannanQuinncriter.	7.616479
F-statistic	0.169669	Durbin-Watson stat	1.989715
Prob(F-statistic)	0.680433		

k. nat_gas_fut

Null Hypothesis: NAT_GAS_FUT has a unit root
Exogenous: Constant
Lag Length: 11 (Automatic - based on SIC, maxlag=14)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.829502	0.0000

Test critical values:	1% level	-3.432098
	5% level	-2.862198
	10% level	-2.567164

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(NAT_GAS_FUT)
Method: Least Squares
Date: 01/28/13 Time: 15:38
Sample (adjusted): 1/19/2000 12/31/2012
Included observations: 3379 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NAT_GAS_FUT(-1)	-0.079828	0.016529	-4.829502	0.0000
D(NAT_GAS_FUT(-1))	-0.791473	0.022785	-34.73703	0.0000
D(NAT_GAS_FUT(-2))	-0.699941	0.026381	-26.53251	0.0000
D(NAT_GAS_FUT(-3))	-0.622504	0.028723	-21.67293	0.0000
D(NAT_GAS_FUT(-4))	-0.558868	0.030049	-18.59876	0.0000
D(NAT_GAS_FUT(-5))	-0.467094	0.030724	-15.20267	0.0000
D(NAT_GAS_FUT(-6))	-0.397179	0.030688	-12.94232	0.0000
D(NAT_GAS_FUT(-7))	-0.339403	0.030006	-11.31106	0.0000
D(NAT_GAS_FUT(-8))	-0.276206	0.028532	-9.680709	0.0000
D(NAT_GAS_FUT(-9))	-0.156424	0.026283	-5.951533	0.0000
D(NAT_GAS_FUT(-10))	-0.097876	0.022761	-4.300167	0.0000
D(NAT_GAS_FUT(-11))	-0.058239	0.017198	-3.386466	0.0007
C	397.7971	89.20963	4.459127	0.0000

R-squared	0.434906	Mean dependent vr	0.283812
Adjusted R-squared	0.432891	S.D.dependen var	2747.493
S.E. of regression	2069.045	Akaike info criterion	18.11140
Sum squared resid	1.44E+10	Schwarz criterion	18.13497
Log likelihood	-30586.21	Hannan Quinn critr.	18.11983
F-statistic	215.8773	Durbin-Watson stat	2.005034
Prob(F-statistic)	0.000000		

l. silver_fut

Null Hypothesis: SILVER_FUT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

	t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-0.736461	0.8357
Test critical values:	1% level	-3.432091	
	5% level	-2.862195	
	10% level	-2.567162	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SILVER_FUT)
Method: Least Squares
Date: 01/28/13 Time: 15:39
Sample (adjusted): 1/04/2000 12/31/2012
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SILVER_FUT(-1)	-0.000520	0.000706	-0.736461	0.4615
C	0.014255	0.011773	1.210780	0.2261

R-squared	0.000160	Mean dependent var	0.007304
Adjusted R-squared	-0.000135	S.D. dependent var	0.409725
S.E. of regression	0.409753	Akaike info criterion	1.054065
Sum squared resid	568.8367	Schwarz criterion	1.057681
Log likelihood	-1784.641	Hannan-Quinn criter.	1.055358
F-statistic	0.542375	Durbin-Watson stat	1.963174
Prob(F-statistic)	0.461501		

APPENDIX 2

UNIT ROOT TEST AFTER 1ST DIFFERENCES

a. **cocoa_spot**

Null Hypothesis: COCOA_SPOT_D has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-63.32229	0.0001
Test critical values:	1% level	-3.432092	
	5% level	-2.862195	
	10% level	-2.567163	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COCOA_SPOT_D)
Method: Least Squares
Date: 01/29/13 Time: 16:26
Sample (adjusted): 3/03/2000 2/27/2013
Included observations: 3389 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COCOA_SPOT_D(-1)	-1.084191	0.017122	-63.32229	0.0000
C	0.447746	0.728266	0.614811	0.5387

R-squared	0.542094	Mean dependent var	-0.001747
Adjusted R-squared	0.541959	S.D. dependent var	62.64016
S.E. of regression	42.39408	Akaike info criterion	10.33248
Sum squared resid	6087312.	Schwarz criterion	10.33610
Log likelihood	-17506.39	Hannan-Quinn criter.	10.33378
F-statistic	4009.712	Durbin-Watson stat	1.998978
Prob(F-statistic)	0.000000		

b. **cocoa_fut**

Null Hypothesis: COCOA_FUT_D has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=28)

	t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-57.72074	0.0001
Test critical values:	1% level	-3.432092	
	5% level	-2.862195	
	10% level	-2.567163	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COCOA_FUT_D)
Method: Least Squares
Date: 01/29/13 Time: 16:26
Sample (adjusted): 3/03/2000 2/27/2013
Included observations: 3389 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COCOA_FUT_D(-1)	-0.991774	0.017182	-57.72074	0.0000
C	0.405262	0.694554	0.583486	0.5596

R-squared	0.495883	Mean dependent var	-0.006197
Adjusted R-squared	0.495735	S.D. dependent var	56.93629
S.E. of regression	40.43140	Akaike info criterion	10.23768
Sum squared resid	5536722.	Schwarz criterion	10.24130
Log likelihood	-17345.75	Hannan-Quinn criter.	10.23897
F-statistic	3331.684	Durbin-Watson stat	2.000067
Prob(F-statistic)	0.000000		

c. **coffee_spot**

Null Hypothesis: COFFEE_SPOT_D has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-43.37054	0.0000
Test critical values:	1% level	-3.432092	
	5% level	-2.862195	
	10% level	-2.567163	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COFFEE_SPOT_D)
Method: Least Squares

Date: 01/29/13 Time: 16:27
Sample (adjusted): 3/06/2000 2/27/2013
Included observations: 3388 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COFFEE_SPOT_D(-1)	-1.042852	0.024045	-43.37054	0.0000
D(COFFEE_SPOT_D(-1))	0.061348	0.017153	3.576493	0.0004
C	5.89E-05	0.000409	0.144216	0.8853

R-squared	0.493256	Mean dependent var	-5.90E-06
Adjusted R-squared	0.492957	S.D. dependent var	0.033395
S.E. of regression	0.023779	Akaike info criterion	-4.639114
Sum squared resid	1.914073	Schwarz criterion	-4.633687
Log likelihood	7861.658	Hannan-Quinn criter.	-4.637174
F-statistic	1647.451	Durbin-Watson stat	1.996147
Prob(F-statistic)	0.000000		

d. **coffee_fut**

Null Hypothesis: COFFEE_FUT_D has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-57.33761	0.0001
Test critical values:	1% level	-3.432251	
	5% level	-2.862266	
	10% level	-2.567200	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COFFEE_FUT_D)
Method: Least Squares
Date: 01/29/13 Time: 16:27
Sample (adjusted): 3/03/2000 2/28/2012
Included observations: 3128 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COFFEE_FUT_D(1)	-1.024486	0.017868	-57.33761	0.0000
C	0.000360	0.000445	0.807548	0.4194

R-squared	0.512598	Mean dependent var	2.88E-05
Adjusted R-squared	0.512442	S.D. dependent var	0.035661
S.E. of regression	0.024901	Akaike info criterion	-4.547208
Sum squared resid	1.938249	Schwarz criterion	-4.543341
Log likelihood	7113.834	Hannan-Quinn criter.	-4.545820
F-statistic	3287.602	Durbin-Watson stat	2.000114
Prob(F-statistic)	0.000000		

e. crude_oil_spot

Null Hypothesis: CRUDE_OIL_SPOT_D has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-55.60527	0.0001
Test critical values:	1% level	-3.432092	
	5% level	-2.862195	
	10% level	-2.567163	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CRUDE_OIL_SPOT_D)
Method: Least Squares
Date: 01/29/13 Time: 16:28
Sample (adjusted): 3/03/2000 2/27/2013
Included observations: 3389 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRUDE_OIL_SPOT_D(-1)	-0.954329	0.017163	-55.60527	0.0000
C	0.024239	0.022994	1.054135	0.2919

R-squared	0.477230	Mean dependent var	0.000413
Adjusted R-squared	0.477075	S.D. dependent var	1.850796
S.E. of regression	1.338376	Akaike info criterion	3.421381
Sum squared resid	6066.962	Schwarz criterion	3.424997
Log likelihood	-5795.529	Hannan-Quinn criter.	3.422673
F-statistic	3091.946	Durbin-Watson stat	1.999041
Prob(F-statistic)	0.000000		

f. crude_oil_fut

Null Hypothesis: CRUDE_OIL_FUT_D has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-60.33349	0.0001
Test critical values:	1% level	-3.432092	
	5% level	-2.862195	
	10% level	-2.567163	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CRUDE_OIL_FUT_D)
Method: Least Squares
Date: 02/04/13 Time: 17:06
Sample (adjusted): 1/05/2000 12/31/2012
Included observations: 3389 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRUDE_OIL_FUT_D(-1)	-1.036087	0.017173	-60.33349	0.0000
C	0.020603	0.024066	0.856095	0.3920

R-squared	0.518011	Mean dependent var	0.000333
Adjusted R-squared	0.517869	S.D. dependent var	2.017498
S.E. of regression	1.400863	Akaike info criterion	3.512644
Sum squared resid	6646.708	Schwarz criterion	3.516261
Log likelihood	-5950.176	Hannan-Quinn criter.	3.513937
F-statistic	3640.130	Durbin-Watson stat	2.001015
Prob(F-statistic)	0.000000		

g. gold_spot

Null Hypothesis: GOLD_SPOT_D has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=28)

	t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-58.25397	0.0001
Test critical values:	1% level	-3.432092	
	5% level	-2.862195	
	10% level	-2.567163	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GOLD_SPOT_D)
Method: Least Squares
Date: 01/29/13 Time: 16:29
Sample (adjusted): 3/03/2000 2/27/2013
Included observations: 3389 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GOLD_SPOT_D(-1)	-1.000875	0.017181	-58.25397	0.0000
C	0.407895	0.186321	2.189205	0.0286

R-squared	0.500481	Mean dependent var	0.004706
Adjusted R-squared	0.500334	S.D. dependent var	15.33407
S.E. of regression	10.83920	Akaike info criterion	7.604806
Sum squared resid	397933.0	Schwarz criterion	7.608423
Log likelihood	-12884.34	HannanQuinn criter.	7.606099
F-statistic	3393.525	Durbin-Watson stat	2.000006
Prob(F-statistic)	0.000000		

h. gold_fut

Null Hypothesis: GOLD_FUT_D has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-57.52904	0.0001
Test critical values:	1% level	-3.432116	
	5% level	-2.862206	
	10% level	-2.567168	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(GOLD_FUT_D)
Method: Least Squares
Date: 01/29/13 Time: 16:30
Sample (adjusted): 3/03/2000 12/31/2012
Included observations: 3347 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GOLD_FUT_D(-1)	-0.995137	0.017298	-57.52904	0.0000
C	0.411855	0.188488	2.185046	0.0290

R-squared	0.497339	Mean dependent var	0.007021
Adjusted R-squared	0.497189	S.D. dependent var	15.36761
S.E. of regression	10.89705	Akaike info criterion	7.615458
Sum squared resid	397204.0	Schwarz criterion	7.619112
Log likelihood	-12742.47	Hannan-Quinn criter.	7.616765
F-statistic	3309.591	Durbin-Watson stat	1.998896
Prob(F-statistic)	0.000000		

i. nat_gas_spot

Null Hypothesis: NAT_GAS_SPOT_D has a unit root
Exogenous: Constant
Lag Length: 19 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-22.75005	0.0000
Test critical values:	1% level	-3.432103	
	5% level	-2.862200	
	10% level	-2.567165	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(NAT_GAS_SPOT_D)
Method: Least Squares
Date: 01/29/13 Time: 16:30
Sample (adjusted): 3/30/2000 2/27/2013
Included observations: 3370 after adjustments

Variable	Coefficient	Std.Error	t-Statistic	Prob.
NAT_GAS_SPOT_D(-1)	-10.41273	0.457701	-22.75005	0.0000
D(NAT_GAS_SPOT_D(-1))	8.511203	0.451642	18.84503	0.0000

D(NAT_GAS_SPOT_D(-2))	7.689762	0.440864	17.44247	0.0000
D(NAT_GAS_SPOT_D(-3))	6.897239	0.426364	16.17688	0.0000
D(NAT_GAS_SPOT_D(-4))	6.134306	0.408616	15.01239	0.0000
D(NAT_GAS_SPOT_D(-5))	5.419067	0.388042	13.96517	0.0000
D(NAT_GAS_SPOT_D(-6))	4.754178	0.365069	13.02268	0.0000
D(NAT_GAS_SPOT_D(-7))	4.142858	0.339985	12.18543	0.0000
D(NAT_GAS_SPOT_D(-8))	3.584195	0.313404	11.43633	0.0000
D(NAT_GAS_SPOT_D(-9))	3.063036	0.285739	10.71970	0.0000
D(NAT_GAS_SPOT_D(-10))	2.591330	0.257178	10.07603	0.0000
D(NAT_GAS_SPOT_D(-11))	2.153908	0.227989	9.447442	0.0000
D(NAT_GAS_SPOT_D(-12))	1.742631	0.198519	8.778155	0.0000
D(NAT_GAS_SPOT_D(-13))	1.375012	0.168978	8.137221	0.0000
D(NAT_GAS_SPOT_D(-14))	1.075951	0.139782	7.697343	0.0000
D(NAT_GAS_SPOT_D(-15))	0.799117	0.111476	7.168514	0.0000
D(NAT_GAS_SPOT_D(-16))	0.557617	0.084533	6.596467	0.0000
D(NAT_GAS_SPOT_D(-17))	0.353973	0.059544	5.944702	0.0000
D(NAT_GAS_SPOT_D(-18))	0.184911	0.036981	5.000181	0.0000
D(NAT_GAS_SPOT_D(-19))	0.066887	0.017244	3.878946	0.0001
C	-1.140215	50.58758	-0.022539	0.9820

R-squared	0.816038	Mean dependent var	-0.795593
Adjusted R-squared	0.814939	S.D. dependent var	6826.529
S.E. of regression	2936.681	Akaike info criterion	18.81416
Sum squared resid	2.89E+10	Schwarz criterion	18.85231
Log likelihood	-31680.86	Hannan-Quinn criter.	18.82780
F-statistic	742.7929	Durbin-Watson stat	2.001888
Prob(F-statistic)	0.000000		

j. **nat_gas_fut**

Null Hypothesis: NAT_GAS_FUT_D has a unit root
Exogenous: Constant
Lag Length: 15 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-24.02430	0.0000
Test critical values:	1% level	-3.432100	
	5% level	-2.862199	
	10% level	-2.567165	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(NAT_GAS_FUT_D)
Method: Least Squares
Date: 01/29/13 Time: 16:30
Sample (adjusted): 3/24/2000 2/27/2013
Included observations: 3374 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NAT_GAS_FUT_D(-1)	-7.800307	0.324684	-24.02430	0.0000
D(NAT_GAS_FUT_D(-1))	5.919787	0.318402	18.59218	0.0000
D(NAT_GAS_FUT_D(-2))	5.123750	0.307462	16.66466	0.0000
D(NAT_GAS_FUT_D(-3))	4.398180	0.292881	15.01695	0.0000
D(NAT_GAS_FUT_D(-4))	3.725462	0.275361	13.52939	0.0000
D(NAT_GAS_FUT_D(-5))	3.132485	0.255367	12.26661	0.0000
D(NAT_GAS_FUT_D(-6))	2.597321	0.233434	11.12660	0.0000
D(NAT_GAS_FUT_D(-7))	2.105747	0.209784	10.03767	0.0000
D(NAT_GAS_FUT_D(-8))	1.661227	0.184681	8.995093	0.0000
D(NAT_GAS_FUT_D(-9))	1.323834	0.158976	8.327241	0.0000
D(NAT_GAS_FUT_D(-10))	1.031876	0.133171	7.748536	0.0000
D(NAT_GAS_FUT_D(-11))	0.764243	0.107536	7.106833	0.0000
D(NAT_GAS_FUT_D(-12))	0.536304	0.082430	6.506176	0.0000
D(NAT_GAS_FUT_D(-13))	0.341311	0.058611	5.823329	0.0000
D(NAT_GAS_FUT_D(-14))	0.182678	0.036584	4.993441	0.0000
D(NAT_GAS_FUT_D(-15))	0.066865	0.017210	3.885322	0.0001
C	3.846128	35.48399	0.108391	0.9137

R-squared	0.811488	Mean dependent var	-0.056906
Adjusted R-squared	0.810590	S.D. dependent var	4735.849
S.E. of regression	2061.103	Akaike info criterion	18.10490
Sum squared resid	1.43E+10	Schwarz criterion	18.13575
Log likelihood	-30525.96	Hannan-Quinn criter.	18.11593
F-statistic	903.1809	Durbin-Watson stat	2.003405
Prob(F-statistic)	0.000000		

k. silver_spot

Null Hypothesis: SILVER_SPOT_D has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic - based on SIC, maxlag=28)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-20.47202	0.0000

Test critical values:	1% level	-3.432095
	5% level	-2.862197
	10% level	-2.567163

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SILVER_SPOT_D)
Method: Least Squares
Date: 01/29/13 Time: 16:31
Sample (adjusted): 3/13/2000 2/27/2013
Included observations: 3383 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SILVER_SPOT_D(-1)	-1.038146	0.050710	-20.47202	0.0000
D(SILVER_SPOT_D(-1))	-0.072872	0.046606	-1.563594	0.1180
D(SILVER_SPOT_D(-2))	-0.080729	0.042325	-1.907344	0.0566
D(SILVER_SPOT_D(-3))	-0.118152	0.037629	-3.139941	0.0017
D(SILVER_SPOT_D(-4))	-0.089782	0.031997	-2.805917	0.0050
D(SILVER_SPOT_D(-5))	-0.098070	0.025599	-3.830957	0.0001
D(SILVER_SPOT_D(-6))	-0.123291	0.017104	-7.208297	0.0000
C	0.007578	0.007859	0.964216	0.3350

R-squared	0.566161	Mean dependent var	-5.62E-05
Adjusted R-squared	0.565261	S.D. dependent var	0.692485
S.E. of regression	0.456588	Akaike info criterion	1.272291
Sum squared resid	703.5948	Schwarz criterion	1.286779
Log likelihood	-2144.080	Hannan-Quinn criter.	1.277471
F-statistic	629.1974	Durbin-Watson stat	1.997621
Prob(F-statistic)	0.000000		

I. silver_fut

Null Hypothesis: SILVER_FUT_D has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=28)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-57.15672	0.0001
Test critical values:	1% level	-3.432092	
	5% level	-2.862195	
	10% level	-2.567163	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SILVER_FUT_D)
Method: Least Squares
Date: 01/29/13 Time: 16:31
Sample (adjusted): 3/03/2000 2/27/2013
Included observations: 3389 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SILVER_FUT_D(-1)	-0.981995	0.017181	-57.15672	0.0000
C	0.007196	0.007040	1.022203	0.3068

R-squared	0.490974	Mean dependent var	9.44E-05
Adjusted R-squared	0.490824	S.D. dependent var	0.574268
S.E. of regression	0.409778	Akaike info criterion	1.054186
Sum squared resid	568.7374	Schwarz criterion	1.057803
Log likelihood	-1784.318	Hannan-Quinn criter.	1.055479
F-statistic	3266.890	Durbin-Watson stat	1.999503
Prob(F-statistic)	0.000000		

APPENDIX 3

KPSS Test

Null Hypothesis: COCOA_SPOT_D is stationary
Exogenous: Constant
Bandwidth: 8 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.070132
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	1808.486
HAC corrected variance (Bartlett kernel)	1574.085

KPSS Test Equation
Dependent Variable: COCOA_SPOT_D
Method: Least Squares
Date: 04/30/13 Time: 12:34
Sample (adjusted): 1/04/2000 12/31/2012
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.412720	0.730503	0.564981	0.5721

R-squared	0.000000	Mean dependent var	0.412720
Adjusted R-squared	0.000000	S.D. dependent var	42.53257
S.E. of regression	42.53257	Akaike info criterion	10.33871
Sum squared resid	6130768.	Schwarz criterion	10.34052
Log likelihood	-17523.12	Hannan Quinn criter.	10.33936
Durbin-Watson stat	2.168374		

Null Hypothesis: COCOA_FUT_D is stationary
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

	LM-Stat.

Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.061035
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	1633.384
HAC corrected variance (Bartlett kernel)	1685.741

KPSS Test Equation
Dependent Variable: COCOA_FUT_D
Method: Least Squares
Date: 04/30/13 Time: 12:35
Sample (adjusted): 1/04/2000 12/31/2012
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.411209	0.694238	0.592318	0.5537

R-squared	0.000000	Mean dependent var	0.411209
Adjusted R-squared	0.000000	S.D. dependent var	40.42110
S.E. of regression	40.42110	Akaike info criterion	10.23688
Sum squared resid	5537171.	Schwarz criterion	10.23868
Log likelihood	-17350.50	Hannan-Quinn criter.	10.23752
Durbin-Watson stat	1.983507		

Null Hypothesis: COFFEE_SPOT_D is stationary

Exogenous: Constant

Bandwidth: 8 (Newey-West automatic) using Bartlett kernel

	LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic	0.149388

Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000567
HAC corrected variance (Bartlett kernel)	0.000569

KPSS Test Equation

Dependent Variable: COFFEE_SPOT_D

Method: Least Squares

Date: 04/30/13 Time: 13:10

Sample (adjusted): 1/04/2000 12/31/2012

Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.49E-05	0.000409	0.158649	0.8740

R-squared	0.000000	Mean dependent var	6.49E-05
Adjusted R-squared	0.000000	S.D. dependent var	0.023817
S.E. of regression	0.023817	Akaike info criterion	-4.636551

Sum squared resid	1.922386	Schwarz criterion	-4.634743
Log likelihood	7859.954	Hannan-Quinn criter.	-4.635905
Durbin-Watson stat	1.964902		

Null Hypothesis: COFFEE_FUT_D is stationary
Exogenous: Constant
Bandwidth: 9 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.275278
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000621
HAC corrected variance (Bartlett kernel)	0.000596

KPSS Test Equation
Dependent Variable: COFFEE_FUT_D
Method: Least Squares
Date: 04/30/13 Time: 13:10
Sample (adjusted): 1/04/2000 12/30/2011
Included observations: 3129 after adjustments

Variable	Coefficiet	Std. Error	t-Statistic	Prob.
C	0.000332	0.000446	0.745970	0.4557
R-squared	0.000000	Mean dependent var		0.000332

Adjusted R-squared	0.000000	S.D. dependent var	0.024924
S.E. of regression	0.024924	Akaike info criterion	-4.545691
Sum squared resid	1.943054	Schwarz criterion	-4.543758
Log likelihood	7112.734	Hannan-Quinn criter.	-4.544998
Durbin-Watson stat	2.046623		

Null Hypothesis: CRUDE_OIL_SPOT_D is stationary
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.047520
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	1.793878
HAC corrected variance (Bartlett kernel)	1.793878

KPSS Test Equation
Dependent Variable: CRUDE_OIL_SPOT_D
Method: Least Squares
Date: 04/30/13 Time: 13:10
Sample (adjusted): 1/04/2000 12/31/2012
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.025006	0.023007	1.086880	0.2772

R-squared	0.000000	Mean dependent var	0.025006

Adjusted R-squared	0.000000	S.D. dependent var	1.339555
S.E. of regression	1.339555	Akaike info criterion	3.422847
Sum squared resid	6081.247	Schwarz criterion	3.424655
Log likelihood	-5800.726	Hannan-Quinn criter.	3.423493
Durbin-Watson stat	1.908393		

Null Hypothesis: CRUDE_OIL_FUT_D is stationary
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.038808
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	1.963247
HAC corrected variance (Bartlett kernel)	1.836817

KPSS Test Equation
Dependent Variable: CRUDE_OIL_FUT_D
Method: Least Squares
Date: 04/30/13 Time: 13:11
Sample (adjusted): 1/04/2000 12/31/2012
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.019844	0.024069	0.824461	0.4097

R-squared	0.000000	Mean dependent var	0.019844
Adjusted R squared	0.000000	S.D. dependent var	1.401366
S.E. of regression	1.401366	Akaike info criterion	3.513067
Sum squared resid	6655.407	Schwarz criterion	3.514875
Log likelihood	-5953.648	Hannan-Quinn criter.	3.513713
Durbin-Watson stat	2.072024		

Null Hypothesis: GOLD_SPOT_D is stationary
Exogenous: Constant
Bandwidth: 18 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.229830
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	117.4149
HAC corrected variance (Bartlett kernel)	104.7747

KPSS Test Equation
Dependent Variable: GOLD_SPOT_D
Method: Least Squares
Date: 04/30/13 Time: 13:11
Sample (adjusted): 1/04/2000 12/31/2012
Included observations: 3390 after adjustments

Variable	Coefficiet	Std. Error	t-Statistic	Prob.
C	0.404546	0.186134	2.173411	0.0298

R-squared	0.000000	Mean dependent var	0.404546
Adjusted R-squared	0.000000	S.D. dependent var	10.83741
S.E. of regression	10.83741	Akaike info criterion	7.604181
Sum squared resid	398036.5	Schwarz criterion	7.605989
Log likelihood	-12888.09	Hannan-Quinn criter.	7.604827
Durbin-Watson stat	2.001406		

Null Hypothesis: GOLD_FUT_D is stationary
Exogenous: Constant
Bandwidth: 21 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.227187
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000

10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	118.6468
HAC corrected variance (Bartlett kernel)	106.5751

KPSS Test Equation
Dependent Variable: GOLD_FUT_D
Method: Least Squares
Date: 04/30/13 Time: 13:11
Sample (adjusted): 1/04/2000 11/01/2012
Included observations: 3348 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.412634	0.188278	2.191620	0.0285

R-squared	0.000000	Mean dependent var	0.412634
Adjusted R squared	0.000000	S.D. dependent var	10.89414
S.E. of regression	10.89414	Akaike info criterion	7.614625
Sum squared resid	397229.5	Schwarz criterion	7.616452
Log likelihood	-12745.88	Hannan-Quinn criter.	7.615279
Durbin-Watson stat	1.989287		

Null Hypothesis: NAT_GAS_SPOT_D is stationary
Exogenous: Constant
Bandwidth: 250 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.038800
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	15542353
HAC corrected variance (Bartlett kernel)	73548.22

KPSS Test Equation
Dependent Variable: NAT_GAS_SPOT_D
Method: Least Squares
Date: 04/30/13 Time: 13:12
Sample (adjusted): 1/04/2000 12/31/2012
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.324189	67.72088	0.004787	0.9962

R-squared	0.000000	Mean dependent var	0.324189
Adjusted R-squared	0.000000	S.D. dependent var	3942.961
S.E. of regression	3942.961	Akaike info criterion	19.39755
Sum squared resid	5.27E+10	Schwarz criterion	19.39935
Log likelihood	-32877.84	Hannan-Quinn criter.	19.39819
Durbin-Watson stat	2.981973		

Null Hypothesis: NAT_GAS_FUT_D is stationary
Exogenous: Constant
Bandwidth: 155 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.048448
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	7528200.
HAC corrected variance (Bartlett kernel)	77470.91

KPSS Test Equation
Dependent Variable: NAT_GAS_FUT_D
Method: Least Squares
Date: 04/30/13 Time: 13:12
Sample (adjusted): 1/04/2000 12/31/2012
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.305605	47.13134	0.006484	0.9948

R-squared	0.000000	Mean dependen tvar	0.305605
Adjusted R squared	0.000000	S.D. dependent var	2744.161
S.E. of regression	2744.161	Akaike info criterion	18.67263
Sum squared resid	2.55E+10	Schwarz criterion	18.67444
Log likelihood	-31649.11	Hannan-Quinn criter.	18.67328
Durbin-Watson stat	2.968116		

Null Hypothesis: SILVER_SPOT_D is stationary
Exogenous: Constant
Bandwidth: 12 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.072666
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.214381
HAC corrected variance (Bartlett kernel)	0.175008

KPSS Test Equation
Dependent Variable: SILVER_SPOT_D
Method: Least Squares
Date: 04/30/13 Time: 13:12
Sample (adjusted): 1/04/2000 12/31/2012
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007304	0.007953	0.918318	0.3585

R-squared	0.000000	Mean dependent var	0.007304
Adjusted R squared	0.000000	S.D. dependent var	0.463082
S.E. of regression	0.463082	Akaike info criterion	1.298468
Sum squared resid	726.7526	Schwarz criterion	1.300276
Log likelihood	-2199.903	Hannan-Quinn criter.	1.299114

Durbin-Watson stat	2.231621

Null Hypothesis: SILVER_FUT_D is stationary
Exogenous: Constant
Bandwidth: 12 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.075295
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.167825
HAC corrected variance (Bartlett kernel)	0.176069

KPSS Test Equation
Dependent Variable: SILVER_FUT_D
Method: Least Squares
Date: 04/30/13 Time: 13:13
Sample (adjusted): 1/04/2000 12/31/2012
Included observations: 3390 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007304	0.007037	1.037906	0.2994

R-squared	0.000000	Mean dependent var	0.007304
Adjusted R squared	0.000000	S.D. dependent var	0.409725
S.E. of regression	0.409725	Akaike info criterion	1.053635
Sum squared resid	568.9278	Schwarz criterion	1.055443
Log likelihood	-1784.912	Hannan-Quinn criter.	1.054282
Durbin-Watson stat	1.963881		

APPENDIX 4

Pairwise Johansen Cointegration Test

Date: 04/30/13 Time: 12:17
Sample (adjusted): 1/10/2000 12/31/2012
Included observations: 3386 after adjustments
Trend assumption: Linear deterministic trend
Series: COCOA_SPOT COCOA_FUT
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.032730	116.3306	15.49471	0.0001
At most 1	0.001078	3.651525	3.841466	0.0560

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

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.032730	112.6791	14.26460	0.0001
At most 1	0.001078	3.651525	3.841466	0.0560

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

COCOA_SPOT	COCOA_FUT
-0.023812	0.024267
0.001279	9.76E-05

Unrestricted Adjustment Coefficients (alpha):

D(COCOA_SPOT)	4.892055	-0.384234
D(COCOA_FUT)	-1.532731	-1.292650

1 Cointegrating Equation(s):	Log likelihood	-33456.11

Normalized cointegrating coefficients (standard error in parentheses)

COCOA_SPOT	COCOA_FUT
1.000000	-1.019114
	(0.00550)

Adjustment coefficients (standard error in parentheses)

D(COCOA_SPOT)	-0.116488
	(0.01191)
D(COCOA_FUT)	0.036497
	(0.01649)

Date: 04/30/13 Time: 12:19
Sample (adjusted): 1/10/2000 12/30/2011
Included observations: 3125 after adjustments
Trend assumption: Linear deterministic trend
Series: COFFEE_SPOT
COFFEE_FUT
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.008113	25.54423	15.49471	0.0011
At most 1	2.82E-05	0.087995	3.841466	0.7667

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

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.008113	25.45623	14.26460	0.0006
At most 1	2.82E-05	0.087995	3.841466	0.7667

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

COFFEE_SPOT	COFFEE_FUT
-19.92971	20.17595
3.362140	-1.546297

Unrestricted Adjustment Coefficients (alpha):

D(COFFEE_SPOT)	0.001385	-4.71E-05
D(COFFEE_FUT)	-0.000220	-0.000131

1 Cointegrating Equation(s):	Log likelihood	15583.84

Normalized cointegrating coefficients (standard error in parentheses)

COFFEE_SPOT	COFFEE_FUT
1.000000	-1.012355
	(0.01821)

Adjustment coefficients (standard error in parentheses)

D(COFFEE_ SPOT)	-0.027598
	(0.00632)
D(COFFEE_ FUT)	0.004380
	(0.00886)

Date: 04/30/13 Time: 12:20
Sample (adjusted): 1/10/2000 12/31/2012
Included observations: 3386 after adjustments
Trend assumption: Linear deterministic trend
Series: CRUDE_OIL_SPOT
CRUDE_OIL_FUT
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.002642	9.821370	15.49471	0.2947
At most 1	0.000255	0.862816	3.841466	0.3530

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.002642	8.958555	14.26460	0.2896
At most 1	0.000255	0.862816	3.841466	0.3530

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

CRUDE_OIL _SPOT	CRUDE_OIL _FUT
-0.146436	0.178028
0.067004	-0.042748

Unrestricted Adjustment Coefficients (alpha):

D(CRUDE_ OIL_SPOT)	-0.001644	-0.020245
D(CRUDE_ OIL_FUT)	-0.052094	-0.015358

1 Cointegrating Equation(s):	Log likelihood	-10372.66

Normalized cointegrating coefficients (standard error in parentheses)

CRUDE_OIL _SPOT	CRUDE_OIL _FUT
1.000000	-1.215742
	(0.08038)

Adjustment coefficients (standard error in parentheses)

D(CRUDE_ OIL_SPOT)	0.000241
	(0.00320)
D(CRUDE_ OIL_FUT)	0.007628
	(0.00352)

Date: 04/30/13 Time: 12:20
Sample (adjusted): 1/10/2000 11/01/2012
Included observations: 3344 after adjustments
Trend assumption: Linear deterministic trend
Series: GOLD_SPOT GOLD_FUT
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**

None *	0.017837	61.59684	15.49471	0.0000
At most 1	0.000422	1.411425	3.841466	0.2348

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

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.017837	60.18542	14.26460	0.0000
At most 1	0.000422	1.411425	3.841466	0.2348

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GOLD_SPOT	GOLD_FUT
-0.017688	0.017516
0.002646	-0.000468

Unrestricted Adjustment Coefficients (alpha):

D(GOLD_SPOT)	1.263822	0.106442
D(GOLD_FUT)	-0.632045	0.201078

1 Cointegrating Equation(s):	Log likelihood	-25388.73

Normalized cointegrating coefficients (standard error in parentheses)

GOLD_SPOT	GOLD_FUT
1.000000	-0.990277

(0.01546)

Adjustment coefficients (standard error in parentheses)

D(GOLD_SPOT)	-0.022355
	(0.00328)
D(GOLD_FUT)	0.011180
	(0.00333)

Date: 04/30/13 Time: 12:21
Sample (adjusted): 1/10/2000 12/31/2012
Included observations: 3386 after adjustments
Trend assumption: Linear deterministic trend
Series: NAT_GAS_SPOT
NAT_GAS_FUT
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.146175	619.1959	15.49471	0.0001
At most 1 *	0.024534	84.10770	3.841466	0.0000

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.146175	535.0882	14.26460	0.0001
At most 1 *	0.024534	84.10770	3.841466	0.0000

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

NAT_GAS_ SPOT	NAT_GAS_F UT
-0.000653	0.000329
-9.85E-05	-0.000396

Unrestricted Adjustment Coefficients (alpha):

D(NAT_GAS _SPOT)	1111.038	180.7445
D(NAT_GAS _FUT)	-270.3838	319.7206

1 Cointegrating Equation(s):	Log likelihood	-62585.42

Normalized cointegrating coefficients (standard error in parentheses)

NAT_GAS_ SPOT	NAT_GAS_F UT
1.000000	-0.504801
	(0.02811)

Adjustment coefficients (standard error in parentheses)

D(NAT_GAS _SPOT)	-0.725051
	(0.03283)
D(NAT_GAS _FUT)	0.176450
	(0.02407)

Date: 04/30/13 Time: 12:21
Sample (adjusted): 1/10/2000 12/31/2012
Included observations: 3386 after adjustments
Trend assumption: Linear deterministic trend
Series: SILVER_SPOT SILVER_FUT
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.201774	763.6749	15.49471	0.0001
At most 1	0.000175	0.592493	3.841466	0.4415

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

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.201774	763.0824	14.26460	0.0001
At most 1	0.000175	0.592493	3.841466	0.4415

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

SILVER_SPOT	SILVER_FUT
-10.71780	10.72213
0.128896	-0.028500

Unrestricted Adjustment Coefficients (alpha):

D(SILVER_SPOT)	0.112469	-0.002164
D(SILVER_FUT)	0.020254	-0.005376

1 Cointegrating Equation(s):	Log likelihood	-1235.018

Normalized cointegrating coefficients (standard error in parentheses)

SILVER_SPOT	SILVER_FUT
1.000000	-1.000405
	(0.00032)

Adjustment coefficients (standard error in parentheses)

D(SILVER_SPOT)	-1.205425
	(0.05113)
D(SILVER_FUT)	-0.217081
	(0.07533)

APPENDIX 5

Pairwise Granger Causality Tests

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
COCOA_SPOT_D does not Granger Cause COCOA_FUT_D	3386	5.66821	0.0002
COCOA_FUT_D does not Granger Cause COCOA_SPOT_D		903.697	0.0000
COFFEE_FUT_D does not Granger Cause COCOA_FUT_D	3125	5.14750	0.0004
COCOA_FUT_D does not Granger Cause COFFEE_FUT_D		1.33562	0.2542
COFFEE_SPOT_D does not Granger Cause COCOA_FUT_D	3386	1.18292	0.3162
COCOA_FUT_D does not Granger Cause COFFEE_SPOT_D		22.1854	4.E-18
CRUDE_OIL_FUT_D does not Granger Cause COCOA_FUT_D	3386	2.35142	0.0519
COCOA_FUT_D does not Granger Cause CRUDE_OIL_FUT_D		0.44639	0.7751
CRUDE_OIL_SPOT_D does not Granger Cause COCOA_FUT_D	3386	1.30276	0.2666
COCOA_FUT_D does not Granger Cause CRUDE_OIL_SPOT_D		0.89943	0.4633
GOLD_FUT_D does not Granger Cause COCOA_FUT_D	3344	0.90666	0.4590
COCOA_FUT_D does not Granger Cause GOLD_FUT_D		0.98184	0.4161
GOLD_SPOT_D does not Granger Cause COCOA_FUT_D	3386	1.54887	0.1853
COCOA_FUT_D does not Granger Cause GOLD_SPOT_D		0.80703	0.5205
NAT_GAS_FUT_D does not Granger Cause COCOA_FUT_D	3386	0.65783	0.6213
COCOA_FUT_D does not Granger Cause NAT_GAS_FUT_D		1.42556	0.2228
NAT_GAS_SPOT_D does not Granger Cause COCOA_FUT_D	3386	1.36248	0.2444
COCOA_FUT_D does not Granger Cause NAT_GAS_SPOT_D		1.45675	0.2127
SILVER_FUT_D does not Granger Cause COCOA_FUT_D	3386	4.05802	0.0028
COCOA_FUT_D does not Granger Cause SILVER_FUT_D		0.44071	0.7793
SILVER_SPOT_D does not Granger Cause COCOA_FUT_D	3386	1.54560	0.1862
COCOA_FUT_D does not Granger Cause SILVER_SPOT_D		12.4093	5.E-10
COFFEE_FUT_D does not Granger Cause COCOA_SPOT_D	3125	24.5011	5.E-20
COCOA_SPOT_D does not Granger Cause COFFEE_FUT_D		1.17388	0.3202
COFFEE_SPOT_D does not Granger Cause COCOA_SPOT_D	3386	4.24517	0.0020
COCOA_SPOT_D does not Granger Cause COFFEE_SPOT_D		3.19471	0.0125
CRUDE_OIL_FUT_D does not Granger Cause COCOA_SPOT_D	3386	29.4173	4.E-24
COCOA_SPOT_D does not Granger Cause CRUDE_OIL_FUT_D		1.20648	0.3058
CRUDE_OIL_SPOT_D does not Granger Cause COCOA_SPOT_D	3386	24.0407	1.E-19

COCOA_SPOT_D does not Granger Cause CRUDE_OIL_SPOT_D		3.43841	0.0082
GOLD_FUT_D does not Granger Cause COCOA_SPOT_D	3344	0.57835	0.6783
COCOA_SPOT_D does not Granger Cause GOLD_FUT_D		0.19553	0.9408
GOLD_SPOT_D does not Granger Cause COCOA_SPOT_D	3386	13.2466	1.E-10
COCOA_SPOT_D does not Granger Cause GOLD_SPOT_D		1.21073	0.3040
NAT_GAS_FUT_D does not Granger Cause COCOA_SPOT_D	3386	2.07944	0.0809
COCOA_SPOT_D does not Granger Cause NAT_GAS_FUT_D		2.02047	0.0889
NAT_GAS_SPOT_D does not Granger Cause COCOA_SPOT_D	3386	0.38784	0.8175
COCOA_SPOT_D does not Granger Cause NAT_GAS_SPOT_D		0.80898	0.5192
SILVER_FUT_D does not Granger Cause COCOA_SPOT_D	3386	11.9134	1.E-09
COCOA_SPOT_D does not Granger Cause SILVER_FUT_D		0.22361	0.9253
SILVER_SPOT_D does not Granger Cause COCOA_SPOT_D	3386	7.49558	5.E-06
COCOA_SPOT_D does not Granger Cause SILVER_SPOT_D		0.98352	0.4152
COFFEE_SPOT_D does not Granger Cause COFFEE_FUT_D	3125	2.95154	0.0190
COFFEE_FUT_D does not Granger Cause COFFEE_SPOT_D		535.960	0.0000
CRUDE_OIL_FUT_D does not Granger Cause COFFEE_FUT_D	3125	1.96994	0.0964
COFFEE_FUT_D does not Granger Cause CRUDE_OIL_FUT_D		2.51205	0.0398
CRUDE_OIL_SPOT_D does not Granger Cause COFFEE_FUT_D	3125	1.95170	0.0992
COFFEE_FUT_D does not Granger Cause CRUDE_OIL_SPOT_D		4.50392	0.0013
GOLD_FUT_D does not Granger Cause COFFEE_FUT_D	3125	0.91909	0.4517
COFFEE_FUT_D does not Granger Cause GOLD_FUT_D		1.94961	0.0995
GOLD_SPOT_D does not Granger Cause COFFEE_FUT_D	3125	1.45565	0.2131
COFFEE_FUT_D does not Granger Cause GOLD_SPOT_D		9.23877	2.E-07
NAT_GAS_FUT_D does not Granger Cause COFFEE_FUT_D	3125	0.21309	0.9313
COFFEE_FUT_D does not Granger Cause NAT_GAS_FUT_D		1.18347	0.3159
NAT_GAS_SPOT_D does not Granger Cause COFFEE_FUT_D	3125	0.60091	0.6620
COFFEE_FUT_D does not Granger Cause NAT_GAS_SPOT_D		0.65110	0.6261
SILVER_FUT_D does not Granger Cause COFFEE_FUT_D	3125	1.42548	0.2228
COFFEE_FUT_D does not Granger Cause SILVER_FUT_D		6.98999	1.E-05
SILVER_SPOT_D does not Granger Cause COFFEE_FUT_D	3125	1.45993	0.2117
COFFEE_FUT_D does not Granger Cause SILVER_SPOT_D		39.1921	5.E-32
CRUDE_OIL_FUT_D does not Granger Cause COFFEE_SPOT_D	3386	25.7131	5.E-21
COFFEE_SPOT_D does not Granger Cause CRUDE_OIL_FUT_D		2.30741	0.0558
CRUDE_OIL_SPOT_D does not Granger Cause COFFEE_SPOT_D	3386	22.0438	6.E-18
COFFEE_SPOT_D does not Granger Cause CRUDE_OIL_SPOT_D		2.21281	0.0652
GOLD_FUT_D does not Granger Cause COFFEE_SPOT_D	3344	2.94675	0.0191

COFFEE_SPOT_D does not Granger Cause GOLD_FUT_D		1.11904	0.3456
GOLD_SPOT_D does not Granger Cause COFFEE_SPOT_D	3386	11.4584	3.E-09
COFFEE_SPOT_D does not Granger Cause GOLD_SPOT_D		4.87309	0.0006
NAT_GAS_FUT_D does not Granger Cause COFFEE_SPOT_D	3386	0.32977	0.8581
COFFEE_SPOT_D does not Granger Cause NAT_GAS_FUT_D		0.55231	0.6974
NAT_GAS_SPOT_D does not Granger Cause COFFEE_SPOT_D	3386	0.92276	0.4496
COFFEE_SPOT_D does not Granger Cause NAT_GAS_SPOT_D		0.63400	0.6382
SILVER_FUT_D does not Granger Cause COFFEE_SPOT_D	3386	25.9533	3.E-21
COFFEE_SPOT_D does not Granger Cause SILVER_FUT_D		5.86579	0.0001
SILVER_SPOT_D does not Granger Cause COFFEE_SPOT_D	3386	7.77848	3.E-06
COFFEE_SPOT_D does not Granger Cause SILVER_SPOT_D		10.9077	9.E-09
CRUDE_OIL_SPOT_D does not Granger Cause CRUDE_OIL_FUT_D	3386	2.91252	0.0203
CRUDE_OIL_FUT_D does not Granger Cause CRUDE_OIL_SPOT_D		94.5232	3.E-76
GOLD_FUT_D does not Granger Cause CRUDE_OIL_FUT_D	3344	3.10704	0.0146
CRUDE_OIL_FUT_D does not Granger Cause GOLD_FUT_D		2.80000	0.0246
GOLD_SPOT_D does not Granger Cause CRUDE_OIL_FUT_D	3386	5.04028	0.0005
CRUDE_OIL_FUT_D does not Granger Cause GOLD_SPOT_D		10.3484	2.E-08
NAT_GAS_FUT_D does not Granger Cause CRUDE_OIL_FUT_D	3386	0.80410	0.5224
CRUDE_OIL_FUT_D does not Granger Cause NAT_GAS_FUT_D		1.67336	0.1533
NAT_GAS_SPOT_D does not Granger Cause CRUDE_OIL_FUT_D	3386	2.09750	0.0785
CRUDE_OIL_FUT_D does not Granger Cause NAT_GAS_SPOT_D		0.77338	0.5424
SILVER_FUT_D does not Granger Cause CRUDE_OIL_FUT_D	3386	5.24089	0.0003
CRUDE_OIL_FUT_D does not Granger Cause SILVER_FUT_D		7.54045	5.E-06
SILVER_SPOT_D does not Granger Cause CRUDE_OIL_FUT_D	3386	5.72214	0.0001
CRUDE_OIL_FUT_D does not Granger Cause SILVER_SPOT_D		70.8612	1.E-57
GOLD_FUT_D does not Granger Cause CRUDE_OIL_SPOT_D	3344	1.00418	0.4039
CRUDE_OIL_SPOT_D does not Granger Cause GOLD_FUT_D		2.09358	0.0790
GOLD_SPOT_D does not Granger Cause CRUDE_OIL_SPOT_D	3386	2.43891	0.0450
CRUDE_OIL_SPOT_D does not Granger Cause GOLD_SPOT_D		0.80780	0.5200
NAT_GAS_FUT_D does not Granger Cause CRUDE_OIL_SPOT_D	3386	1.31106	0.2634
CRUDE_OIL_SPOT_D does not Granger Cause NAT_GAS_FUT_D		1.45262	0.2140
NAT_GAS_SPOT_D does not Granger Cause CRUDE_OIL_SPOT_D	3386	1.72053	0.1425

CRUDE_OIL_SPOT_D does not Granger Cause NAT_GAS_SPOT_D		0.79442	0.5286
SILVER_FUT_D does not Granger Cause CRUDE_OIL_SPOT_D	3386	4.94292	0.0006
CRUDE_OIL_SPOT_D does not Granger Cause SILVER_FUT_D		6.10374	7.E-05
SILVER_SPOT_D does not Granger Cause CRUDE_OIL_SPOT_D	3386	1.24423	0.2899
CRUDE_OIL_SPOT_D does not Granger Cause SILVER_SPOT_D		30.3871	7.E-25
GOLD_SPOT_D does not Granger Cause GOLD_FUT_D	3344	2.66067	0.0311
GOLD_FUT_D does not Granger Cause GOLD_SPOT_D		3.06264	0.0157
NAT_GAS_FUT_D does not Granger Cause GOLD_FUT_D	3344	0.23536	0.9185
GOLD_FUT_D does not Granger Cause NAT_GAS_FUT_D		0.26966	0.8976
NAT_GAS_SPOT_D does not Granger Cause GOLD_FUT_D	3344	0.59322	0.6676
GOLD_FUT_D does not Granger Cause NAT_GAS_SPOT_D		0.76995	0.5446
SILVER_FUT_D does not Granger Cause GOLD_FUT_D	3344	1.63126	0.1635
GOLD_FUT_D does not Granger Cause SILVER_FUT_D		2.58602	0.0352
SILVER_SPOT_D does not Granger Cause GOLD_FUT_D	3344	6.36485	4.E-05
GOLD_FUT_D does not Granger Cause SILVER_SPOT_D		0.79691	0.5270
NAT_GAS_FUT_D does not Granger Cause GOLD_SPOT_D	3386	0.27628	0.8934
GOLD_SPOT_D does not Granger Cause NAT_GAS_FUT_D		1.05114	0.3792
NAT_GAS_SPOT_D does not Granger Cause GOLD_SPOT_D	3386	0.75787	0.5526
GOLD_SPOT_D does not Granger Cause NAT_GAS_SPOT_D		1.20294	0.3074
SILVER_FUT_D does not Granger Cause GOLD_SPOT_D	3386	46.8936	2.E-38
GOLD_SPOT_D does not Granger Cause SILVER_FUT_D		4.13386	0.0024
SILVER_SPOT_D does not Granger Cause GOLD_SPOT_D	3386	2.84997	0.0226
GOLD_SPOT_D does not Granger Cause SILVER_SPOT_D		115.137	4.E-92
NAT_GAS_SPOT_D does not Granger Cause NAT_GAS_FUT_D	3386	5.17807	0.0004
NAT_GAS_FUT_D does not Granger Cause NAT_GAS_SPOT_D		1.43047	0.2212
SILVER_FUT_D does not Granger Cause NAT_GAS_FUT_D	3386	0.37288	0.8281
NAT_GAS_FUT_D does not Granger Cause SILVER_FUT_D		0.78556	0.5344
SILVER_SPOT_D does not Granger Cause NAT_GAS_FUT_D	3386	0.50350	0.7332
NAT_GAS_FUT_D does not Granger Cause SILVER_SPOT_D		0.64225	0.6324
SILVER_FUT_D does not Granger Cause NAT_GAS_SPOT_D	3386	0.27956	0.8913
NAT_GAS_SPOT_D does not Granger Cause SILVER_FUT_D		1.95057	0.0994
SILVER_SPOT_D does not Granger Cause NAT_GAS_SPOT_D	3386	0.29137	0.8837
NAT_GAS_SPOT_D does not Granger Cause SILVER_SPOT_D		1.58767	0.1747
SILVER_SPOT_D does not Granger Cause SILVER_FUT_D	3386	3.65433	0.0056
SILVER_FUT_D does not Granger Cause SILVER_SPOT_D		1149.93	0.0000

APPENDIX 6

Probability Distribution of VAR model

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.102551	0.026320	3.896312	0.0001*
C(2)	0.000634	0.035006	0.018099	0.9856
C(3)	-0.051595	0.028322	-1.821730	0.0685
C(4)	-0.017209	0.022781	-0.755400	0.4500
C(5)	-2.55E-06	1.94E-06	-1.313801	0.1889
C(6)	-4.49E-06	1.94E-06	-2.310229	0.0209*
C(7)	3.75E-06	2.79E-06	1.343921	0.1790
C(8)	-1.62E-06	2.79E-06	-0.580838	0.5614
C(9)	-6.41E-05	0.000184	-0.348170	0.7277
C(10)	-0.000172	0.000248	-0.692334	0.4887
C(11)	-4.18E-05	0.000228	-0.183264	0.8546
C(12)	-7.82E-05	0.000167	-0.468323	0.6396
C(13)	1.113110	0.316923	3.512247	0.0004*
C(14)	0.016595	0.371987	0.044611	0.9644
C(15)	0.967069	0.391724	2.468751	0.0136*
C(16)	0.375911	0.324163	1.159636	0.2462
C(17)	0.008670	0.007148	1.212938	0.2252
C(18)	-0.022147	0.007520	-2.945041	0.0032*
C(19)	0.002636	0.007862	0.335286	0.7374
C(20)	0.002873	0.007344	0.391126	0.6957
C(21)	-0.001124	0.000673	-1.671009	0.0947
C(22)	0.000992	0.000672	1.475624	0.1401
C(23)	-0.002261	0.000874	-2.587689	0.0097*
C(24)	0.002428	0.000874	2.777225	0.0055*
C(25)	0.006515	0.006917	0.941852	0.3463
C(26)	1.054662	0.020509	51.42421	0.0000*
C(27)	0.361802	0.027277	13.26376	0.0000*
C(28)	-0.759698	0.022069	-34.42343	0.0000*
C(29)	-0.229831	0.017751	-12.94722	0.0000*
C(30)	-3.59E-06	1.51E-06	-2.369948	0.0178*
C(31)	-2.75E-06	1.51E-06	-1.817739	0.0691
C(32)	5.88E-07	2.18E-06	0.270224	0.7870
C(33)	-1.61E-06	2.18E-06	-0.738319	0.4603
C(34)	-7.24E-05	0.000143	-0.504797	0.6137
C(35)	-0.000172	0.000193	-0.888181	0.3744

C(36)	0.000132	0.000178	0.740576	0.4590
C(37)	3.16E-05	0.000130	0.243166	0.8079
C(38)	0.471856	0.246953	1.910712	0.0560
C(39)	0.483446	0.289861	1.667857	0.0954
C(40)	0.672510	0.305240	2.203217	0.0276*
C(41)	0.459580	0.252595	1.819434	0.0689
C(42)	0.019004	0.005570	3.412082	0.0006*
C(43)	0.001711	0.005860	0.292033	0.7703
C(44)	-0.010544	0.006126	-1.721163	0.0852
C(45)	-0.011804	0.005723	-2.062531	0.0392*
C(46)	-0.000878	0.000524	-1.674243	0.0941
C(47)	0.000231	0.000524	0.440905	0.6593
C(48)	-0.000801	0.000681	-1.176371	0.2395
C(49)	0.002066	0.000681	3.032585	0.0024*
C(50)	0.003537	0.005390	0.656263	0.5117
C(51)	43.67881	232.7625	0.187654	0.8511
C(52)	186.4517	309.5787	0.602276	0.5470
C(53)	23.61458	250.4690	0.094281	0.9249
C(54)	-70.66297	201.4649	-0.350746	0.7258
C(55)	-0.635845	0.017171	-37.03020	0.0000*
C(56)	-0.292963	0.017186	-17.04694	0.0000*
C(57)	-0.064698	0.024702	-2.619126	0.0088*
C(58)	-0.035873	0.024712	-1.451639	0.1466
C(59)	-0.017193	1.627636	-0.010563	0.9916
C(60)	4.420438	2.194036	2.014751	0.0439*
C(61)	-0.829072	2.017381	-0.410965	0.6811
C(62)	0.407662	1.476827	0.276039	0.7825
C(63)	-864.3829	2802.732	-0.308407	0.7578
C(64)	-6513.263	3289.701	-1.979895	0.0477*
C(65)	2363.627	3464.246	0.682292	0.4951
C(66)	2369.662	2866.765	0.826598	0.4085
C(67)	67.64125	63.21250	1.070061	0.2846
C(68)	-51.62492	66.50432	-0.776264	0.4376
C(69)	-100.2038	69.52982	-1.441162	0.1495
C(70)	-30.47056	64.95097	-0.469132	0.6390
C(71)	-5.746579	5.951235	-0.965611	0.3342
C(72)	6.405058	5.946318	1.077147	0.2814
C(73)	13.64560	7.726052	1.766180	0.0774
C(74)	0.421811	7.732223	0.054552	0.9565
C(75)	-4.200720	61.17285	-0.068670	0.9453
C(76)	-14.98605	160.5189	-0.093360	0.9256

C(77)	-110.0888	213.4933	-0.515654	0.6061
C(78)	88.21806	172.7298	0.510729	0.6095
C(79)	-23.06205	138.9353	-0.165991	0.8682
C(80)	0.005559	0.011842	0.469460	0.6387
C(81)	0.012820	0.011852	1.081685	0.2794
C(82)	-0.639721	0.017035	-37.55278	0.0000*
C(83)	-0.321888	0.017042	-18.88788	0.0000*
C(84)	1.236283	1.122459	1.101406	0.2707
C(85)	-1.465983	1.513063	-0.968884	0.3326
C(86)	2.753018	1.391237	1.978827	0.0478*
C(87)	-0.981578	1.018458	-0.963789	0.3352
C(88)	-432.8209	1932.835	-0.223931	0.8228
C(89)	2151.837	2268.662	0.948505	0.3429
C(90)	-1921.410	2389.032	-0.804263	0.4213
C(91)	-283.1400	1976.994	-0.143217	0.8861
C(92)	50.63175	43.59295	1.161467	0.2455
C(93)	20.34462	45.86307	0.443595	0.6573
C(94)	11.24830	47.94954	0.234586	0.8145
C(95)	25.20948	44.79184	0.562814	0.5736
C(96)	-2.465013	4.104123	-0.600619	0.5481
C(97)	1.516014	4.100732	0.369694	0.7116
C(98)	-1.956259	5.328082	-0.367160	0.7135
C(99)	-0.025540	5.332337	-0.004790	0.9962
C(100)	-0.899709	42.18635	-0.021327	0.9830
C(101)	6.631828	2.720273	2.437928	0.0148
C(102)	1.648110	3.618016	0.455529	0.6487
C(103)	-3.842419	2.927207	-1.312657	0.1893
C(104)	-1.466702	2.354500	-0.622936	0.5333
C(105)	0.000296	0.000201	1.474236	0.1404
C(106)	-0.000105	0.000201	-0.523864	0.6004
C(107)	3.50E-05	0.000289	0.121370	0.9034
C(108)	-0.000255	0.000289	-0.883652	0.3769
C(109)	-0.030217	0.019022	-1.588514	0.1122
C(110)	-0.046038	0.025641	-1.795446	0.0726
C(111)	0.082209	0.023577	3.486860	0.0005*
C(112)	0.042781	0.017260	2.478661	0.0132*
C(113)	87.68692	32.75526	2.677034	0.0074*
C(114)	-3.577872	38.44642	-0.093061	0.9259
C(115)	29.10286	40.48631	0.718832	0.4722
C(116)	-1.468467	33.50360	-0.043830	0.9650
C(117)	-0.020648	0.738758	-0.027950	0.9777

C(118)	-0.943266	0.777230	-1.213627	0.2249
C(119)	0.989999	0.812588	1.218328	0.2231
C(120)	-0.093549	0.759076	-0.123241	0.9019
C(121)	-0.020810	0.069552	-0.299198	0.7648
C(122)	-0.081901	0.069494	-1.178530	0.2386
C(123)	-0.011673	0.090294	-0.129280	0.8971
C(124)	0.156972	0.090366	1.737075	0.0824
C(125)	0.318695	0.714921	0.445776	0.6558
C(126)	-7.797260	1.963329	-3.971449	0.0001*
C(127)	1.616788	2.611266	0.619159	0.5358
C(128)	-3.999577	2.112682	-1.893128	0.0583
C(129)	-1.046259	1.699336	-0.615687	0.5381
C(130)	3.85E-05	0.000145	0.265905	0.7903
C(131)	2.21E-05	0.000145	0.152701	0.8786
C(132)	3.15E-05	0.000208	0.151248	0.8798
C(133)	-5.42E-06	0.000208	-0.026012	0.9792
C(134)	0.741864	0.013729	54.03650	0.0000*
C(135)	0.355527	0.018506	19.21097	0.0000*
C(136)	-0.351402	0.017016	-20.65080	0.0000*
C(137)	-0.063456	0.012457	-5.094049	0.0000*
C(138)	13.92736	23.64077	0.589125	0.5558
C(139)	-13.95943	27.74831	-0.503073	0.6149
C(140)	19.48872	29.22058	0.666952	0.5048
C(141)	10.38059	24.18088	0.429289	0.6677
C(142)	1.194929	0.533191	2.241089	0.0250*
C(143)	-0.451777	0.560957	-0.805368	0.4206
C(144)	0.424120	0.586477	0.723165	0.4696
C(145)	-0.107272	0.547855	-0.195804	0.8448
C(146)	0.016299	0.050198	0.324698	0.7454
C(147)	0.023260	0.050157	0.463752	0.6428
C(148)	0.156841	0.065168	2.406695	0.0161*
C(149)	0.039656	0.065221	0.608036	0.5432
C(150)	0.091920	0.515987	0.178144	0.8586
C(151)	0.000674	0.001699	0.396784	0.6915
C(152)	-0.002029	0.002260	-0.897763	0.3693
C(153)	0.001770	0.001828	0.968178	0.3330
C(154)	0.002648	0.001472	1.798997	0.0720
C(155)	1.36E-07	1.25E-07	1.081847	0.2793
C(156)	8.46E-09	1.25E-07	0.067441	0.9462
C(157)	-1.52E-09	1.80E-07	-0.008451	0.9933
C(158)	-4.29E-09	1.80E-07	-0.023788	0.9810

C(159)	-3.99E-06	1.19E-05	-0.336115	0.7368
C(160)	-4.36E-06	1.60E-05	-0.271971	0.7856
C(161)	2.22E-05	1.47E-05	1.509345	0.1312
C(162)	3.08E-06	1.08E-05	0.286092	0.7748
C(163)	-0.042680	0.020449	-2.087089	0.0369*
C(164)	-0.069777	0.024012	-2.905955	0.0037*
C(165)	0.059799	0.025277	2.365716	0.0180*
C(166)	-0.025545	0.020918	-1.221200	0.2220
C(167)	-0.000134	0.000461	-0.290467	0.7715
C(168)	-0.000521	0.000485	-1.073678	0.2830
C(169)	0.000217	0.000507	0.428338	0.6684
C(170)	0.000931	0.000474	1.964995	0.0494*
C(171)	4.06E-05	4.34E-05	0.934344	0.3501
C(172)	-4.64E-05	4.34E-05	-1.070543	0.2844
C(173)	-7.53E-05	5.64E-05	-1.333440	0.1824
C(174)	2.42E-05	5.65E-05	0.428808	0.6681
C(175)	0.000351	0.000446	0.786156	0.4318
C(176)	-0.000903	0.001250	-0.721781	0.4704
C(177)	-0.005008	0.001663	-3.011150	0.0026*
C(178)	0.002527	0.001346	1.877783	0.0604
C(179)	0.002246	0.001082	2.075305	0.0380
C(180)	-1.63E-07	9.22E-08	-1.764029	0.0777
C(181)	-7.32E-08	9.23E-08	-0.792342	0.4282
C(182)	3.09E-08	1.33E-07	0.232506	0.8161
C(183)	2.45E-09	1.33E-07	0.018478	0.9853
C(184)	9.90E-06	8.74E-06	1.132218	0.2575
C(185)	2.73E-06	1.18E-05	0.231798	0.8167
C(186)	1.78E-05	1.08E-05	1.645067	0.1000
C(187)	1.87E-05	7.93E-06	2.353213	0.0186*
C(188)	0.589947	0.015057	39.18122	0.0000*
C(189)	0.271258	0.017673	15.34873	0.0000*
C(190)	-0.331213	0.018611	-17.79695	0.0000*
C(191)	-0.154895	0.015401	-10.05756	0.0000*
C(192)	9.66E-07	0.000340	0.002843	0.9977
C(193)	-0.000560	0.000357	-1.568311	0.1168
C(194)	0.000684	0.000374	1.830974	0.0671
C(195)	0.000499	0.000349	1.431132	0.1524
C(196)	6.98E-05	3.20E-05	2.182513	0.0291*
C(197)	8.76E-06	3.19E-05	0.274268	0.7839
C(198)	-8.34E-06	4.15E-05	-0.200879	0.8408
C(199)	0.000100	4.15E-05	2.414313	0.0158*

C(200)	0.000117	0.000329	0.356821	0.7212
C(201)	0.097738	0.094833	1.030626	0.3027
C(202)	0.291298	0.126130	2.309507	0.0209*
C(203)	-0.141427	0.102047	-1.385893	0.1658
C(204)	-0.027940	0.082082	-0.340386	0.7336
C(205)	-4.64E-06	7.00E-06	-0.663727	0.5069
C(206)	-7.04E-06	7.00E-06	-1.006055	0.3144
C(207)	-4.76E-06	1.01E-05	-0.472834	0.6363
C(208)	-1.32E-05	1.01E-05	-1.314264	0.1888
C(209)	-0.000486	0.000663	-0.733213	0.4634
C(210)	-0.000533	0.000894	-0.595803	0.5513
C(211)	0.000692	0.000822	0.841732	0.3999
C(212)	0.000199	0.000602	0.331285	0.7404
C(213)	2.965985	1.141903	2.597405	0.0094*
C(214)	-0.763101	1.340307	-0.569348	0.5691
C(215)	0.526755	1.411421	0.373209	0.7090
C(216)	-1.154971	1.167992	-0.988852	0.3227
C(217)	-0.071799	0.025754	-2.787834	0.0053*
C(218)	-0.072242	0.027096	-2.666206	0.0077*
C(219)	0.059348	0.028328	2.095004	0.0362*
C(220)	0.018847	0.026463	0.712229	0.4763
C(221)	-0.003234	0.002425	-1.333680	0.1823
C(222)	0.008313	0.002423	3.431500	0.0006*
C(223)	-0.001833	0.003148	-0.582447	0.5603
C(224)	0.006146	0.003150	1.950970	0.0511
C(225)	0.019169	0.024923	0.769108	0.4418
C(226)	0.097443	0.085213	1.143517	0.2528
C(227)	0.222429	0.113335	1.962573	0.0497*
C(228)	-0.097628	0.091695	-1.064701	0.2870
C(229)	-0.036198	0.073755	-0.490780	0.6236
C(230)	-7.76E-06	6.29E-06	-1.234010	0.2172
C(231)	-2.91E-06	6.29E-06	-0.462180	0.6440
C(232)	3.19E-06	9.04E-06	0.352274	0.7246
C(233)	-8.58E-06	9.05E-06	-0.948790	0.3427
C(234)	-0.000869	0.000596	-1.458936	0.1446
C(235)	-0.000843	0.000803	-1.049511	0.2939
C(236)	0.001007	0.000739	1.363254	0.1728
C(237)	0.000713	0.000541	1.318003	0.1875
C(238)	1.917676	1.026066	1.868959	0.0616
C(239)	-0.257347	1.204343	-0.213682	0.8308
C(240)	0.433267	1.268243	0.341627	0.7326

C(241)	-0.662528	1.049508	-0.631274	0.5279
C(242)	0.422668	0.023142	18.26429	0.0000*
C(243)	0.147050	0.024347	6.039778	0.0000*
C(244)	-0.274194	0.025455	-10.77192	0.0000*
C(245)	-0.124467	0.023778	-5.234478	0.0000*
C(246)	-0.002784	0.002179	-1.277871	0.2013
C(247)	0.003106	0.002177	1.426651	0.1537
C(248)	-0.005389	0.002828	-1.905342	0.0567
C(249)	0.003254	0.002831	1.149620	0.2503
C(250)	0.022655	0.022395	1.011617	0.3117
C(251)	0.206582	0.709880	0.291010	0.7710
C(252)	-1.402937	0.944154	-1.485919	0.1373
C(253)	0.446312	0.763881	0.584269	0.5590
C(254)	1.594721	0.614428	2.595455	0.0095*
C(255)	-3.56E-05	5.24E-05	-0.680284	0.4963
C(256)	-5.40E-06	5.24E-05	-0.103109	0.9179
C(257)	-2.68E-05	7.53E-05	-0.355105	0.7225
C(258)	-3.08E-05	7.54E-05	-0.408424	0.6830
C(259)	-0.005837	0.004964	-1.175813	0.2397
C(260)	0.003225	0.006691	0.482037	0.6298
C(261)	-0.007044	0.006153	-1.144840	0.2523
C(262)	0.000302	0.004504	0.067053	0.9465
C(263)	-4.117732	8.547784	-0.481731	0.6300
C(264)	7.842906	10.03294	0.781715	0.4344
C(265)	-11.79900	10.56527	-1.116772	0.2641
C(266)	-7.534985	8.743072	-0.861824	0.3888
C(267)	0.187396	0.192786	0.972041	0.3310
C(268)	-0.209839	0.202825	-1.034579	0.3009
C(269)	-0.127557	0.212052	-0.601536	0.5475
C(270)	0.050278	0.198088	0.253819	0.7996
C(271)	0.037135	0.018150	2.046002	0.0408*
C(272)	-0.026250	0.018135	-1.447490	0.1478
C(273)	-0.071591	0.023563	-3.038296	0.0024*
C(274)	0.034457	0.023582	1.461179	0.1440
C(275)	0.470904	0.186565	2.524074	0.0116
C(276)	9.381236	0.674877	13.90066	0.0000*
C(277)	3.101846	0.897600	3.455712	0.0005*
C(278)	-4.489604	0.726216	-6.182190	0.0000*
C(279)	-2.304627	0.584132	-3.945389	0.0001*
C(280)	-3.65E-05	4.98E-05	-0.732533	0.4638
C(281)	-8.62E-05	4.98E-05	-1.729404	0.0837

C(282)	9.33E-05	7.16E-05	1.303280	0.1925
C(283)	3.49E-06	7.17E-05	0.048687	0.9612
C(284)	-0.005379	0.004719	-1.139800	0.2544
C(285)	-0.001804	0.006361	-0.283603	0.7767
C(286)	0.004764	0.005849	0.814438	0.4154
C(287)	0.002470	0.004282	0.576931	0.5640
C(288)	14.41737	8.126307	1.774160	0.0760
C(289)	10.54063	9.538236	1.105092	0.2691
C(290)	16.74551	10.04432	1.667163	0.0955
C(291)	6.429930	8.311965	0.773575	0.4392
C(292)	0.438674	0.183280	2.393467	0.0167*
C(293)	-0.531520	0.192824	-2.756500	0.0058*
C(294)	-0.329701	0.201596	-1.635451	0.1020
C(295)	0.231548	0.188320	1.229545	0.2189
C(296)	-0.035215	0.017255	-2.040863	0.0413*
C(297)	0.001884	0.017241	0.109267	0.9130
C(298)	-0.139485	0.022401	-6.226715	0.0000*
C(299)	0.018552	0.022419	0.827509	0.4080
C(300)	0.427682	0.177366	2.411294	0.0159*
Determinant residual covariance			7.15E+14	

Appendix 7
Regression Models of VAR Model for different Commodities

SILVER_FUT_D=C(1)*SILVER_FUT_D(-1)+C(2)*SILVER_FUT_D(-2)+C(3)*SILVER_SPOT_D(-1) + C(4)*SILVER_SPOT_D(-2) + C(5)*NAT_GAS_SPOT_D(-1) + C(6)*NAT_GAS_SPOT_D(-2) + C(7)*NAT_GAS_FUT_D(-1) + C(8)*NAT_GAS_FUT_D(-2) + C(9)*COCOA_FUT_D(-1) + C(10)*COCOA_FUT_D(-2) + C(11)*COCOA_SPOT_D(-1) + C(12)*COCOA_SPOT_D(-2) + C(13)*COFFEE_FUT_D(-1) + C(14)*COFFEE_FUT_D(-2) + C(15)*COFFEE_SPOT_D(-1) + C(16)*COFFEE_SPOT_D(-2) + C(17)*CRUDE_OIL_FUT_D(-1) + C(18)*CRUDE_OIL_FUT_D(-2) + C(19)*CRUDE_OIL_SPOT_D(-1) + C(20)*CRUDE_OIL_SPOT_D(-2) + C(21)*GOLD_FUT_D(-1) + C(22)*GOLD_FUT_D(-2) + C(23)*GOLD_SPOT_D(-1) + C(24)*GOLD_SPOT_D(-2) + C(25)

SILVER_SPOT_D = C(26)*SILVER_FUT_D(-1) + C(27)*SILVER_FUT_D(-2) + C(28)*SILVER_SPOT_D(-1) + C(29)*SILVER_SPOT_D(-2) + C(30)*NAT_GAS_SPOT_D(-1) + C(31)*NAT_GAS_SPOT_D(-2) + C(32)*NAT_GAS_FUT_D(-1) + C(33)*NAT_GAS_FUT_D(-2) + C(34)*COCOA_FUT_D(-1) + C(35)*COCOA_FUT_D(-2) + C(36)*COCOA_SPOT_D(-1) + C(37)*COCOA_SPOT_D(-2) + C(38)*COFFEE_FUT_D(-1) + C(39)*COFFEE_FUT_D(-2) + C(40)*COFFEE_SPOT_D(-1) + C(41)*COFFEE_SPOT_D(-2) + C(42)*CRUDE_OIL_FUT_D(-1) + C(43)*CRUDE_OIL_FUT_D(-2) + C(44)*CRUDE_OIL_SPOT_D(-1) + C(45)*CRUDE_OIL_SPOT_D(-2) + C(46)*GOLD_FUT_D(-1) + C(47)*GOLD_FUT_D(-2) + C(48)*GOLD_SPOT_D(-1) + C(49)*GOLD_SPOT_D(-2) + C(50)

NAT_GAS_SPOT_D = C(51)*SILVER_FUT_D(-1) + C(52)*SILVER_FUT_D(-2) + C(53)*SILVER_SPOT_D(-1) + C(54)*SILVER_SPOT_D(-2) + C(55)*NAT_GAS_SPOT_D(-1) + C(56)*NAT_GAS_SPOT_D(-2) +

C(57)*NAT_GAS_FUT_D(-1) + C(58)*NAT_GAS_FUT_D(-2) +
C(59)*COCOA_FUT_D(-1) + C(60)*COCOA_FUT_D(-2) +
C(61)*COCOA_SPOT_D(-1) + C(62)*COCOA_SPOT_D(-2) +
C(63)*COFFEE_FUT_D(-1) + C(64)*COFFEE_FUT_D(-2) +
C(65)*COFFEE_SPOT_D(-1) + C(66)*COFFEE_SPOT_D(-2) +
C(67)*CRUDE_OIL_FUT_D(-1) + C(68)*CRUDE_OIL_FUT_D(-2) +
C(69)*CRUDE_OIL_SPOT_D(-1) + C(70)*CRUDE_OIL_SPOT_D(-2) +
C(71)*GOLD_FUT_D(-1) + C(72)*GOLD_FUT_D(-2) +
C(73)*GOLD_SPOT_D(-1) + C(74)*GOLD_SPOT_D(-2) + C(75)

NAT_GAS_FUT_D = C(76)*SILVER_FUT_D(-1) + C(77)*SILVER_FUT_D(-2)
+ C(78)*SILVER_SPOT_D(-1) + C(79)*SILVER_SPOT_D(-2) +
C(80)*NAT_GAS_SPOT_D(-1) + C(81)*NAT_GAS_SPOT_D(-2) +
C(82)*NAT_GAS_FUT_D(-1) + C(83)*NAT_GAS_FUT_D(-2) +
C(84)*COCOA_FUT_D(-1) + C(85)*COCOA_FUT_D(-2) +
C(86)*COCOA_SPOT_D(-1) + C(87)*COCOA_SPOT_D(-2) +
C(88)*COFFEE_FUT_D(-1) + C(89)*COFFEE_FUT_D(-2) +
C(90)*COFFEE_SPOT_D(-1) + C(91)*COFFEE_SPOT_D(-2) +
C(92)*CRUDE_OIL_FUT_D(-1) + C(93)*CRUDE_OIL_FUT_D(-2) +
C(94)*CRUDE_OIL_SPOT_D(-1) + C(95)*CRUDE_OIL_SPOT_D(-2) +
C(96)*GOLD_FUT_D(-1) + C(97)*GOLD_FUT_D(-2) +
C(98)*GOLD_SPOT_D(-1) + C(99)*GOLD_SPOT_D(-2) + C(100)

COCOA_FUT_D = C(101)*SILVER_FUT_D(-1) + C(102)*SILVER_FUT_D(-2)
+ C(103)*SILVER_SPOT_D(-1) + C(104)*SILVER_SPOT_D(-2) +
C(105)*NAT_GAS_SPOT_D(-1) + C(106)*NAT_GAS_SPOT_D(-2) +
C(107)*NAT_GAS_FUT_D(-1) + C(108)*NAT_GAS_FUT_D(-2) +
C(109)*COCOA_FUT_D(-1) + C(110)*COCOA_FUT_D(-2) +
C(111)*COCOA_SPOT_D(-1) + C(112)*COCOA_SPOT_D(-2) +
C(113)*COFFEE_FUT_D(-1) + C(114)*COFFEE_FUT_D(-2) +
C(115)*COFFEE_SPOT_D(-1) + C(116)*COFFEE_SPOT_D(-2) +

C(117)*CRUDE_OIL_FUT_D(-1) + C(118)*CRUDE_OIL_FUT_D(-2) + C(119)*CRUDE_OIL_SPOT_D(-1) + C(120)*CRUDE_OIL_SPOT_D(-2) + C(121)*GOLD_FUT_D(-1) + C(122)*GOLD_FUT_D(-2) + C(123)*GOLD_SPOT_D(-1) + C(124)*GOLD_SPOT_D(-2) + C(125)

COCOA_SPOT_D = C(126)*SILVER_FUT_D(-1) + C(127)*SILVER_FUT_D(-2) + C(128)*SILVER_SPOT_D(-1) + C(129)*SILVER_SPOT_D(-2) + C(130)*NAT_GAS_SPOT_D(-1) + C(131)*NAT_GAS_SPOT_D(-2) + C(132)*NAT_GAS_FUT_D(-1) + C(133)*NAT_GAS_FUT_D(-2) + C(134)*COCOA_FUT_D(-1) + C(135)*COCOA_FUT_D(-2) + C(136)*COCOA_SPOT_D(-1) + C(137)*COCOA_SPOT_D(-2) + C(138)*COFFEE_FUT_D(-1) + C(139)*COFFEE_FUT_D(-2) + C(140)*COFFEE_SPOT_D(-1) + C(141)*COFFEE_SPOT_D(-2) + C(142)*CRUDE_OIL_FUT_D(-1) + C(143)*CRUDE_OIL_FUT_D(-2) + C(144)*CRUDE_OIL_SPOT_D(-1) + C(145)*CRUDE_OIL_SPOT_D(-2) + C(146)*GOLD_FUT_D(-1) + C(147)*GOLD_FUT_D(-2) + C(148)*GOLD_SPOT_D(-1) + C(149)*GOLD_SPOT_D(-2) + C(150)

COFFEE_FUT_D = C(151)*SILVER_FUT_D(-1) + C(152)*SILVER_FUT_D(-2) + C(153)*SILVER_SPOT_D(-1) + C(154)*SILVER_SPOT_D(-2) + C(155)*NAT_GAS_SPOT_D(-1) + C(156)*NAT_GAS_SPOT_D(-2) + C(157)*NAT_GAS_FUT_D(-1) + C(158)*NAT_GAS_FUT_D(-2) + C(159)*COCOA_FUT_D(-1) + C(160)*COCOA_FUT_D(-2) + C(161)*COCOA_SPOT_D(-1) + C(162)*COCOA_SPOT_D(-2) + C(163)*COFFEE_FUT_D(-1) + C(164)*COFFEE_FUT_D(-2) + C(165)*COFFEE_SPOT_D(-1) + C(166)*COFFEE_SPOT_D(-2) + C(167)*CRUDE_OIL_FUT_D(-1) + C(168)*CRUDE_OIL_FUT_D(-2) + C(169)*CRUDE_OIL_SPOT_D(-1) + C(170)*CRUDE_OIL_SPOT_D(-2) + C(171)*GOLD_FUT_D(-1) + C(172)*GOLD_FUT_D(-2) + C(173)*GOLD_SPOT_D(-1) + C(174)*GOLD_SPOT_D(-2) + C(175)

COFFEE_SPOT_D = C(176)*SILVER_FUT_D(-1) + C(177)*SILVER_FUT_D(-2) + C(178)*SILVER_SPOT_D(-1) + C(179)*SILVER_SPOT_D(-2) + C(180)*NAT_GAS_SPOT_D(-1) + C(181)*NAT_GAS_SPOT_D(-2) + C(182)*NAT_GAS_FUT_D(-1) + C(183)*NAT_GAS_FUT_D(-2) + C(184)*COCOA_FUT_D(-1) + C(185)*COCOA_FUT_D(-2) + C(186)*COCOA_SPOT_D(-1) + C(187)*COCOA_SPOT_D(-2) + C(188)*COFFEE_FUT_D(-1) + C(189)*COFFEE_FUT_D(-2) + C(190)*COFFEE_SPOT_D(-1) + C(191)*COFFEE_SPOT_D(-2) + C(192)*CRUDE_OIL_FUT_D(-1) + C(193)*CRUDE_OIL_FUT_D(-2) + C(194)*CRUDE_OIL_SPOT_D(-1) + C(195)*CRUDE_OIL_SPOT_D(-2) + C(196)*GOLD_FUT_D(-1) + C(197)*GOLD_FUT_D(-2) + C(198)*GOLD_SPOT_D(-1) + C(199)*GOLD_SPOT_D(-2) + C(200)

CRUDE_OIL_FUT_D = C(201)*SILVER_FUT_D(-1) + C(202)*SILVER_FUT_D(-2) + C(203)*SILVER_SPOT_D(-1) + C(204)*SILVER_SPOT_D(-2) + C(205)*NAT_GAS_SPOT_D(-1) + C(206)*NAT_GAS_SPOT_D(-2) + C(207)*NAT_GAS_FUT_D(-1) + C(208)*NAT_GAS_FUT_D(-2) + C(209)*COCOA_FUT_D(-1) + C(210)*COCOA_FUT_D(-2) + C(211)*COCOA_SPOT_D(-1) + C(212)*COCOA_SPOT_D(-2) + C(213)*COFFEE_FUT_D(-1) + C(214)*COFFEE_FUT_D(-2) + C(215)*COFFEE_SPOT_D(-1) + C(216)*COFFEE_SPOT_D(-2) + C(217)*CRUDE_OIL_FUT_D(-1) + C(218)*CRUDE_OIL_FUT_D(-2) + C(219)*CRUDE_OIL_SPOT_D(-1) + C(220)*CRUDE_OIL_SPOT_D(-2) + C(221)*GOLD_FUT_D(-1) + C(222)*GOLD_FUT_D(-2) + C(223)*GOLD_SPOT_D(-1) + C(224)*GOLD_SPOT_D(-2) + C(225)

CRUDE_OIL_SPOT_D = C(226)*SILVER_FUT_D(-1) + C(227)*SILVER_FUT_D(-2) + C(228)*SILVER_SPOT_D(-1) + C(229)*SILVER_SPOT_D(-2) + C(230)*NAT_GAS_SPOT_D(-1) + C(231)*NAT_GAS_SPOT_D(-2) + C(232)*NAT_GAS_FUT_D(-1) +

C(233)*NAT_GAS_FUT_D(-2) + C(234)*COCOA_FUT_D(-1) +
C(235)*COCOA_FUT_D(-2) + C(236)*COCOA_SPOT_D(-1) +
C(237)*COCOA_SPOT_D(-2) + C(238)*COFFEE_FUT_D(-1) +
C(239)*COFFEE_FUT_D(-2) + C(240)*COFFEE_SPOT_D(-1) +
C(241)*COFFEE_SPOT_D(-2) + C(242)*CRUDE_OIL_FUT_D(-1) +
C(243)*CRUDE_OIL_FUT_D(-2) + C(244)*CRUDE_OIL_SPOT_D(-1) +
C(245)*CRUDE_OIL_SPOT_D(-2) + C(246)*GOLD_FUT_D(-1) +
C(247)*GOLD_FUT_D(-2) + C(248)*GOLD_SPOT_D(-1) +
C(249)*GOLD_SPOT_D(-2) + C(250)

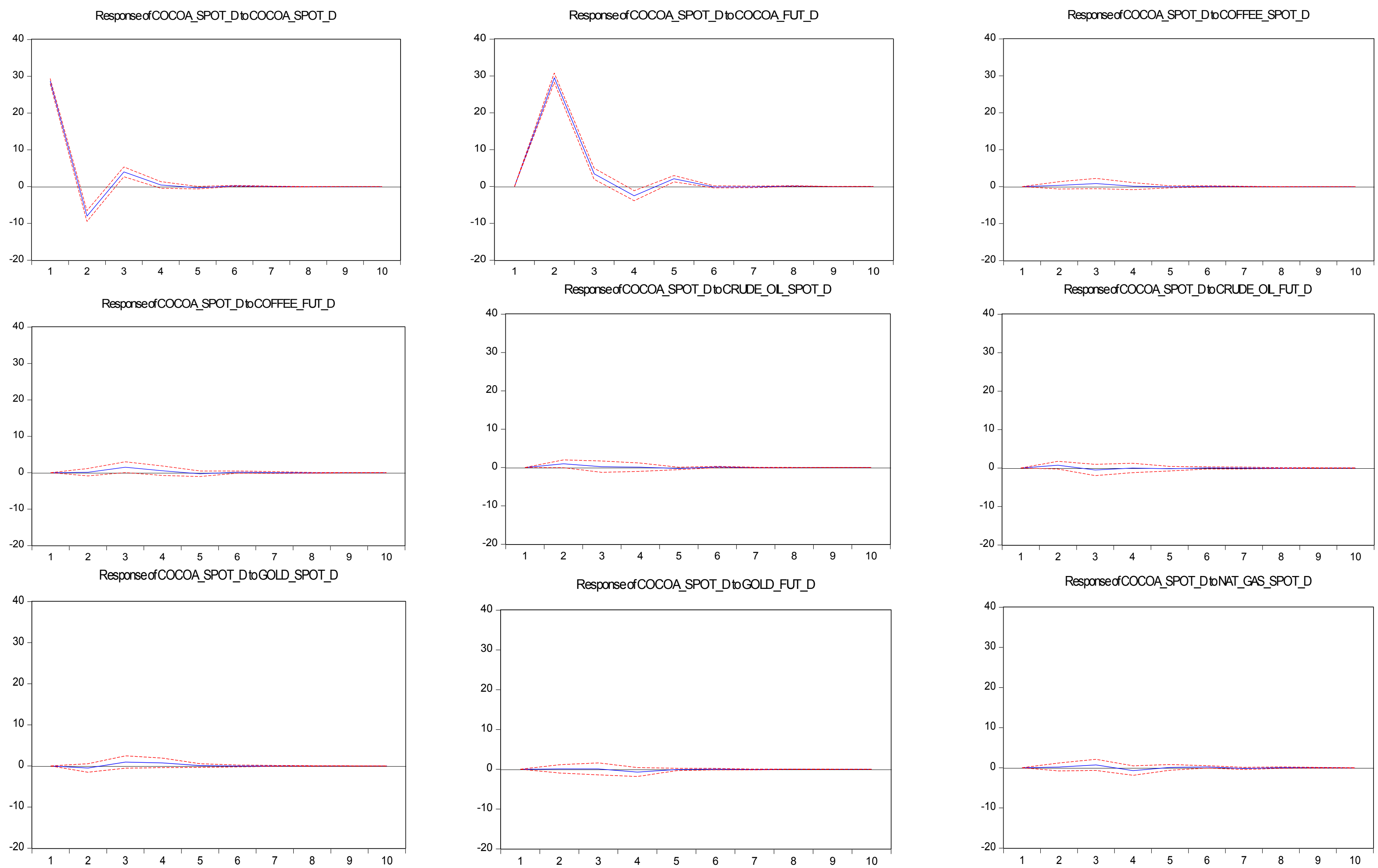
GOLD_FUT_D = C(251)*SILVER_FUT_D(-1) + C(252)*SILVER_FUT_D(-2) +
C(253)*SILVER_SPOT_D(-1) + C(254)*SILVER_SPOT_D(-2) +
C(255)*NAT_GAS_SPOT_D(-1) + C(256)*NAT_GAS_SPOT_D(-2) +
C(257)*NAT_GAS_FUT_D(-1) + C(258)*NAT_GAS_FUT_D(-2) +
C(259)*COCOA_FUT_D(-1) + C(260)*COCOA_FUT_D(-2) +
C(261)*COCOA_SPOT_D(-1) + C(262)*COCOA_SPOT_D(-2) +
C(263)*COFFEE_FUT_D(-1) + C(264)*COFFEE_FUT_D(-2) +
C(265)*COFFEE_SPOT_D(-1) + C(266)*COFFEE_SPOT_D(-2) +
C(267)*CRUDE_OIL_FUT_D(-1) + C(268)*CRUDE_OIL_FUT_D(-2) +
C(269)*CRUDE_OIL_SPOT_D(-1) + C(270)*CRUDE_OIL_SPOT_D(-2) +
C(271)*GOLD_FUT_D(-1) + C(272)*GOLD_FUT_D(-2) +
C(273)*GOLD_SPOT_D(-1) + C(274)*GOLD_SPOT_D(-2) + C(275)

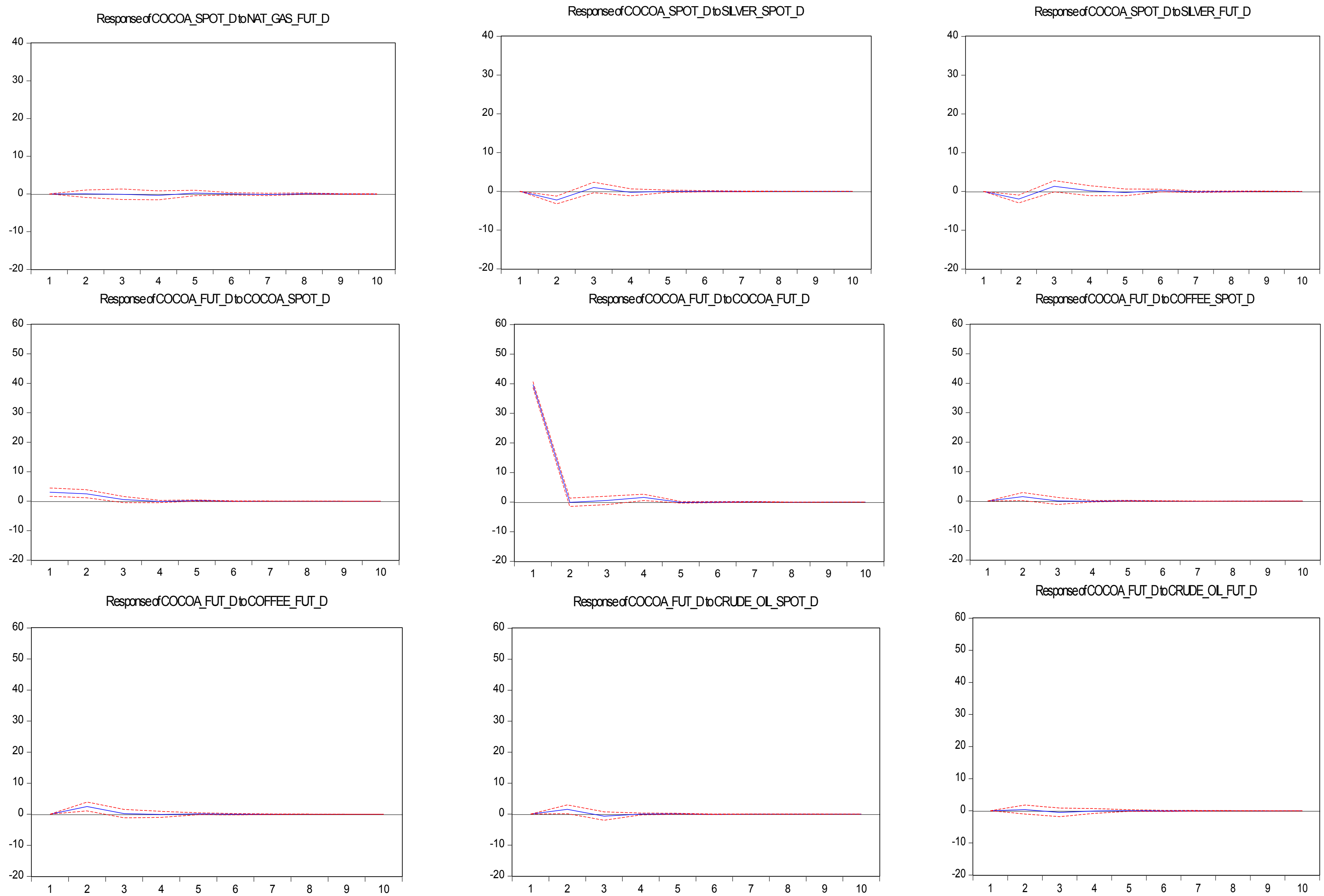
GOLD_SPOT_D = C(276)*SILVER_FUT_D(-1) + C(277)*SILVER_FUT_D(-2)
+ C(278)*SILVER_SPOT_D(-1) + C(279)*SILVER_SPOT_D(-2) +
C(280)*NAT_GAS_SPOT_D(-1) + C(281)*NAT_GAS_SPOT_D(-2) +
C(282)*NAT_GAS_FUT_D(-1) + C(283)*NAT_GAS_FUT_D(-2) +
C(284)*COCOA_FUT_D(-1) + C(285)*COCOA_FUT_D(-2) +
C(286)*COCOA_SPOT_D(-1) + C(287)*COCOA_SPOT_D(-2) +
C(288)*COFFEE_FUT_D(-1) + C(289)*COFFEE_FUT_D(-2) +
C(290)*COFFEE_SPOT_D(-1) + C(291)*COFFEE_SPOT_D(-2) +

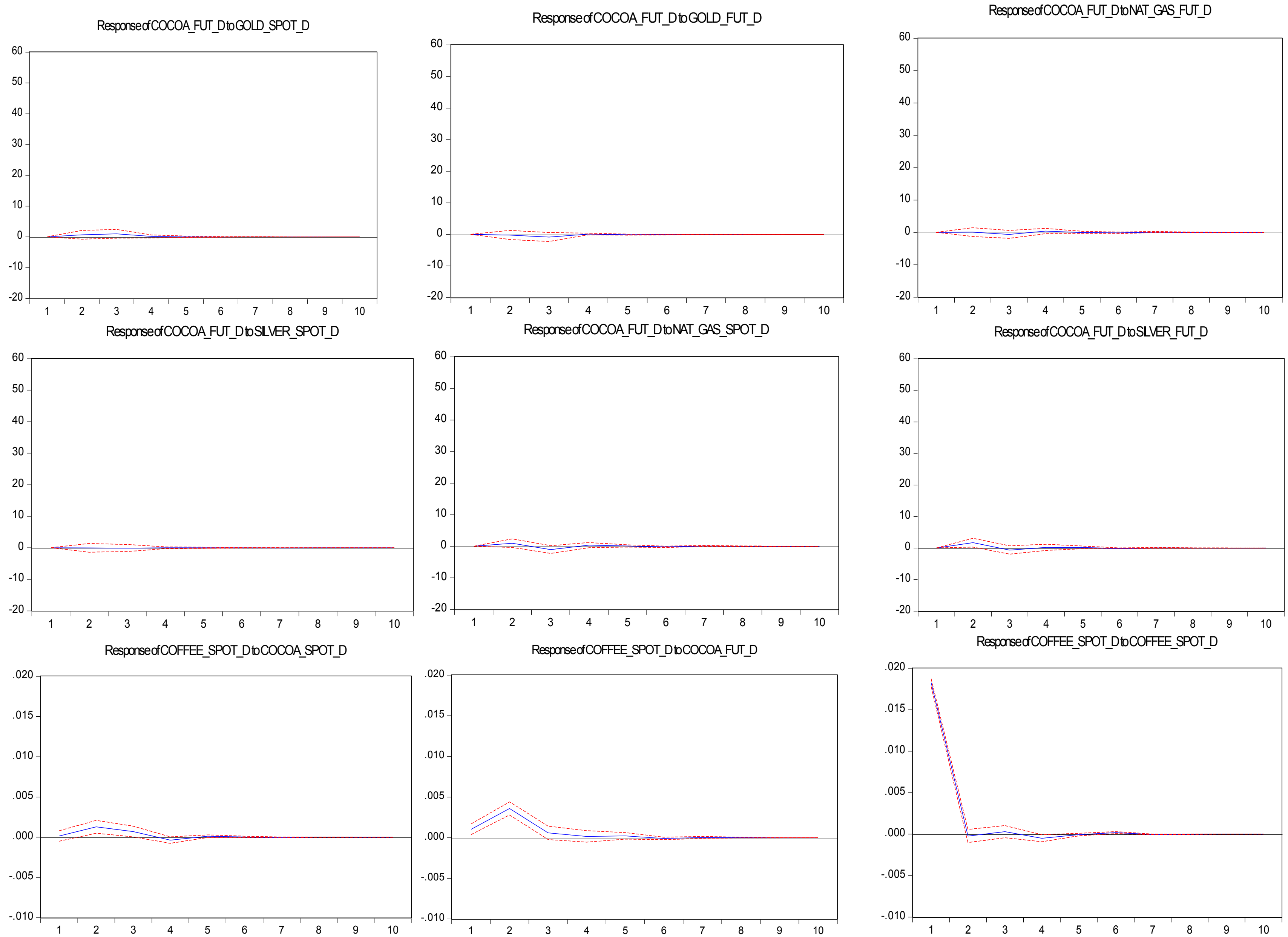
C(292)*CRUDE_OIL_FUT_D(-1) + C(293)*CRUDE_OIL_FUT_D(-2) +
C(294)*CRUDE_OIL_SPOT_D(-1) + C(295)*CRUDE_OIL_SPOT_D(-2) +
C(296)*GOLD_FUT_D(-1) + C(297)*GOLD_FUT_D(-2) +
C(298)*GOLD_SPOT_D(-1) + C(299)*GOLD_SPOT_D(-2) + C(300)

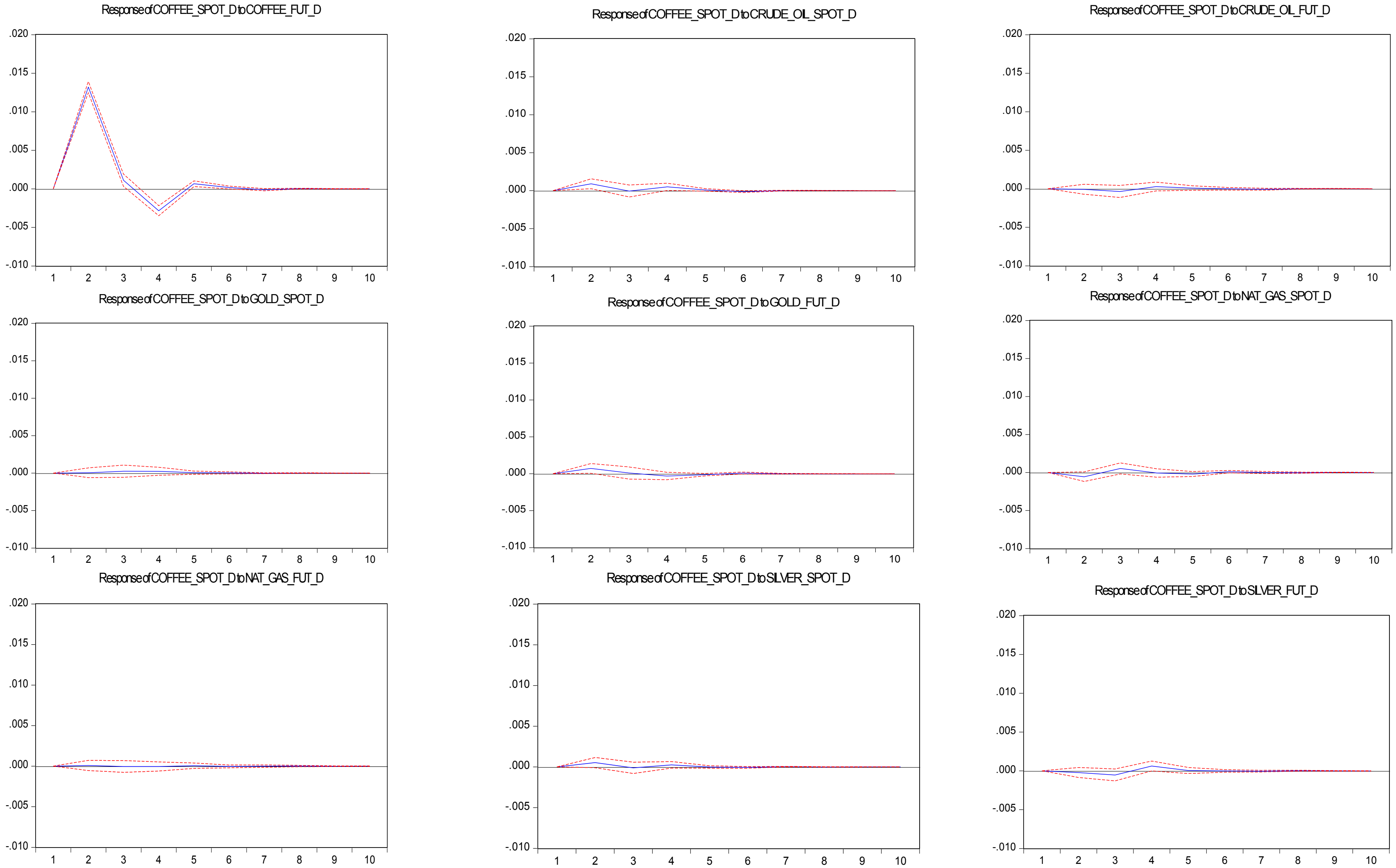
Appendix 8

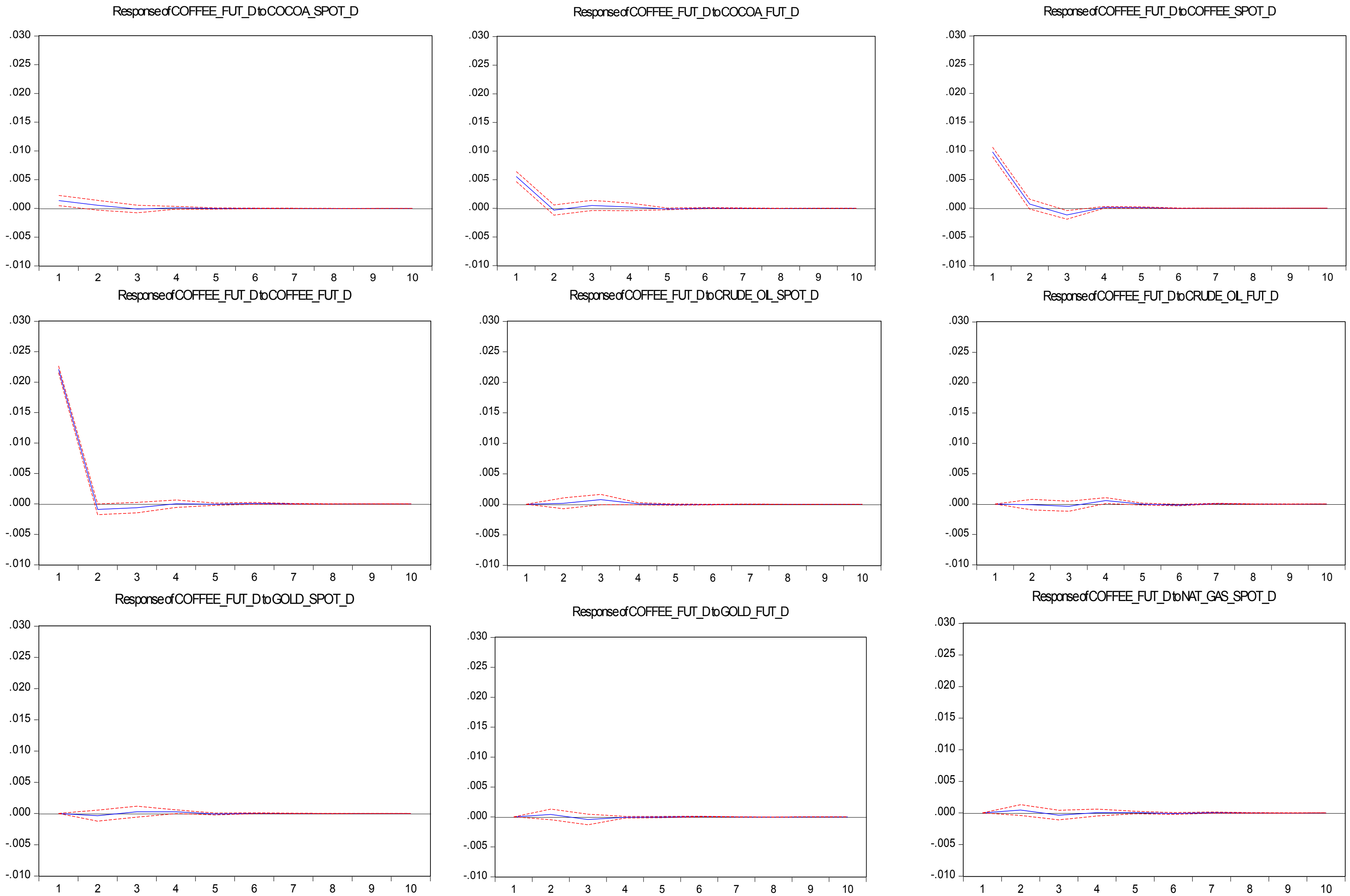
Impulse Response Function Figures



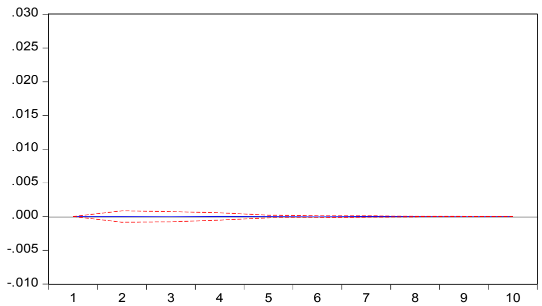

Response of COCOA_SPOT_D to NAT_GAS_FUT_D
Response of COCOA_SPOT_D to SILVER_SPOT_D
Response of COCOA_SPOT_D to SILVER_FUT_D
Response of COCOA_FUT_D to COCOA_SPOT_D
Response of COCOA_FUT_D to COCOA_FUT_D
Response of COCOA_FUT_D to COFFEE_SPOT_D
Response of COCOA_FUT_D to COFFEE_FUT_D
Response of COCOA_FUT_D to CRUDE_OIL_SPOT_D
Response of COCOA_FUT_D to CRUDE_OIL_FUT_D


Response of COCOA_FUT_D to GOLD_SPOT_D
Response of COCOA_FUT_D to GOLD_FUT_D
Response of COCOA_FUT_D to NAT_GAS_FUT_D
Response of COCOA_FUT_D to SILVER_SPOT_D
Response of COCOA_FUT_D to NAT_GAS_SPOT_D
Response of COCOA_FUT_D to SILVER_FUT_D
Response of COFFEE_SPOT_D to COCOA_SPOT_D
Response of COFFEE_SPOT_D to COCOA_FUT_D
Response of COFFEE_SPOT_D to COFFEE_SPOT_D

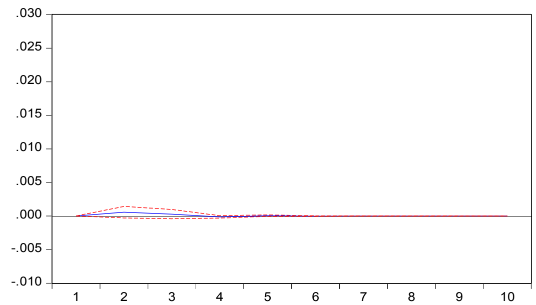

Response of COFFEE_SPOT_D to COFFEE_FUT_D
Response of COFFEE_SPOT_D to CRUDE_OIL_SPOT_D
Response of COFFEE_SPOT_D to CRUDE_OIL_FUT_D
Response of COFFEE_SPOT_D to GOLD_SPOT_D
Response of COFFEE_SPOT_D to GOLD_FUT_D
Response of COFFEE_SPOT_D to NAT_GAS_SPOT_D
Response of COFFEE_SPOT_D to NAT_GAS_FUT_D
Response of COFFEE_SPOT_D to SILVER_SPOT_D
Response of COFFEE_SPOT_D to SILVER_FUT_D
.020
.015
.010
.005
.000
-.005
-.010
1 2 3 4 5 6 7 8 9 10


Response of COFFEE_FUT_D to COCOA_SPOT_D
Response of COFFEE_FUT_D to COCOA_FUT_D
Response of COFFEE_FUT_D to COFFEE_SPOT_D
Response of COFFEE_FUT_D to COFFEE_FUT_D
Response of COFFEE_FUT_D to CRUDE_OIL_SPOT_D
Response of COFFEE_FUT_D to CRUDE_OIL_FUT_D
Response of COFFEE_FUT_D to GOLD_SPOT_D
Response of COFFEE_FUT_D to GOLD_FUT_D
Response of COFFEE_FUT_D to NAT_GAS_SPOT_D
.030
.025
.020
.015
.010
.005
.000
-.005
-.010
1 2 3 4 5 6 7 8 9 10

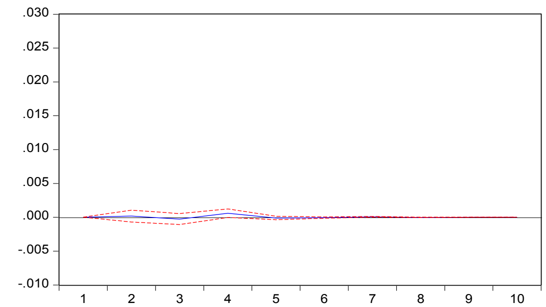
Response of COFFEE_FUT_D to NAT_GAS_FUT_D



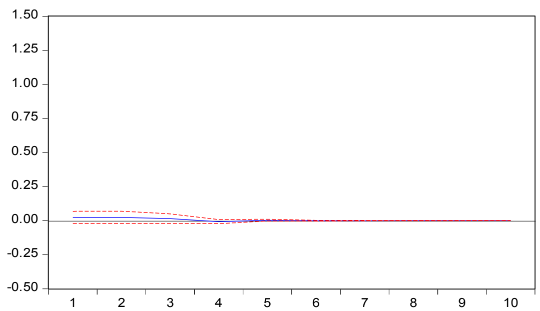
Response of COFFEE_FUT_D to SILVER_SPOT_D



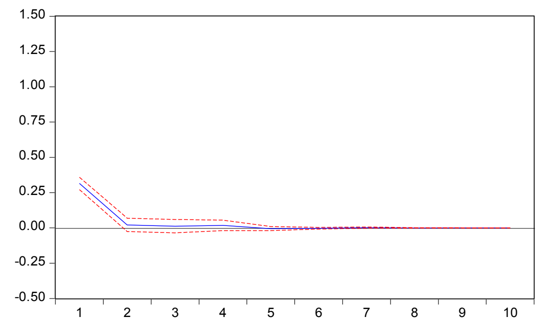
Response of COFFEE_FUT_D to SILVER_FUT_D



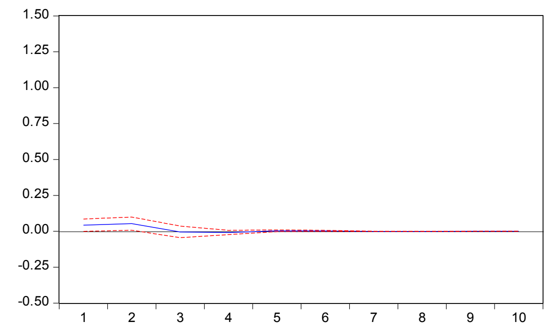
Response of CRUDE_OIL_SPOT_D to COCOA_SPOT_D



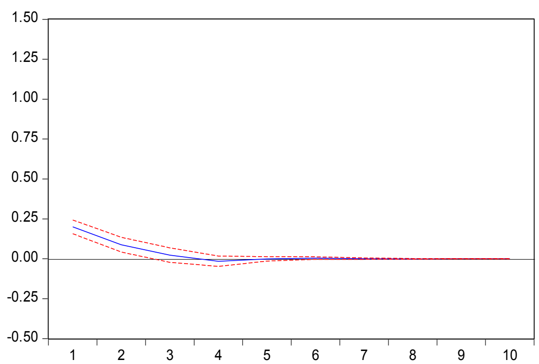
Response of CRUDE_OIL_SPOT_D to COCOA_FUT_D



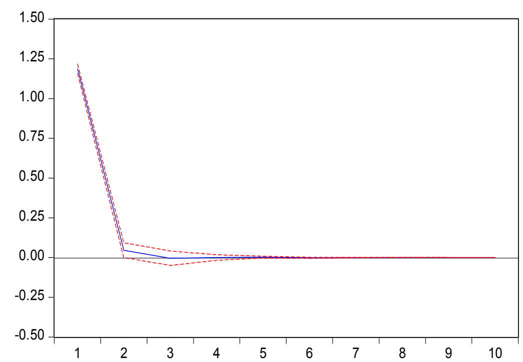
Response of CRUDE_OIL_SPOT_D to COFFEE_SPOT_D



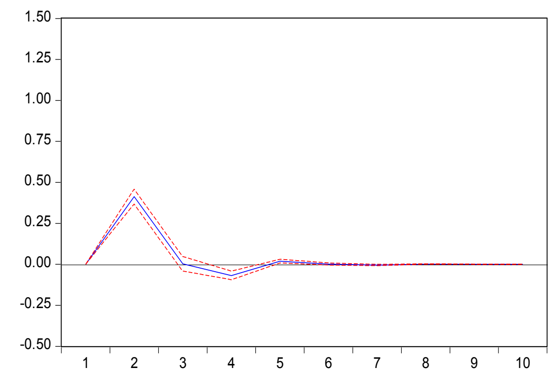
Response of CRUDE_OIL_SPOT_D to COFFEE_FUT_D

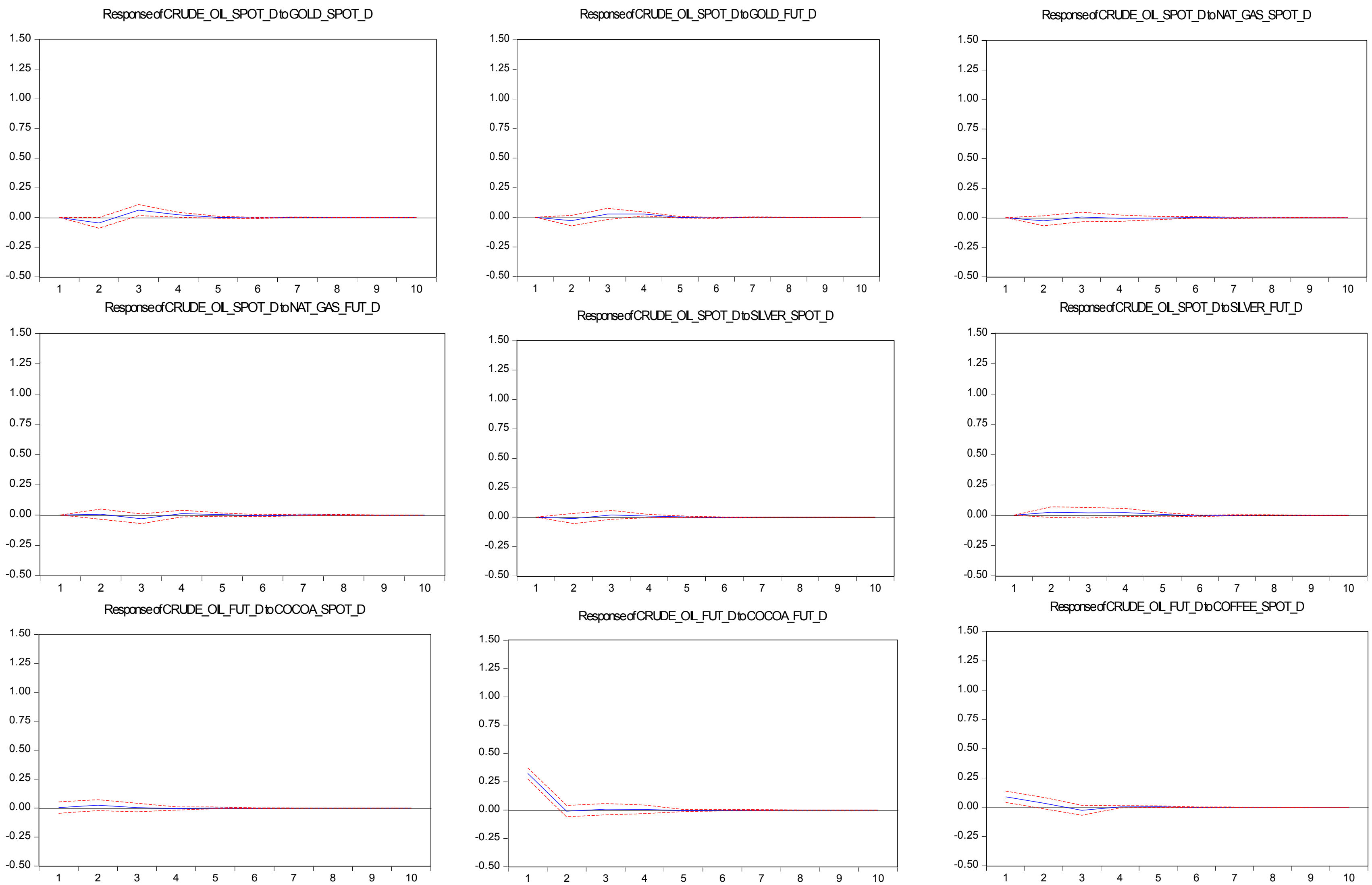


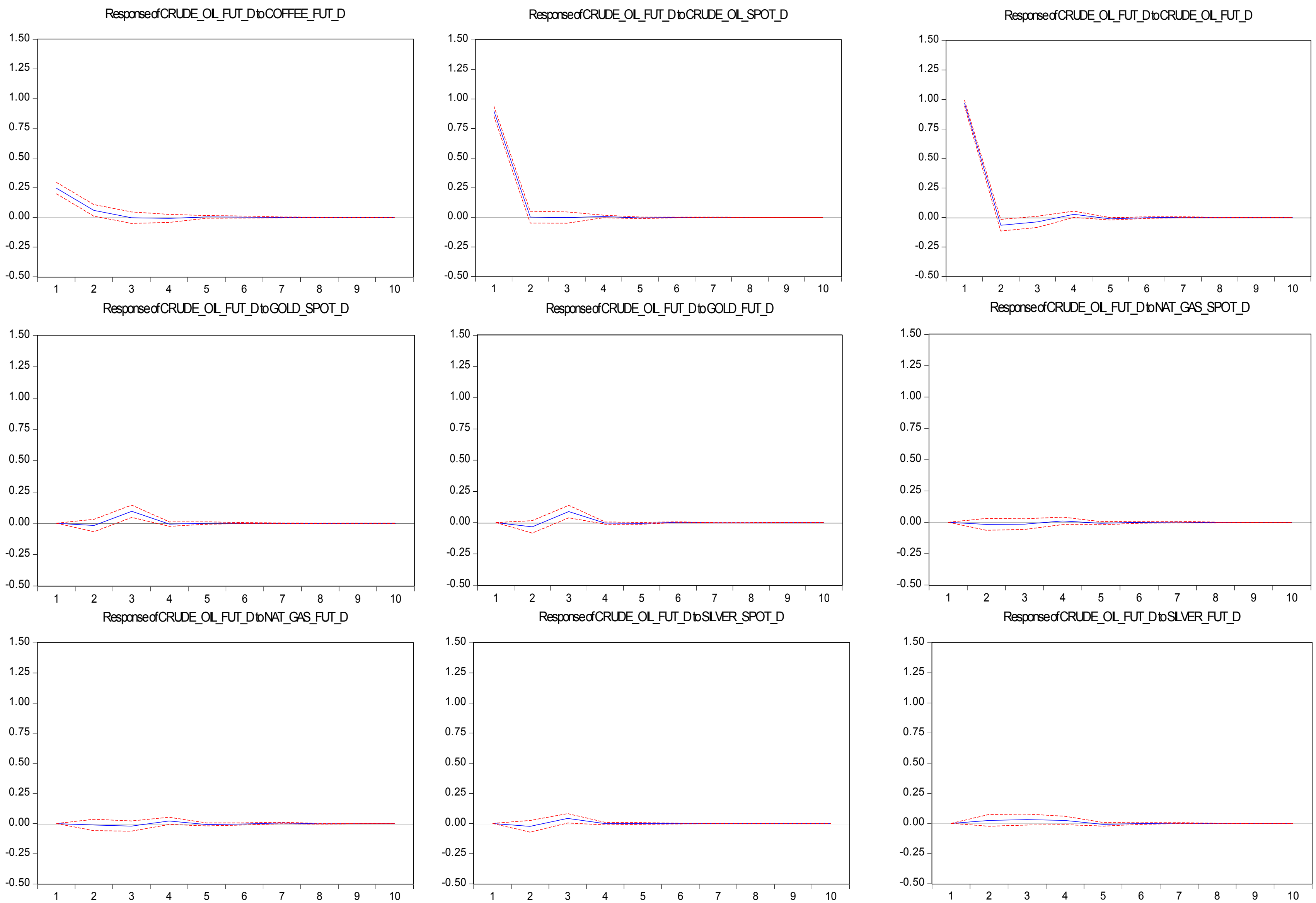
Response of CRUDE_OIL_SPOT_D to CRUDE_OIL_SPOT_D

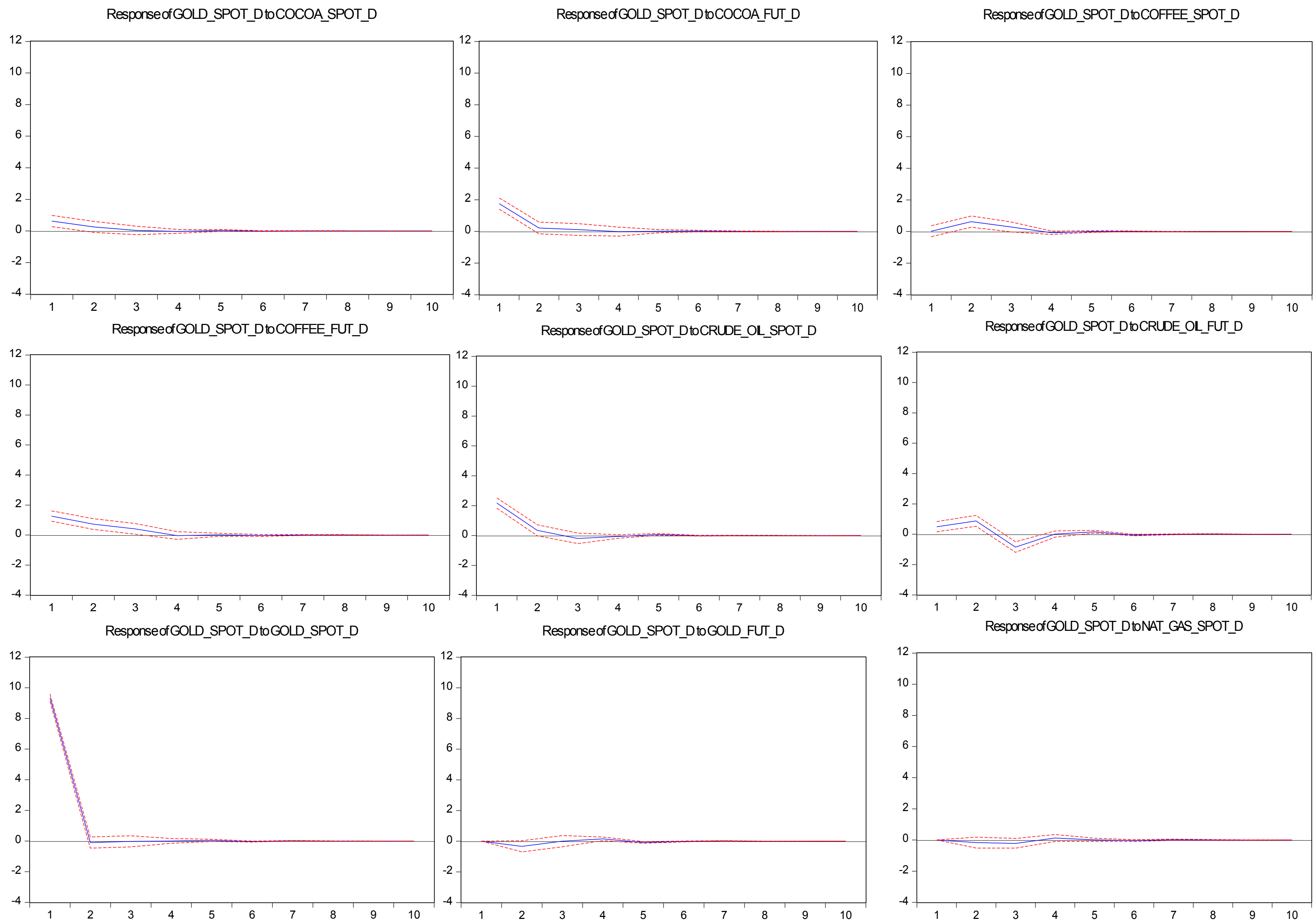


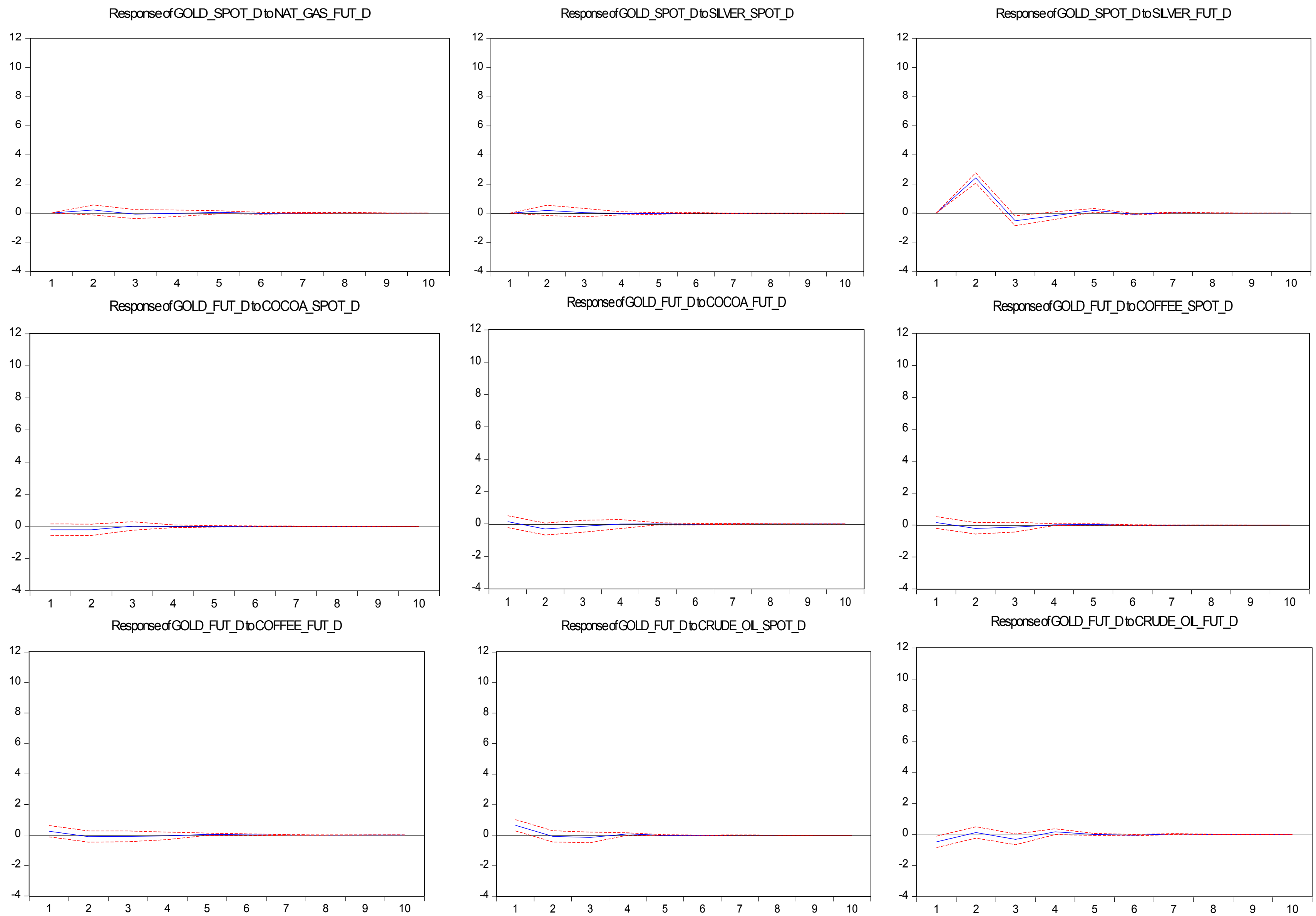
Response of CRUDE_OIL_SPOT_D to CRUDE_OIL_FUT_D



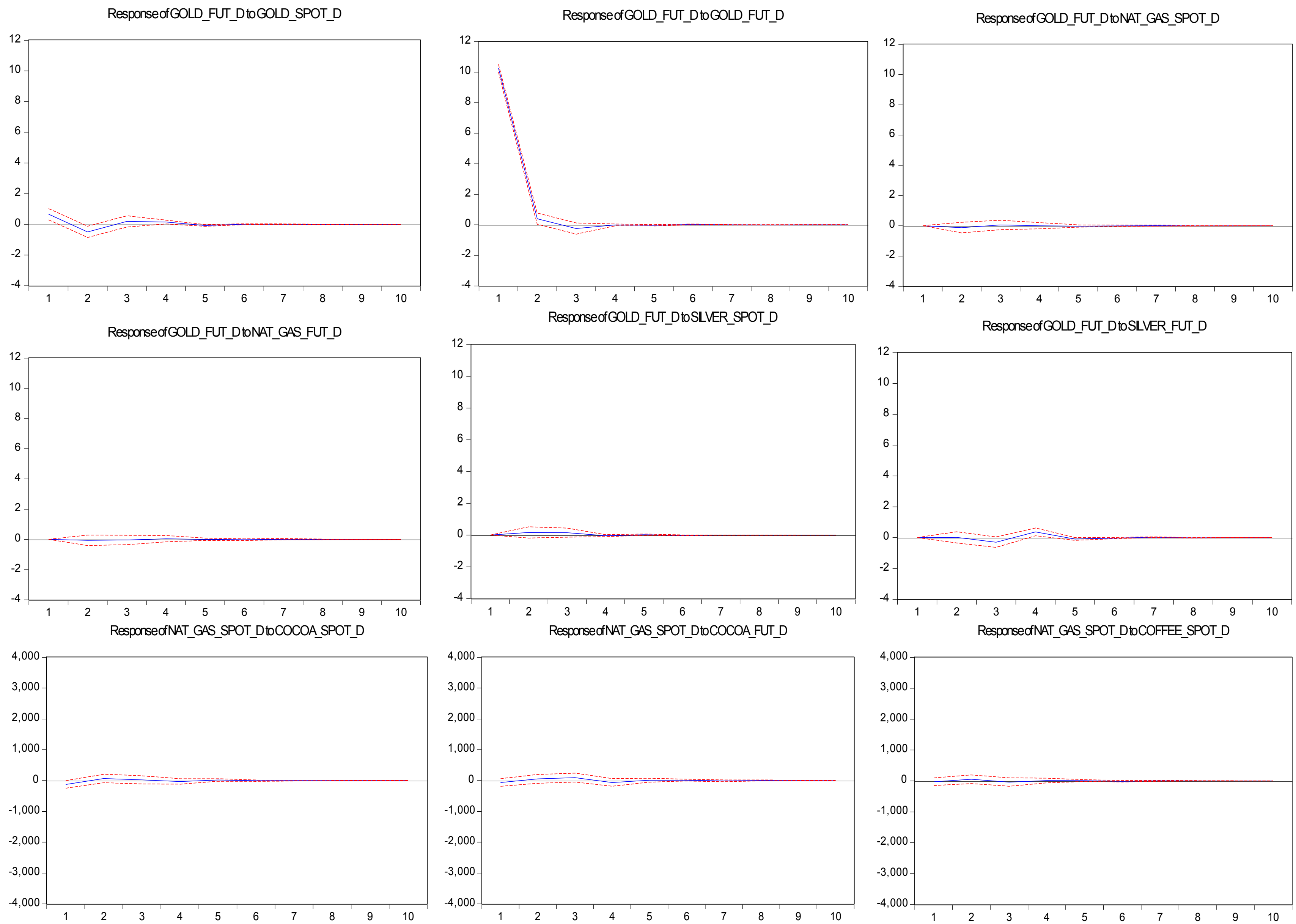

Response of CRUDE_OIL_SPOT_D to GOLD_SPOT_D
Response of CRUDE_OIL_SPOT_D to GOLD_FUT_D
Response of CRUDE_OIL_SPOT_D to NAT_GAS_SPOT_D
Response of CRUDE_OIL_SPOT_D to NAT_GAS_FUT_D
Response of CRUDE_OIL_SPOT_D to SILVER_SPOT_D
Response of CRUDE_OIL_SPOT_D to SILVER_FUT_D
Response of CRUDE_OIL_FUT_D to COCOA_SPOT_D
Response of CRUDE_OIL_FUT_D to COCOA_FUT_D
Response of CRUDE_OIL_FUT_D to COFFEE_SPOT_D

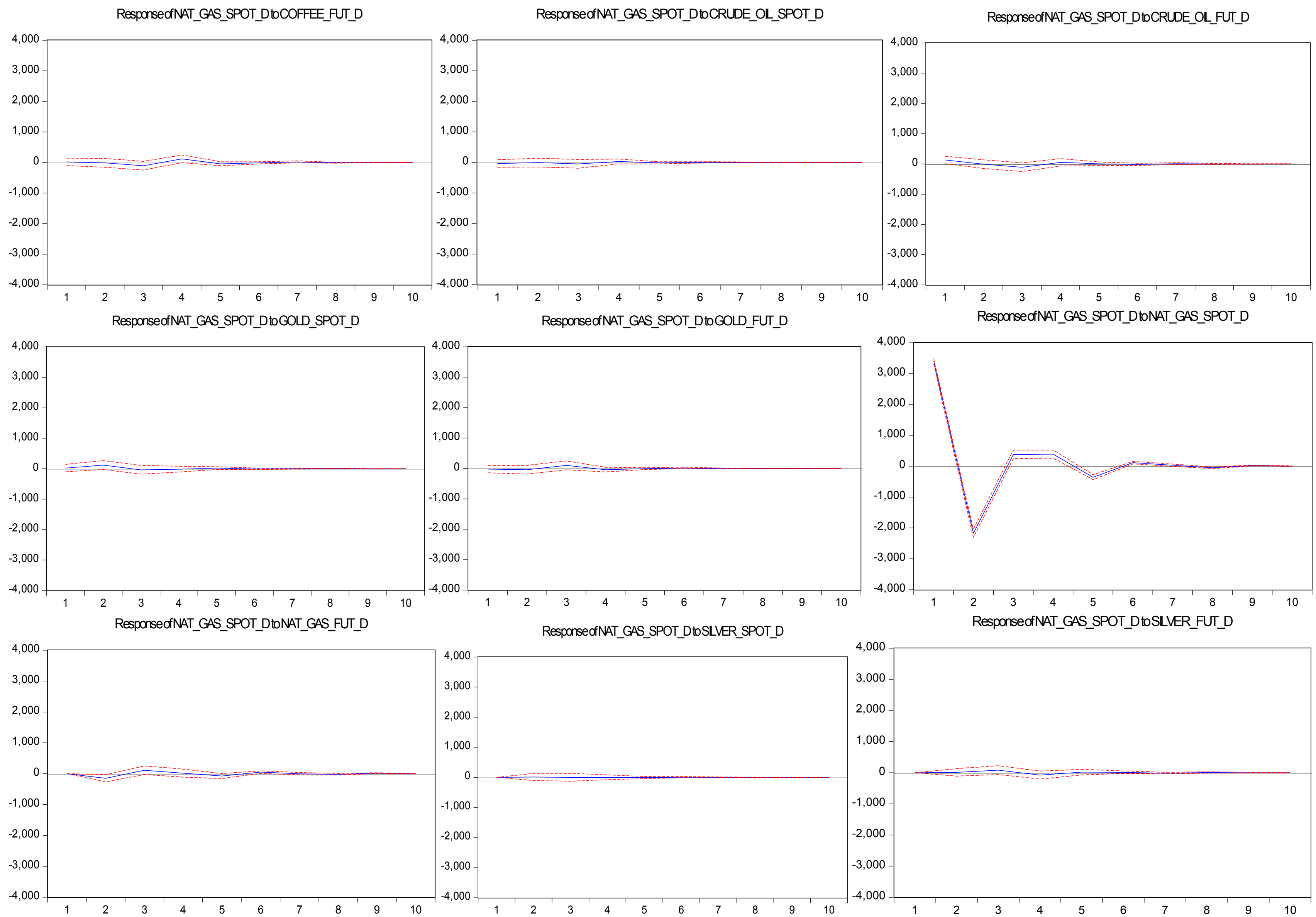

Response of CRUDE_OIL_FUT_D to COFFEE_FUT_D
Response of CRUDE_OIL_FUT_D to CRUDE_OIL_SPOT_D
Response of CRUDE_OIL_FUT_D to CRUDE_OIL_FUT_D
Response of CRUDE_OIL_FUT_D to GOLD_SPOT_D
Response of CRUDE_OIL_FUT_D to GOLD_FUT_D
Response of CRUDE_OIL_FUT_D to NAT_GAS_SPOT_D
Response of CRUDE_OIL_FUT_D to NAT_GAS_FUT_D
Response of CRUDE_OIL_FUT_D to SILVER_SPOT_D
Response of CRUDE_OIL_FUT_D to SILVER_FUT_D

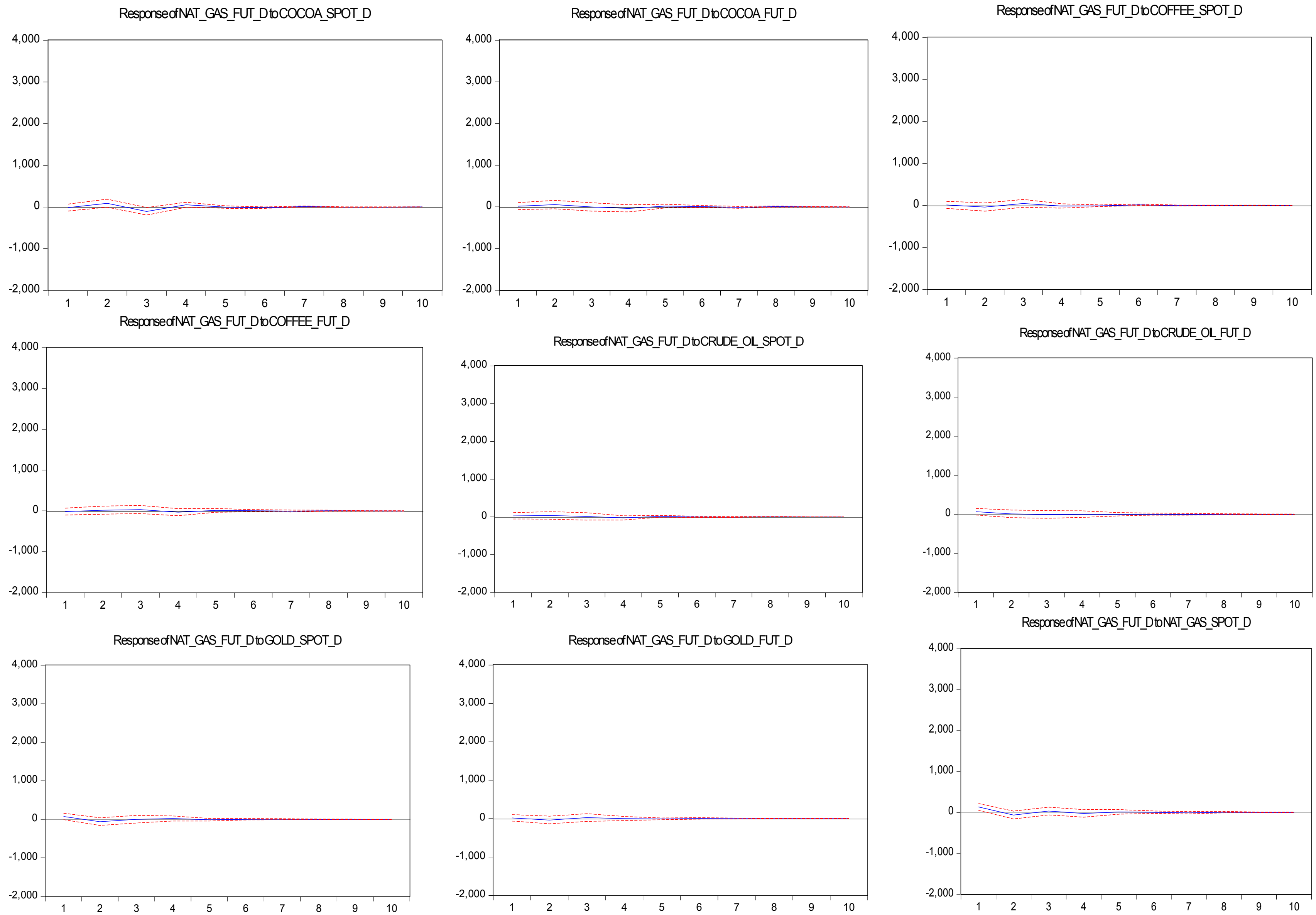

Response of GOLD_SPOT_D to COCOA_SPOT_D
Response of GOLD_SPOT_D to COCOA_FUT_D
Response of GOLD_SPOT_D to COFFEE_SPOT_D
Response of GOLD_SPOT_D to COFFEE_FUT_D
Response of GOLD_SPOT_D to CRUDE_OIL_SPOT_D
Response of GOLD_SPOT_D to CRUDE_OIL_FUT_D
Response of GOLD_SPOT_D to GOLD_SPOT_D
Response of GOLD_SPOT_D to GOLD_FUT_D
Response of GOLD_SPOT_D to NAT_GAS_SPOT_D

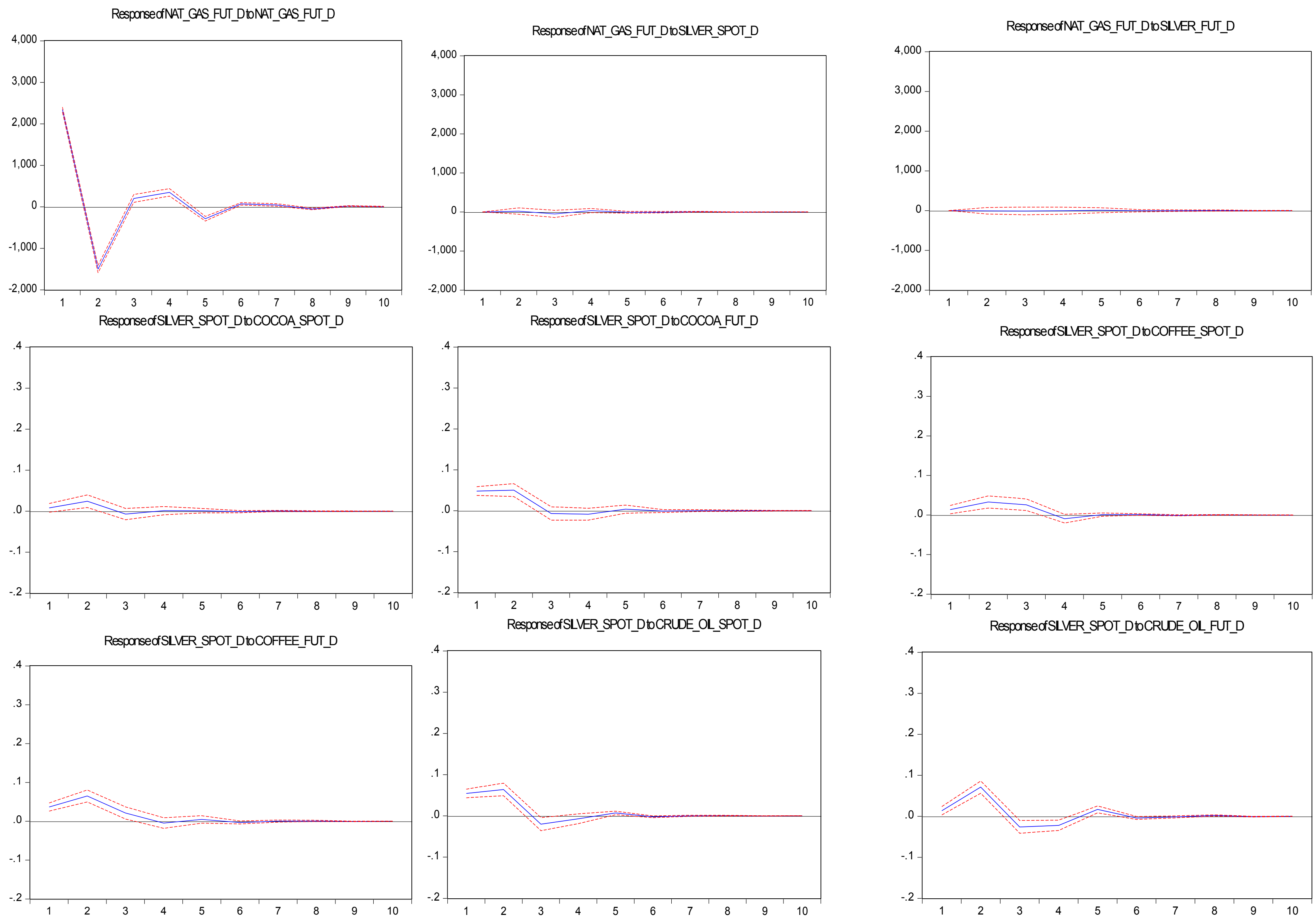


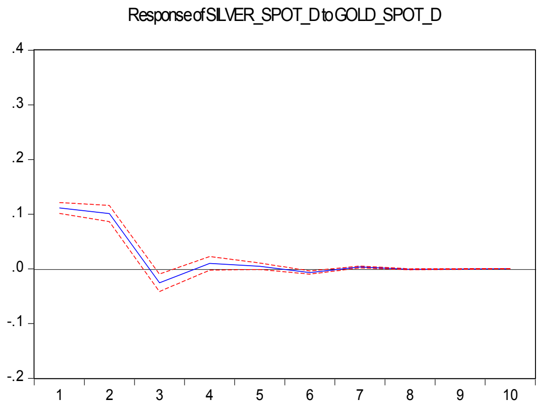
Response of GOLD_SPOT_D to NAT_GAS_FUT_D
Response of GOLD_SPOT_D to SILVER_SPOT_D
Response of GOLD_SPOT_D to SILVER_FUT_D
Response of GOLD_FUT_D to COCOA_SPOT_D
Response of GOLD_FUT_D to COCOA_FUT_D
Response of GOLD_FUT_D to COFFEE_SPOT_D
Response of GOLD_FUT_D to COFFEE_FUT_D
Response of GOLD_FUT_D to CRUDE_OIL_SPOT_D
Response of GOLD_FUT_D to CRUDE_OIL_FUT_D

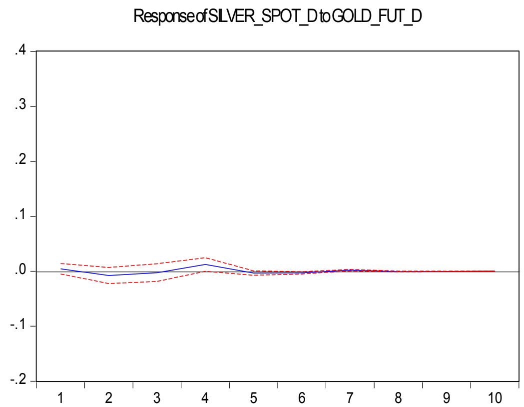

Response of GOLD_FUT_D to GOLD_SPOT_D
Response of GOLD_FUT_D to GOLD_FUT_D
Response of GOLD_FUT_D to NAT_GAS_SPOT_D
Response of GOLD_FUT_D to NAT_GAS_FUT_D
Response of GOLD_FUT_D to SILVER_SPOT_D
Response of GOLD_FUT_D to SILVER_FUT_D
Response of NAT_GAS_SPOT_D to COCOA_SPOT_D
Response of NAT_GAS_SPOT_D to COCOA_FUT_D
Response of NAT_GAS_SPOT_D to COFFEE_SPOT_D

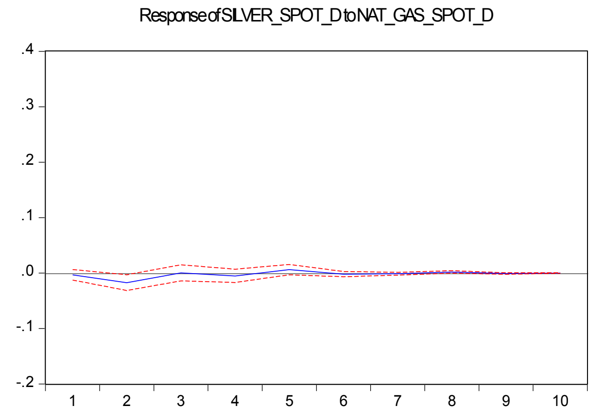

Response of NAT_GAS_SPOT_D to COFFEE_FUT_D
Response of NAT_GAS_SPOT_D to CRUDE_OIL_SPOT_D
Response of NAT_GAS_SPOT_D to CRUDE_OIL_FUT_D
Response of NAT_GAS_SPOT_D to GOLD_SPOT_D
Response of NAT_GAS_SPOT_D to GOLD_FUT_D
Response of NAT_GAS_SPOT_D to NAT_GAS_SPOT_D
Response of NAT_GAS_SPOT_D to NAT_GAS_FUT_D
Response of NAT_GAS_SPOT_D to SILVER_SPOT_D
Response of NAT_GAS_SPOT_D to SILVER_FUT_D
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
1 2 3 4 5 6 7 8 9 10

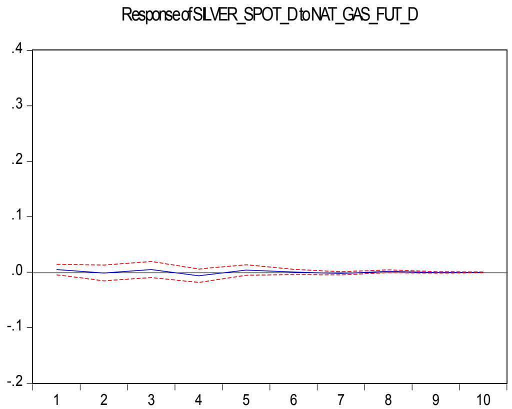

Response of NAT_GAS_FUT_D to COCOA_SPOT_D
Response of NAT_GAS_FUT_D to COCOA_FUT_D
Response of NAT_GAS_FUT_D to COFFEE_SPOT_D
Response of NAT_GAS_FUT_D to COFFEE_FUT_D
Response of NAT_GAS_FUT_D to CRUDE_OIL_SPOT_D
Response of NAT_GAS_FUT_D to CRUDE_OIL_FUT_D
Response of NAT_GAS_FUT_D to GOLD_SPOT_D
Response of NAT_GAS_FUT_D to GOLD_FUT_D
Response of NAT_GAS_FUT_D to NAT_GAS_SPOT_D

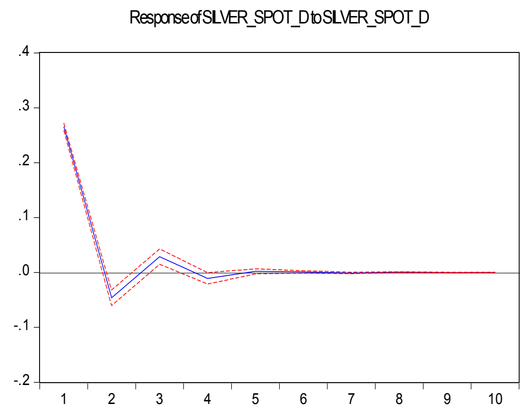

Response of NAT_GAS_FUT_D to NAT_GAS_FUT_D
Response of NAT_GAS_FUT_D to SILVER_SPOT_D
Response of NAT_GAS_FUT_D to SILVER_FUT_D
Response of SILVER_SPOT_D to COCOA_SPOT_D
Response of SILVER_SPOT_D to COCOA_FUT_D
Response of SILVER_SPOT_D to COFFEE_SPOT_D
Response of SILVER_SPOT_D to COFFEE_FUT_D
Response of SILVER_SPOT_D to CRUDE_OIL_SPOT_D
Response of SILVER_SPOT_D to CRUDE_OIL_FUT_D

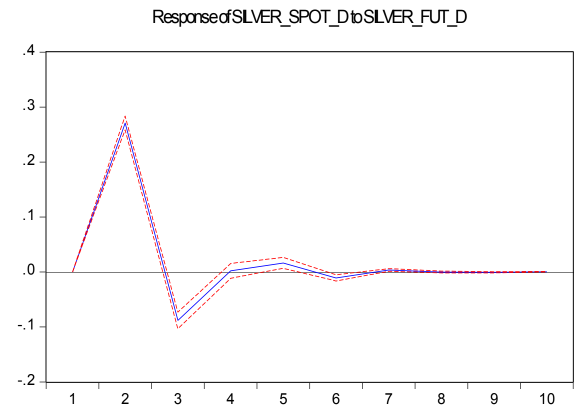

Response of SILVER_SPOT_D to GOLD_SPOT_D

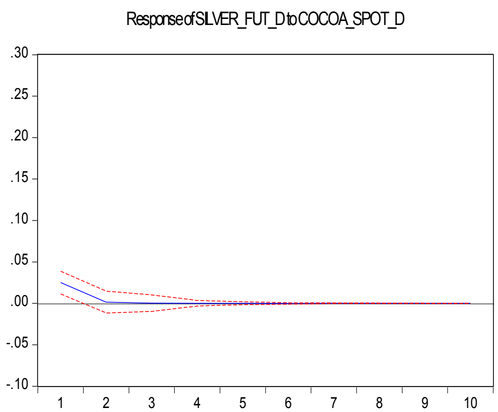

Response of SILVER_SPOT_D to GOLD_FUT_D

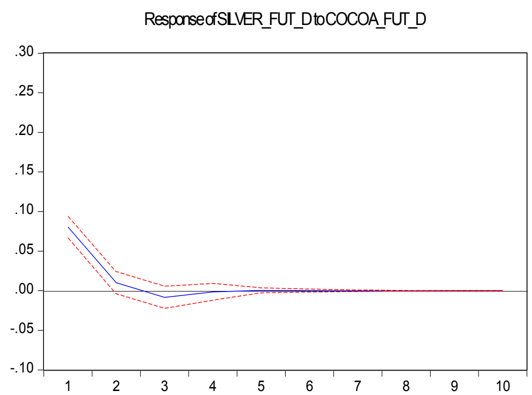

Response of SILVER_SPOT_D to NAT_GAS_SPOT_D

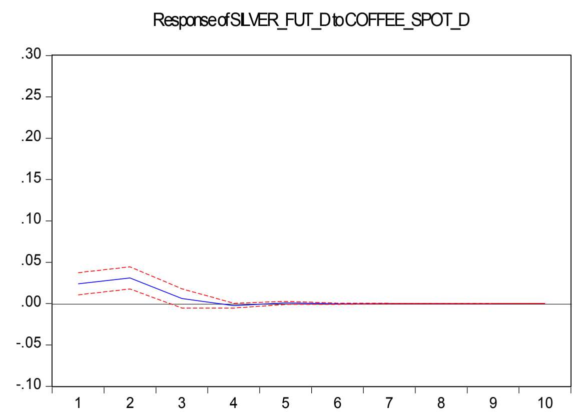

Response of SILVER_SPOT_D to NAT_GAS_FUT_D

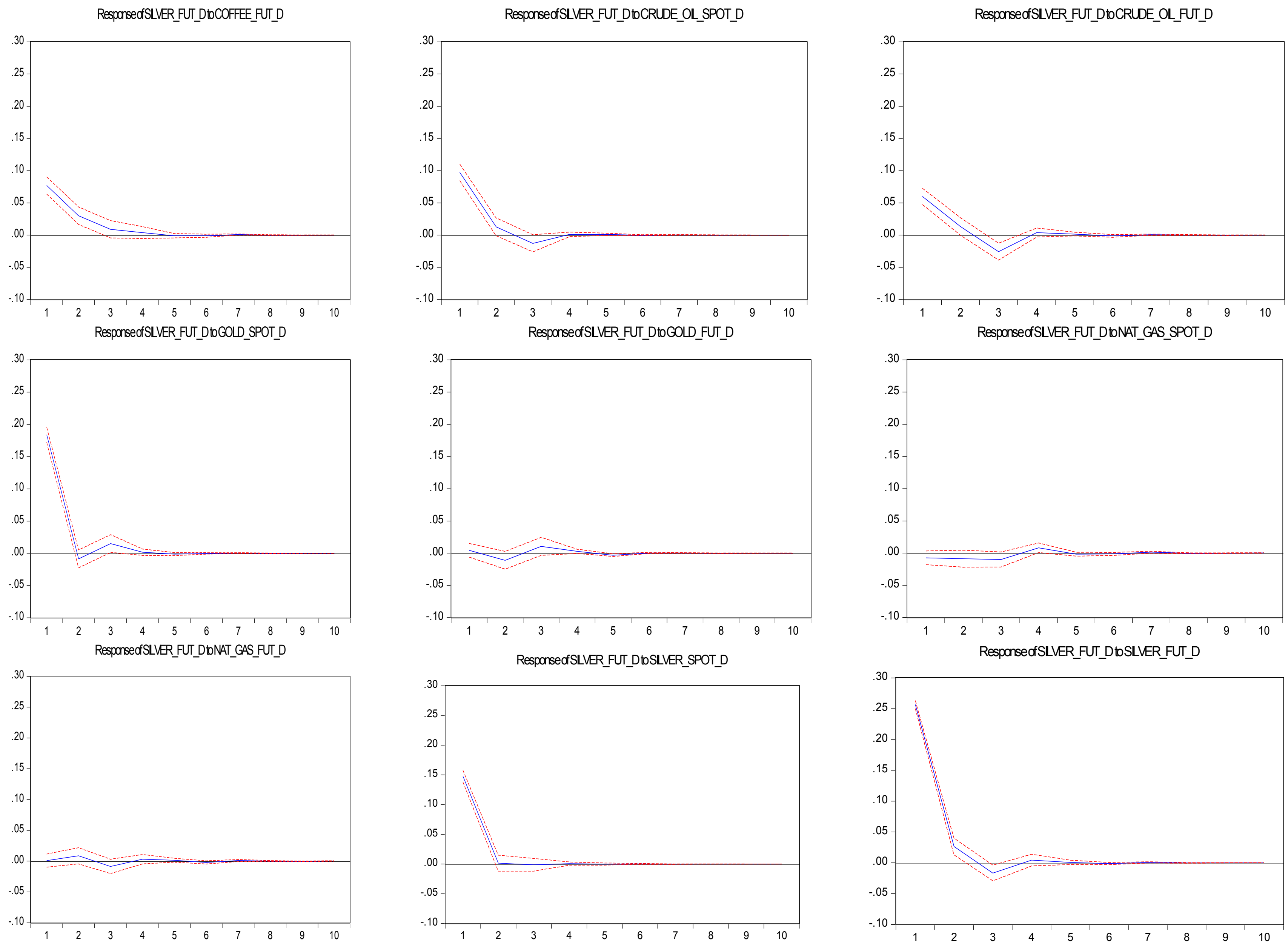

Response of SILVER_SPOT_D to SILVER_SPOT_D


Response of SILVER_SPOT_D to SILVER_FUT_D


Response of SILVER_FUT_D to COCOA_SPOT_D

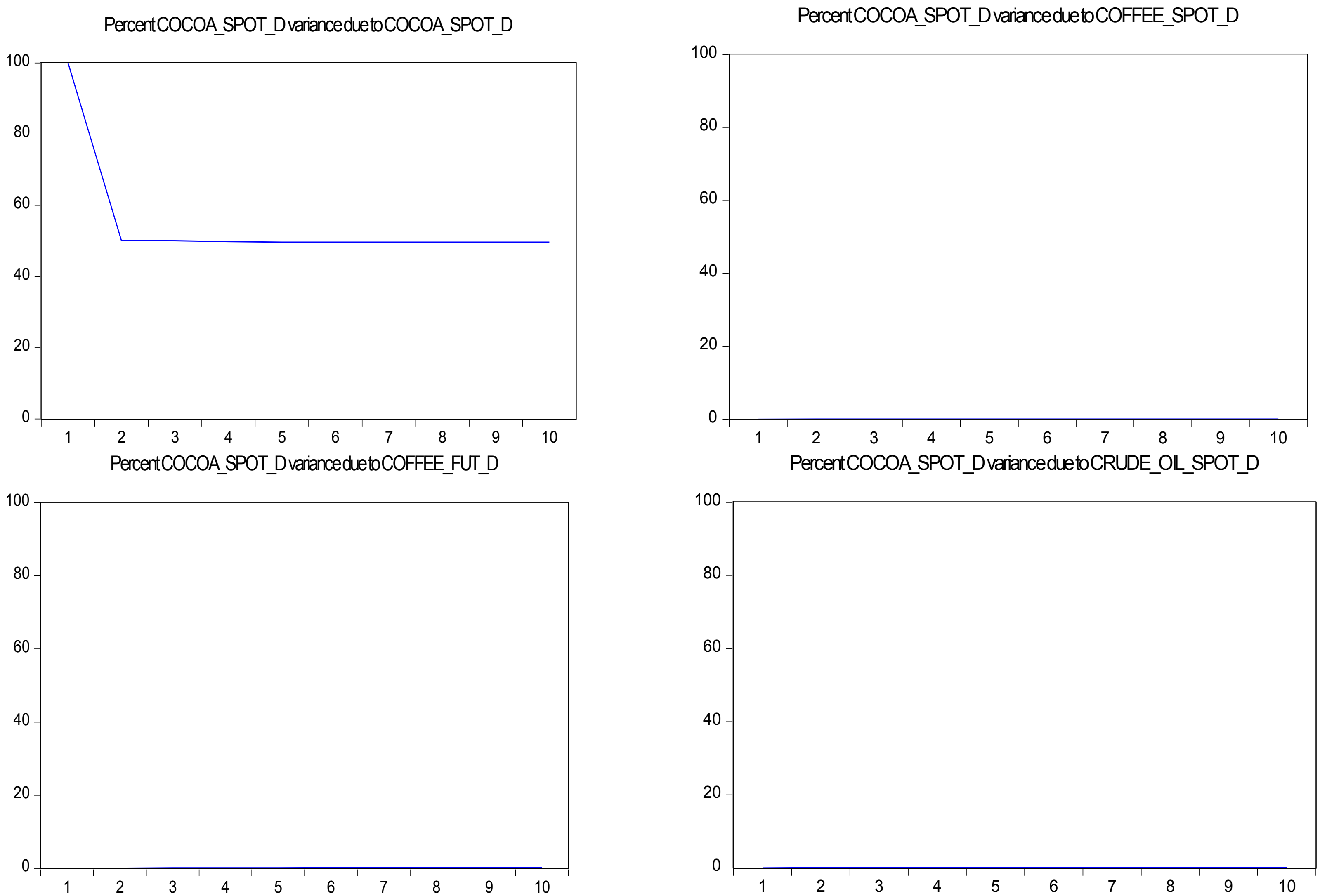

Response of SILVER_FUT_D to COCOA_FUT_D

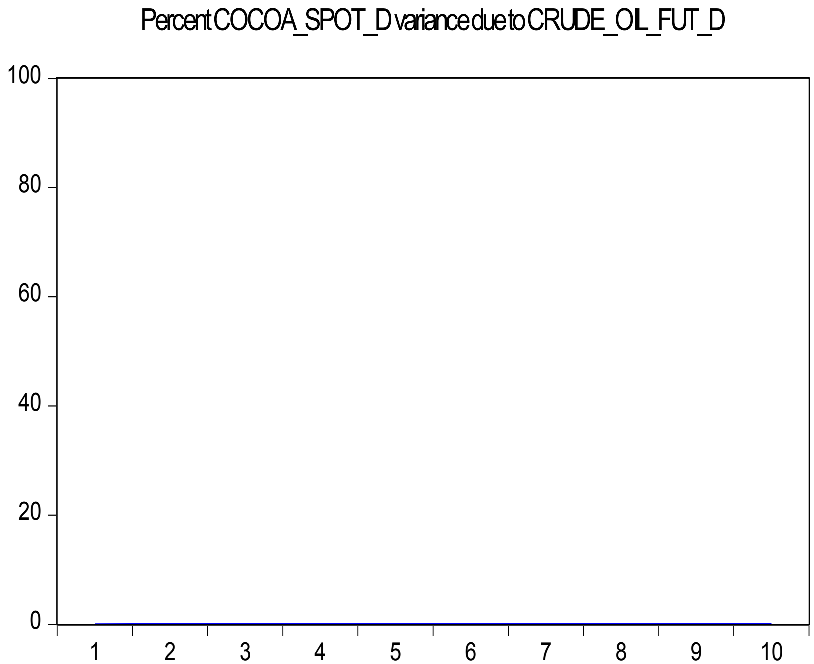

Response of SILVER_FUT_D to COFFEE_SPOT_D

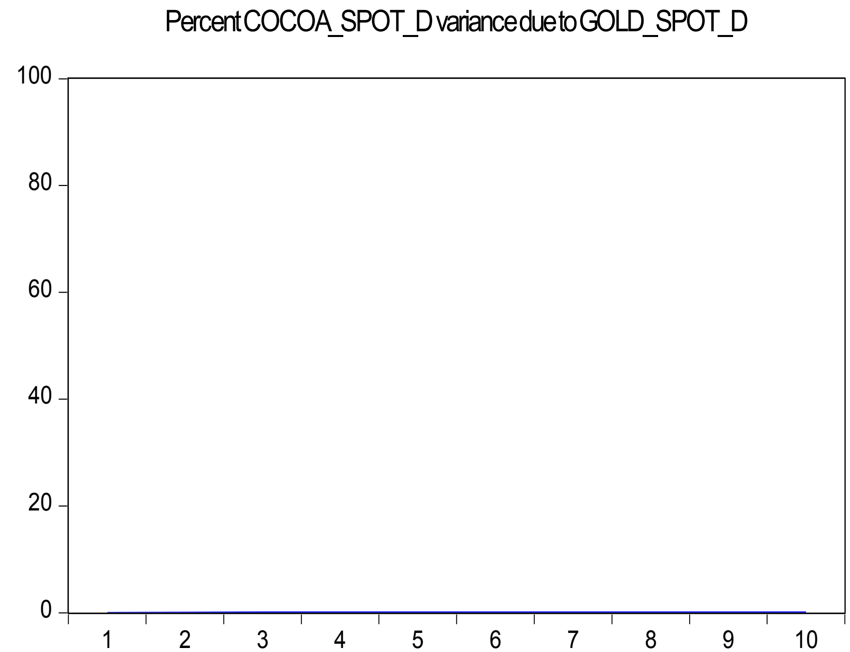

Response of SILVER_FUT_D to COFFEE_FUT_D
Response of SILVER_FUT_D to CRUDE_OIL_SPOT_D
Response of SILVER_FUT_D to CRUDE_OIL_FUT_D
Response of SILVER_FUT_D to GOLD_SPOT_D
Response of SILVER_FUT_D to GOLD_FUT_D
Response of SILVER_FUT_D to NAT_GAS_SPOT_D
Response of SILVER_FUT_D to NAT_GAS_FUT_D
Response of SILVER_FUT_D to SILVER_SPOT_D
Response of SILVER_FUT_D to SILVER_FUT_D
.30
.25
.20
.15
.10
.05
.00
-.05
-.10
1 2 3 4 5 6 7 8 9 10

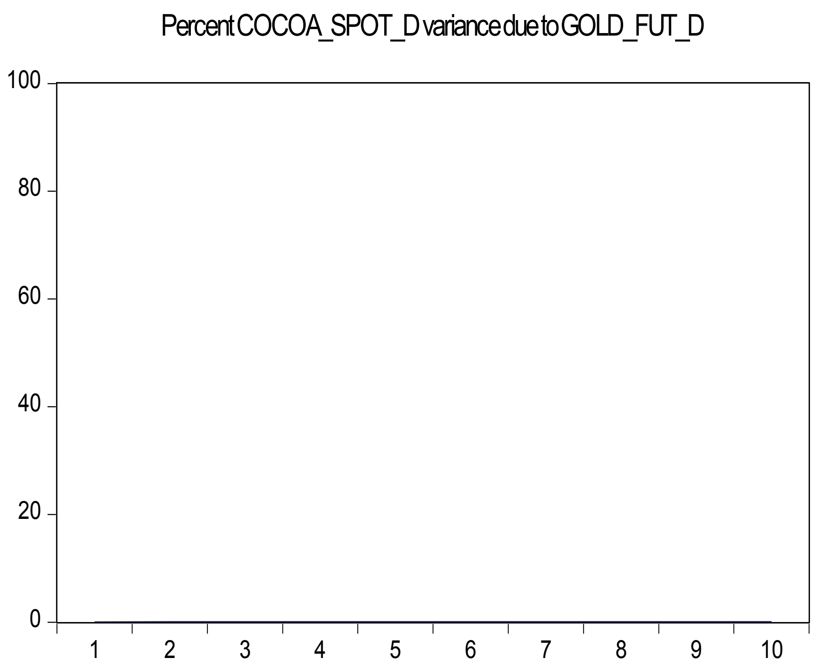
Appendix 9

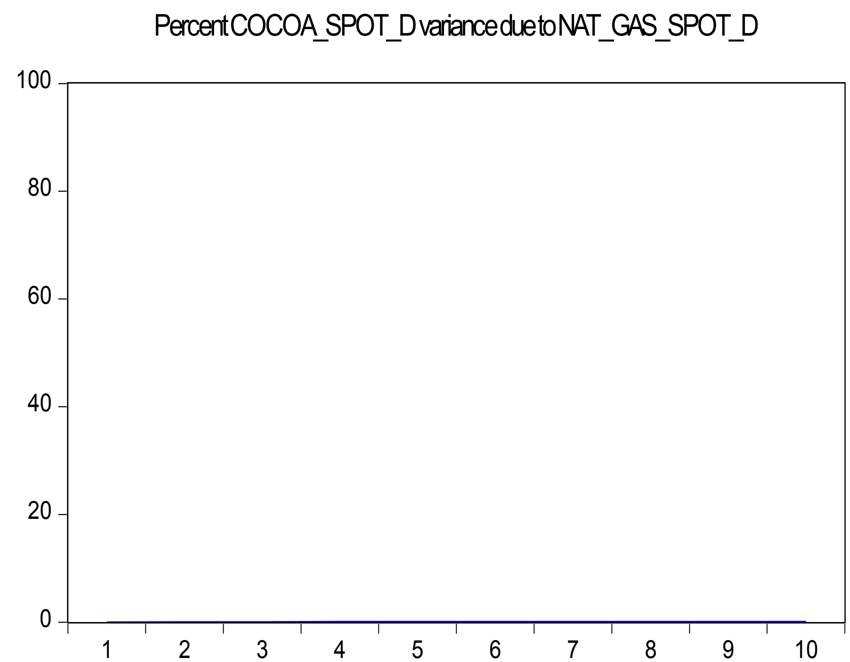
Variance decomposition function

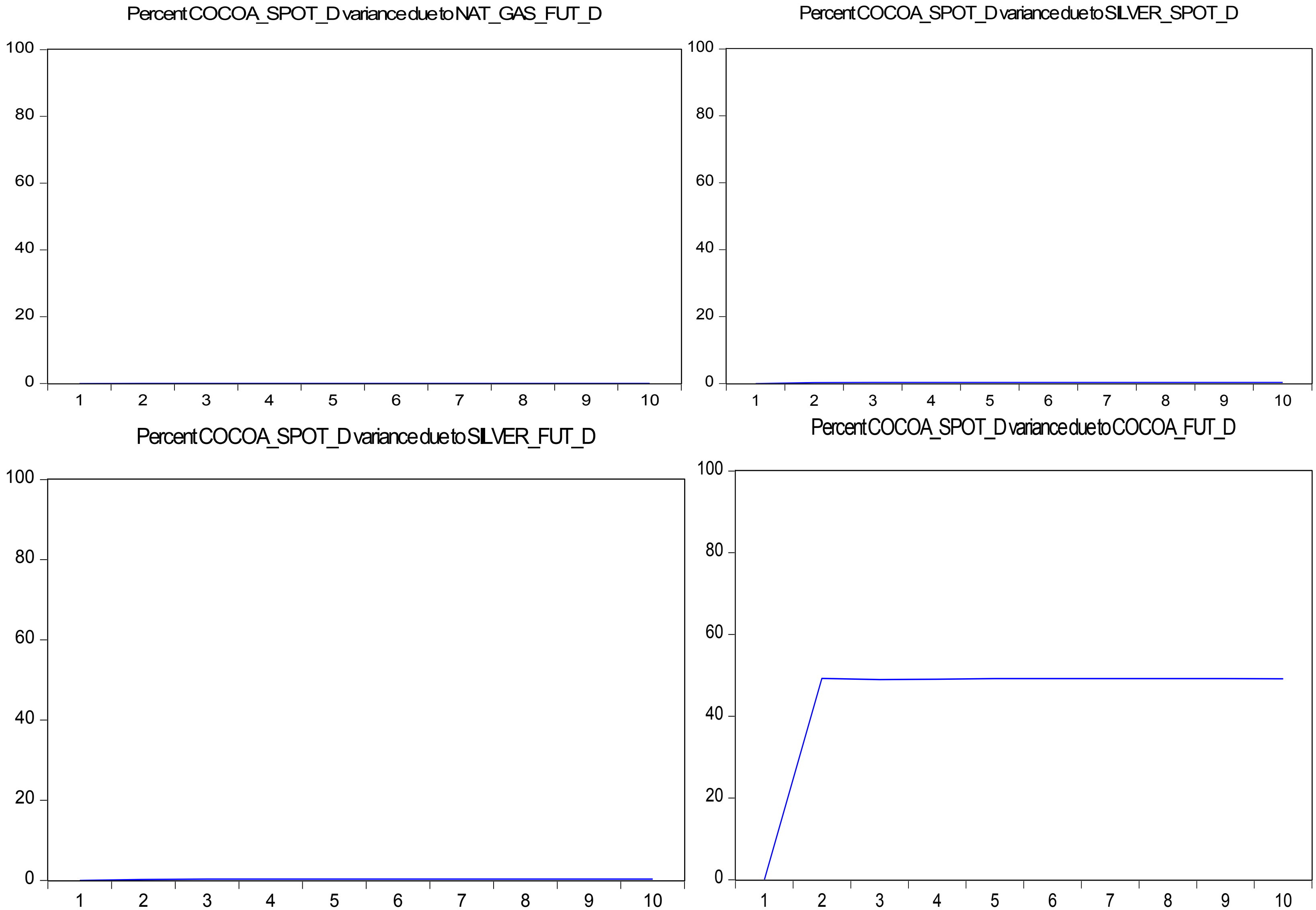


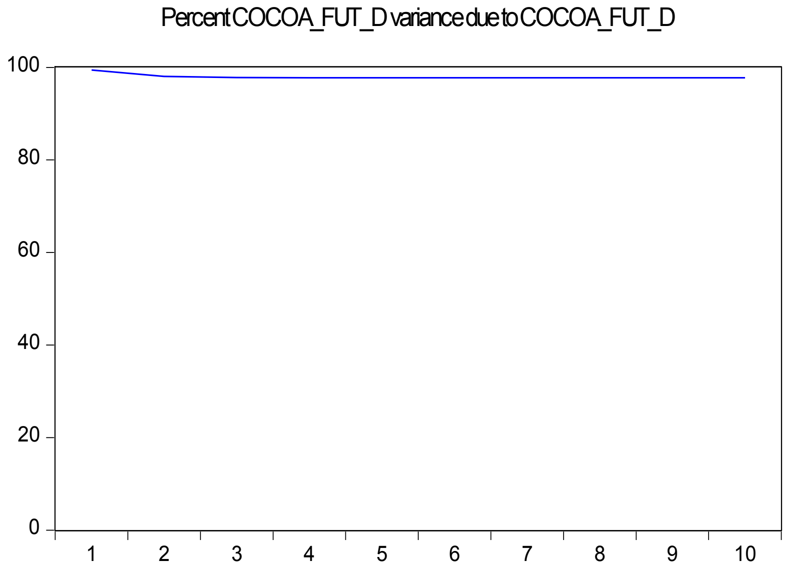

Percent COCOA_SPOT_D variance due to CRUDE_OIL_FUT_D
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10

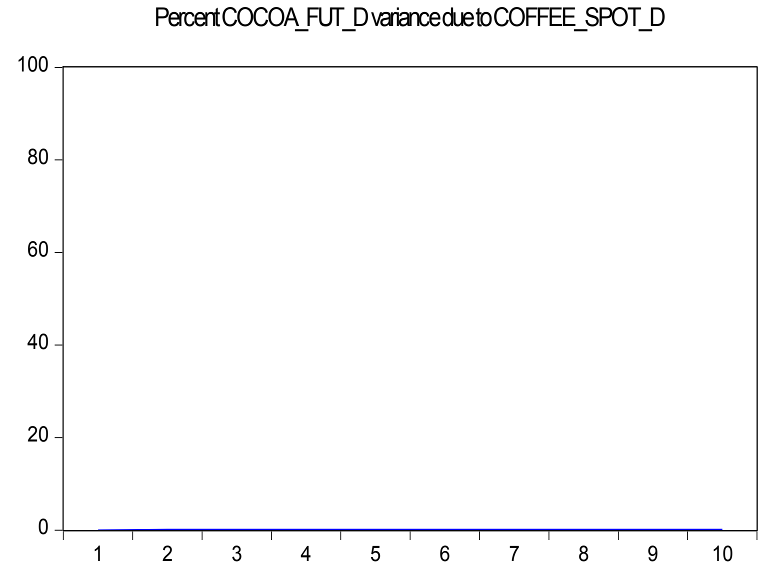

Percent COCOA_SPOT_D variance due to GOLD_SPOT_D
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10

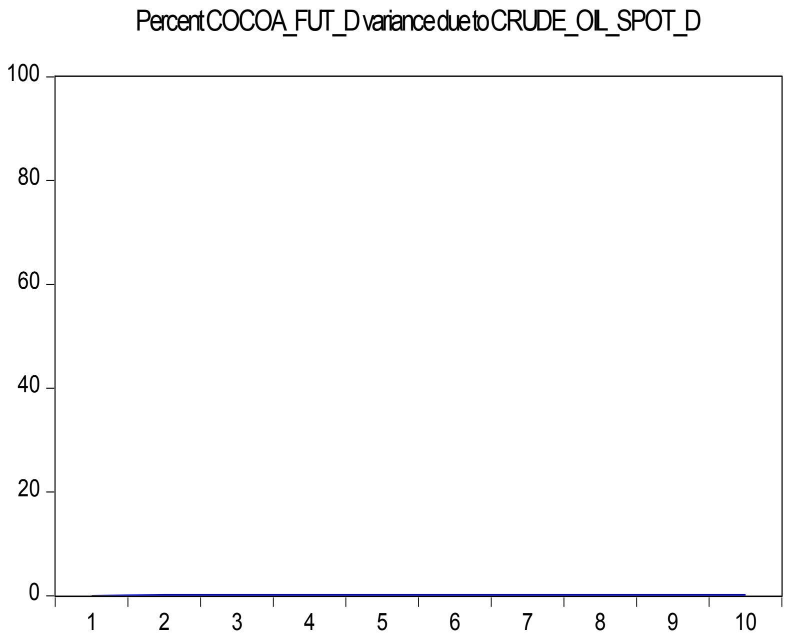

Percent COCOA_SPOT_D variance due to GOLD_FUT_D
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10

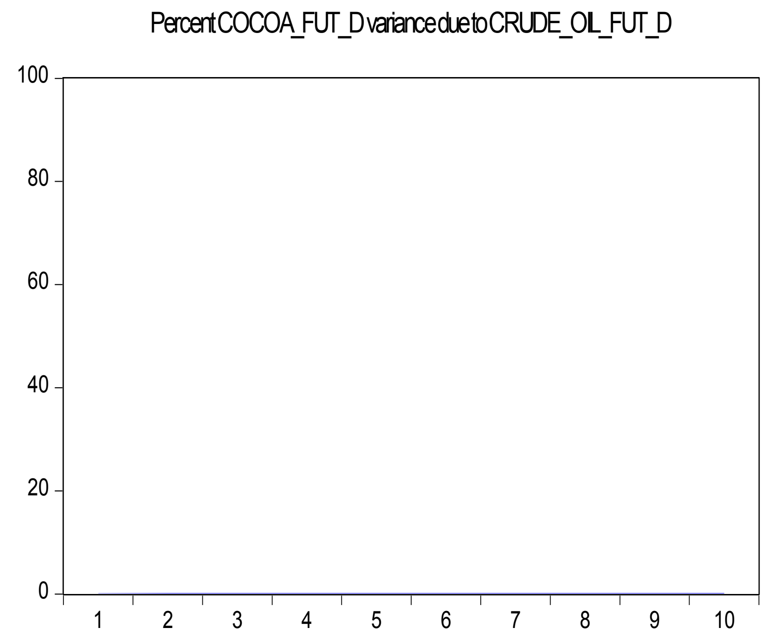

Percent COCOA_SPOT_D variance due to NAT_GAS_SPOT_D
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10

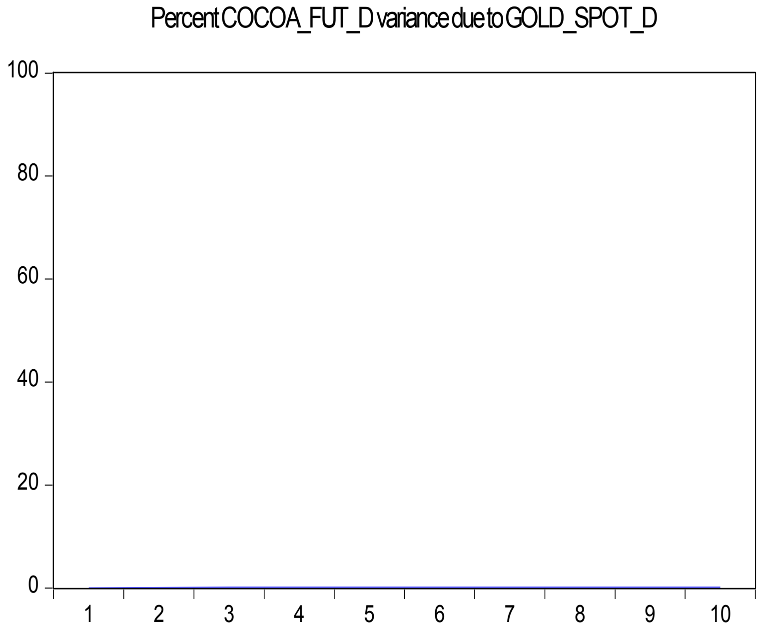

Percent COCOA_SPOT_D variance due to NAT_GAS_FUT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10
Percent COCOA_SPOT_D variance due to SILVER_SPOT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10
Percent COCOA_SPOT_D variance due to SILVER_FUT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10
Percent COCOA_SPOT_D variance due to COCOA_FUT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10

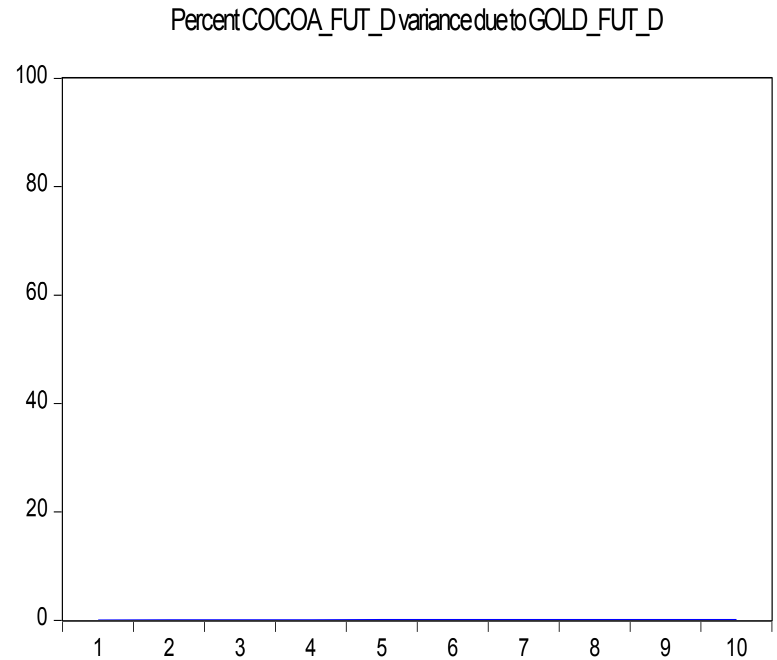

Percent COCOA_FUT_D variance due to COCOA_FUT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10

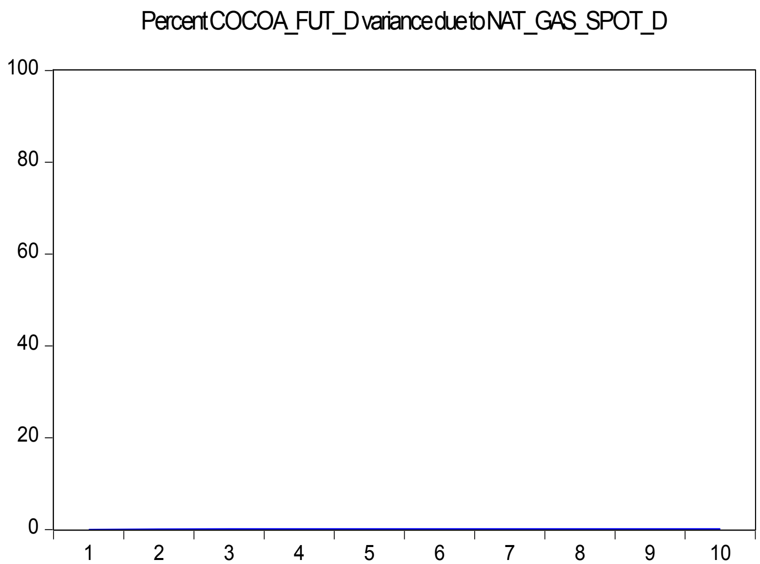

Percent COCOA_FUT_D variance due to COFFEE_SPOT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10

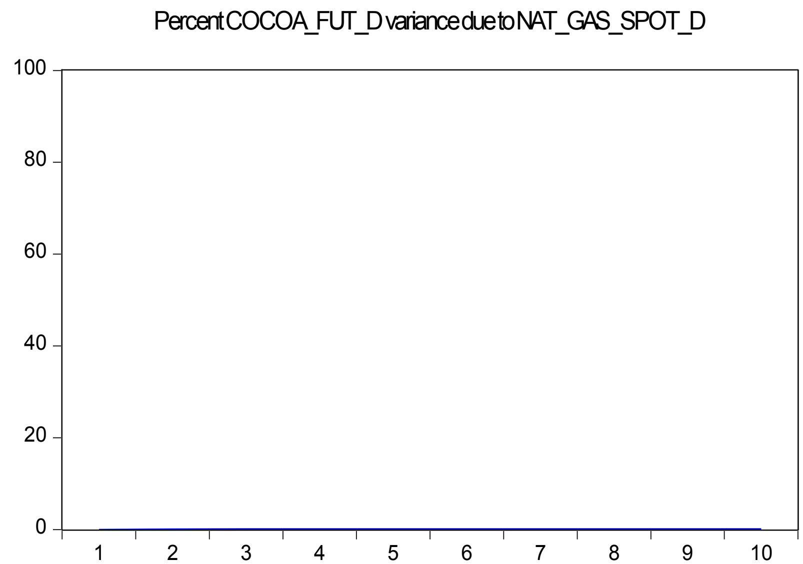

Percent COCOA_FUT_D variance due to CRUDE_OIL_SPOT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10

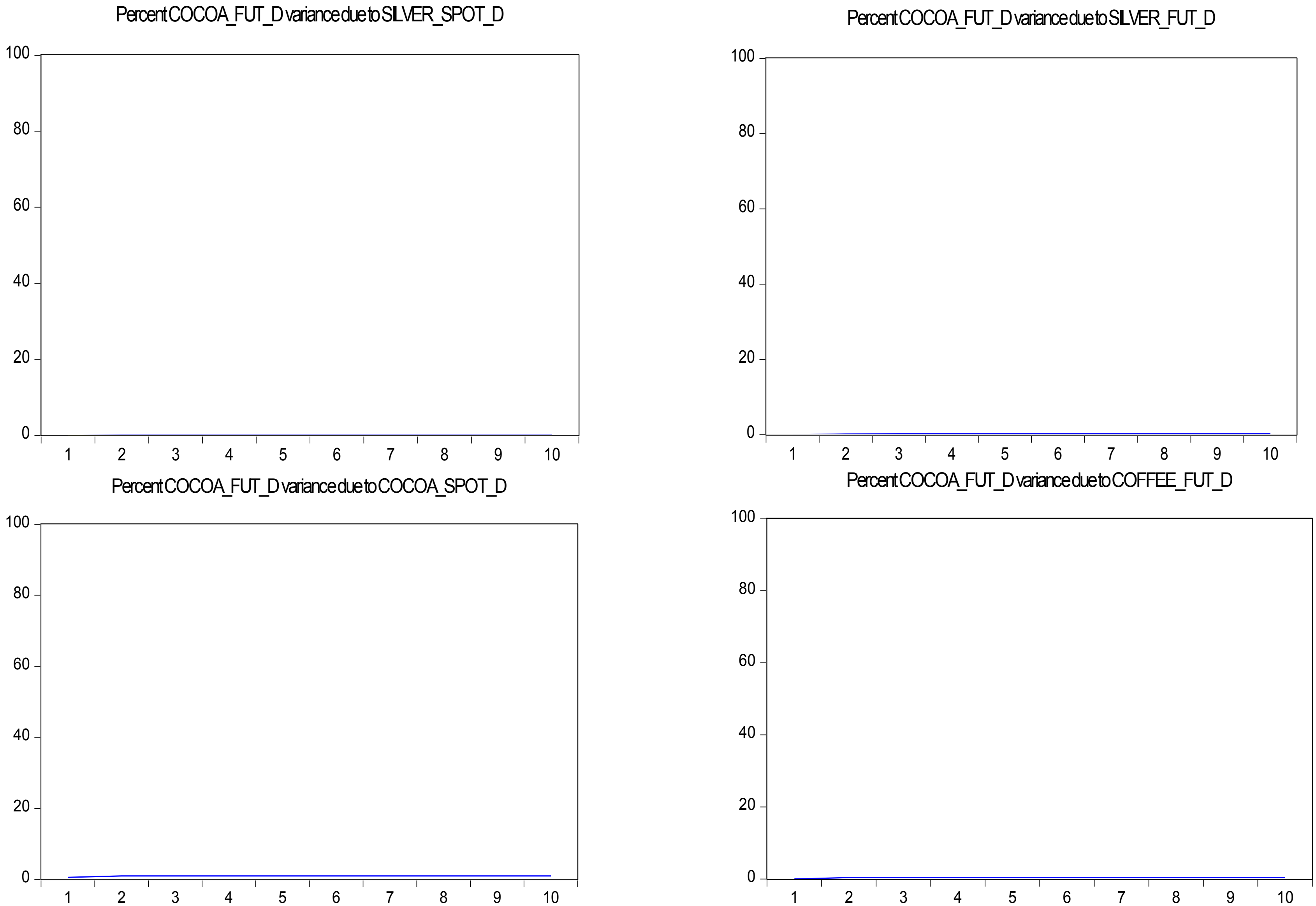

Percent COCOA_FUT_D variance due to CRUDE_OIL_FUT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10

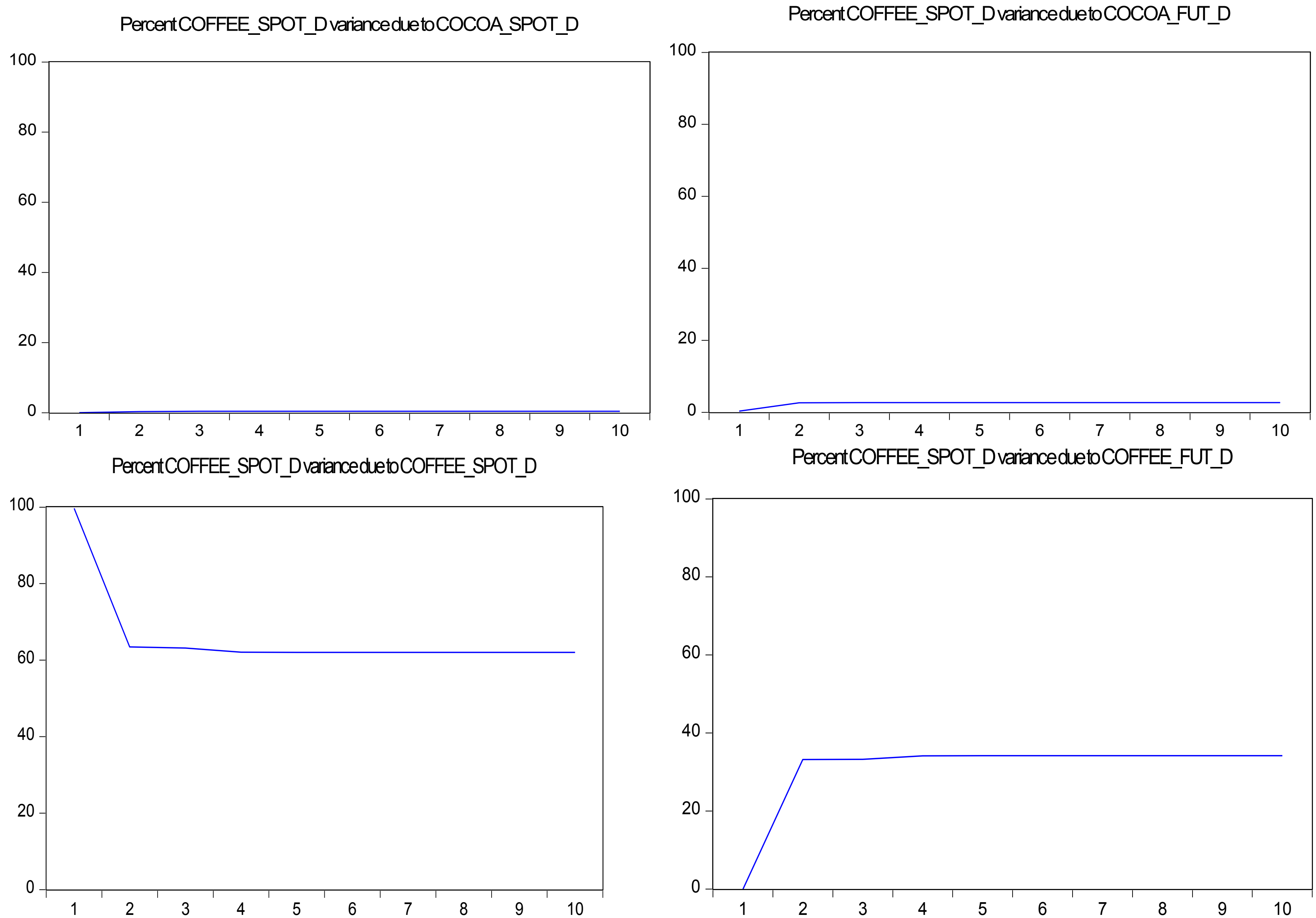

Percent COCOA_FUT_D variance due to GOLD_SPOT_D


Percent COCOA_FUT_D variance due to GOLD_FUT_D

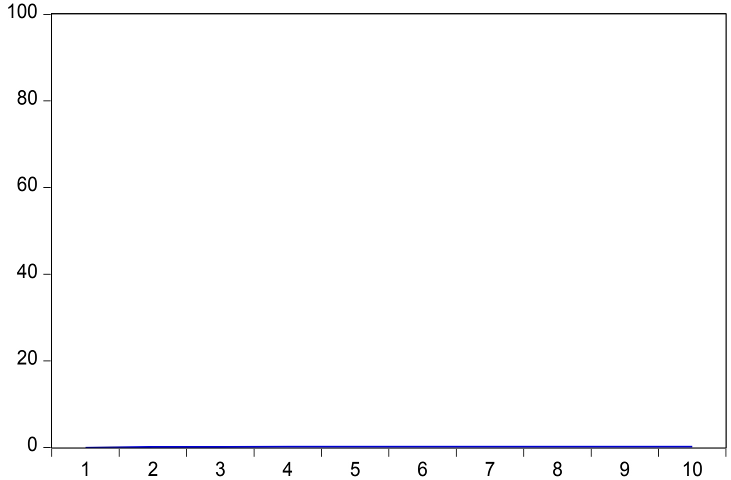

Percent COCOA_FUT_D variance due to NAT_GAS_SPOT_D


Percent COCOA_FUT_D variance due to NAT_GAS_SPOT_D

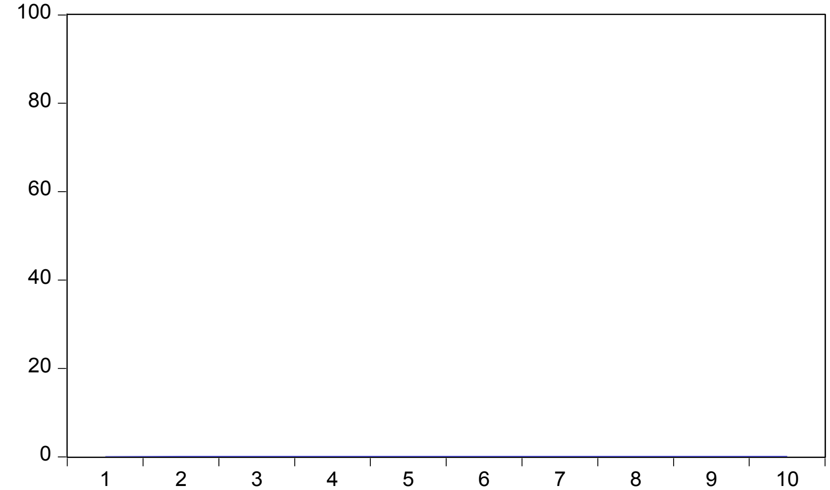

Percent COCOA_FUT_D variance due to SILVER_SPOT_D
Percent COCOA_FUT_D variance due to SILVER_FUT_D
Percent COCOA_FUT_D variance due to COCOA_SPOT_D
Percent COCOA_FUT_D variance due to COFFEE_FUT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10


Percent COFFEE_SPOT_D variance due to COCOA_SPOT_D
Percent COFFEE_SPOT_D variance due to COCOA_FUT_D
Percent COFFEE_SPOT_D variance due to COFFEE_SPOT_D
Percent COFFEE_SPOT_D variance due to COFFEE_FUT_D
0
20
40
60
80
100
1
2
3
4
5
6
7
8
9
10

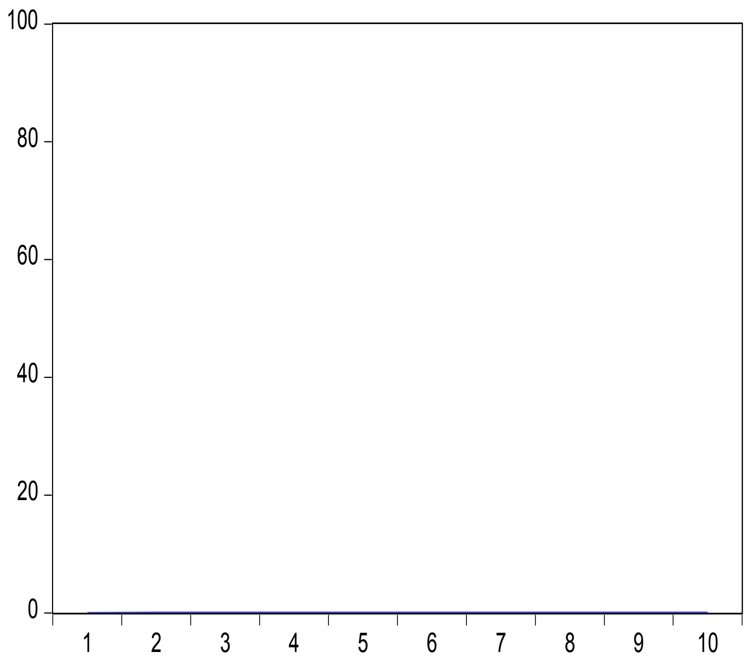
Percent COFFEE_SPOT_D variance due to CRUDE_OIL_SPOT_D



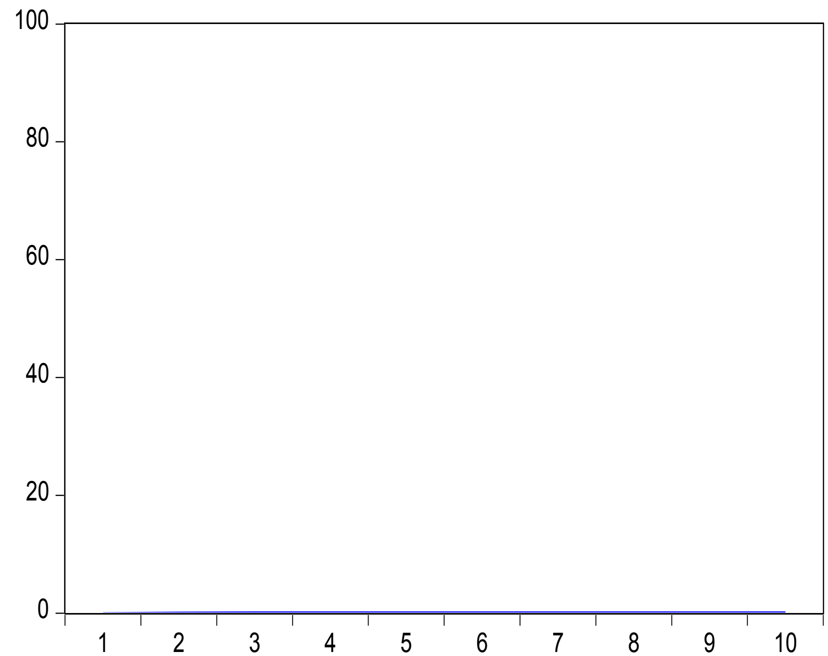
Percent COFFEE_SPOT_D variance due to CRUDE_OIL_FUT_D



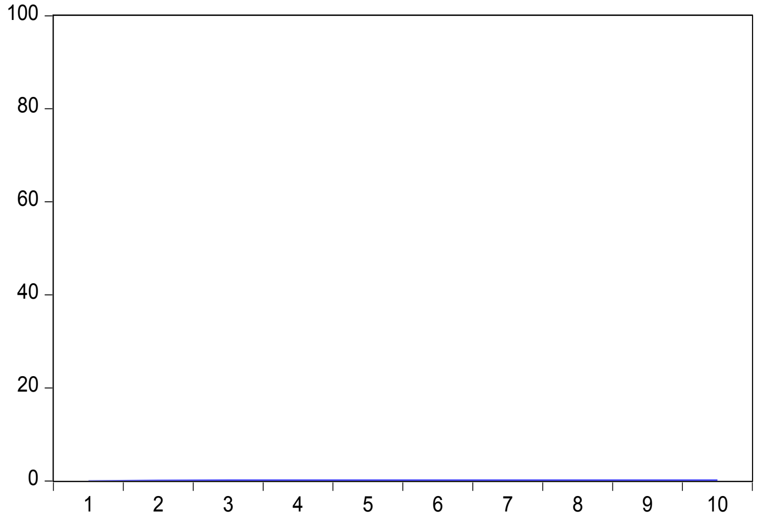
Percent COFFEE_SPOT_D variance due to GOLD_SPOT_D



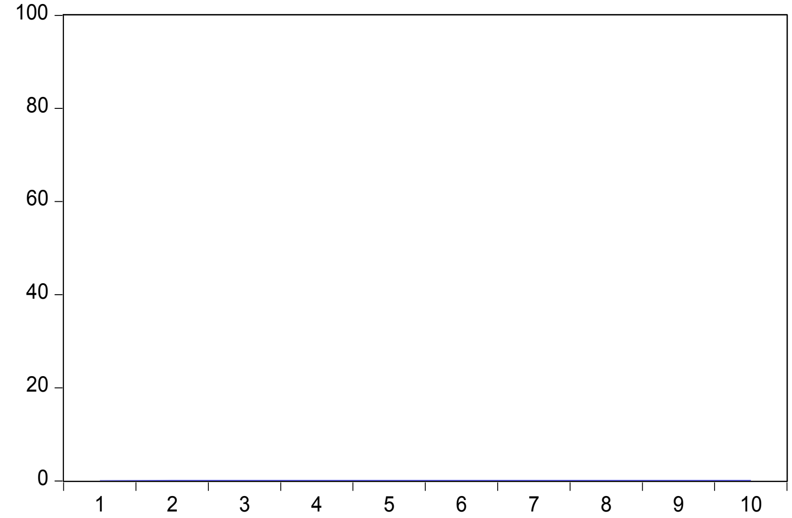
Percent COFFEE_SPOT_D variance due to GOLD_FUT_D



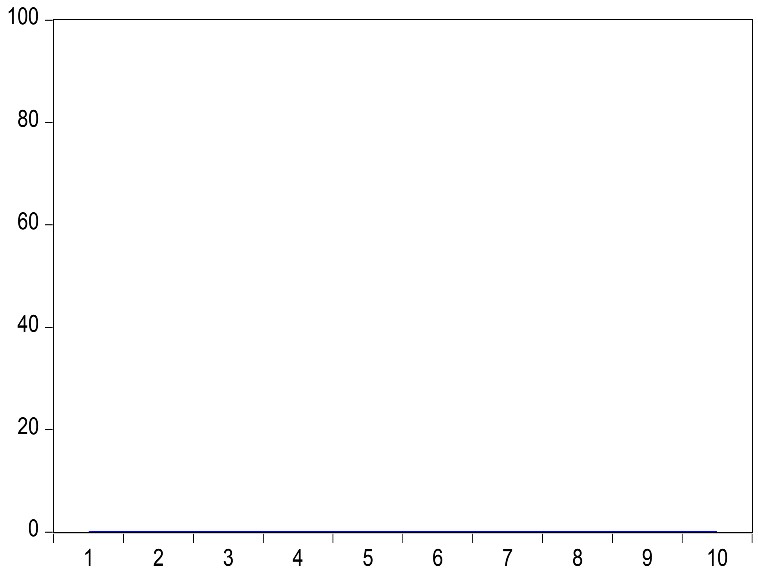
Percent COFFEE_SPOT_D variance due to NAT_GAS_SPOT_D



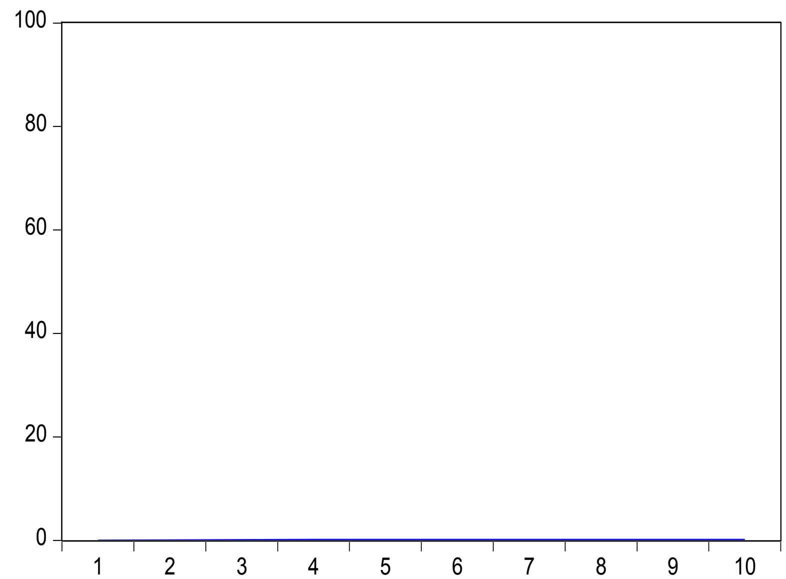
Percent COFFEE_SPOT_D variance due to NAT_GAS_FUT_D

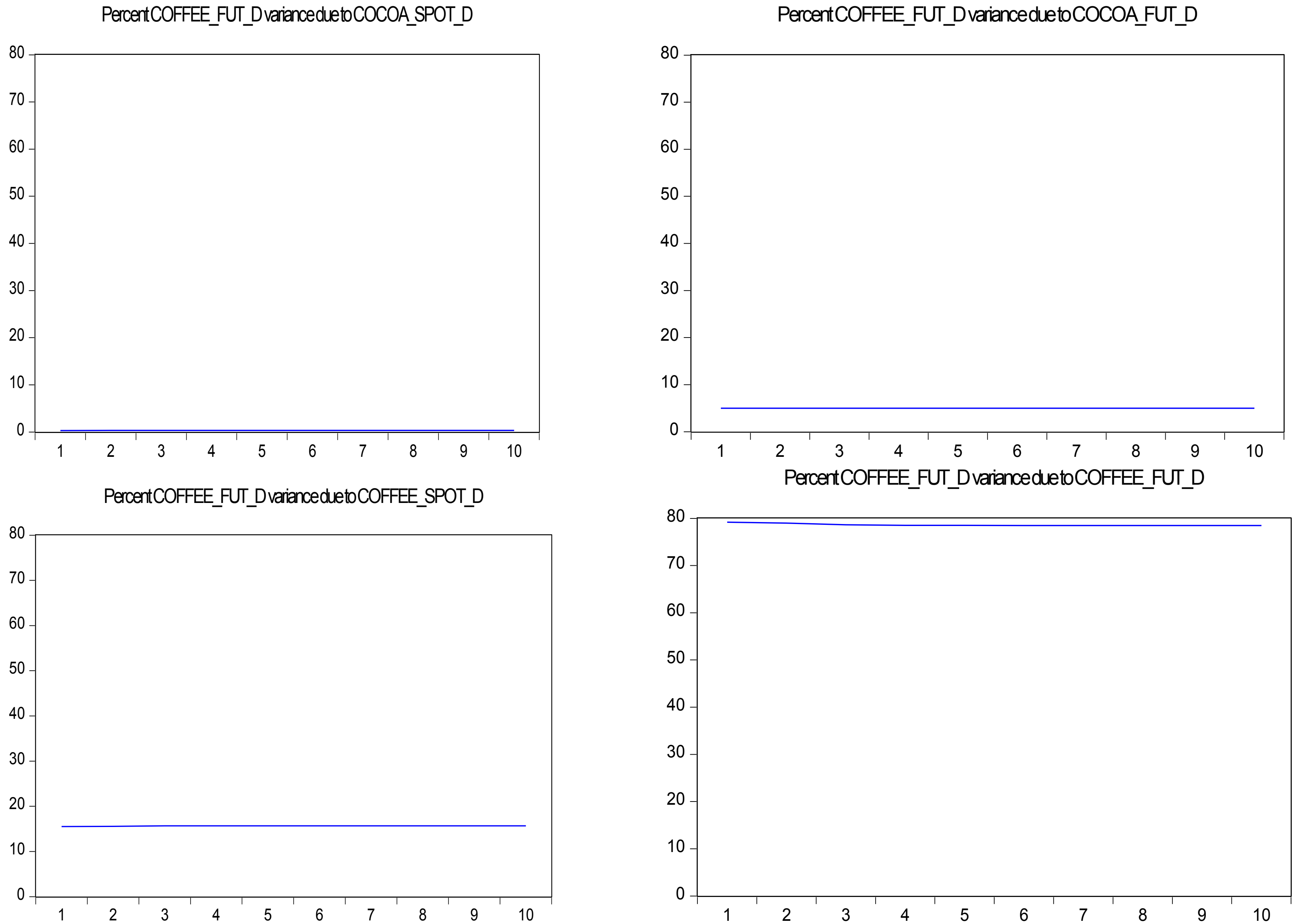


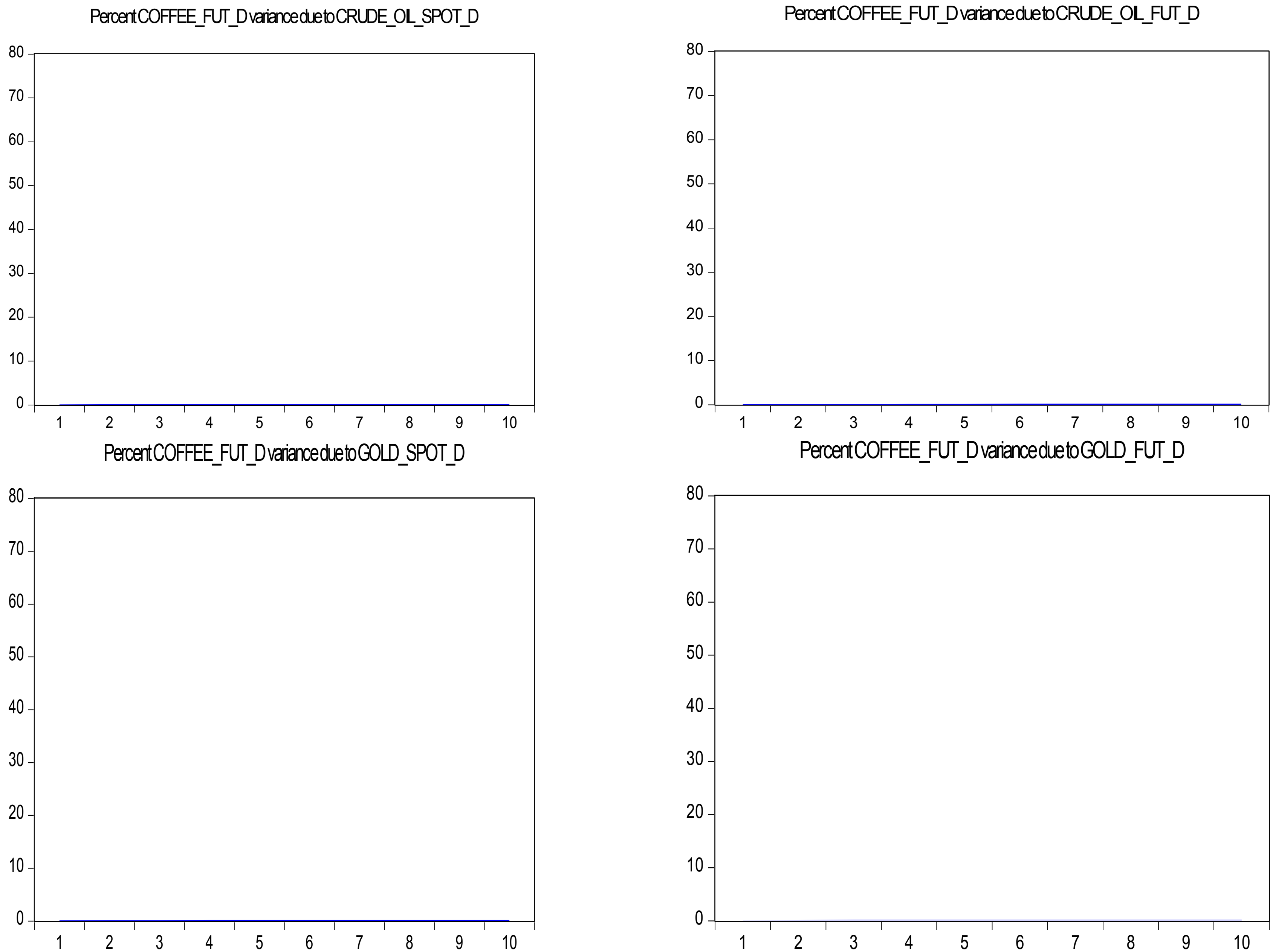
Percent COFFEE_SPOT_D variance due to SILVER_SPOT_D

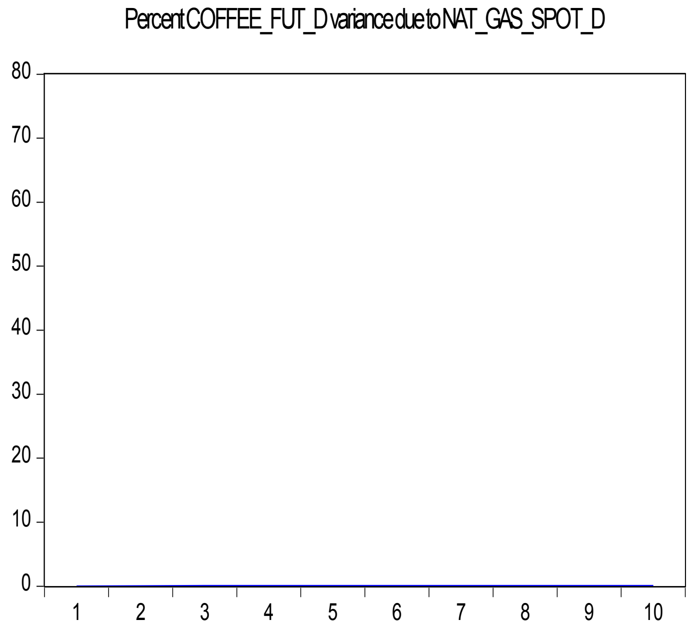


Percent COFFEE_SPOT_D variance due to SILVER_FUT_D




Percent COFFEE_FUT_D variance due to COCOA_SPOT_D
Percent COFFEE_FUT_D variance due to COCOA_FUT_D
Percent COFFEE_FUT_D variance due to COFFEE_SPOT_D
Percent COFFEE_FUT_D variance due to COFFEE_FUT_D


Percent COFFEE_FUT_D variance due to CRUDE_OIL_SPOT_D
Percent COFFEE_FUT_D variance due to CRUDE_OIL_FUT_D
Percent COFFEE_FUT_D variance due to GOLD_SPOT_D
Percent COFFEE_FUT_D variance due to GOLD_FUT_D
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
8
9
10


Percent COFFEE_FUT_D variance due to NAT_GAS_SPOT_D
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40
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10
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7
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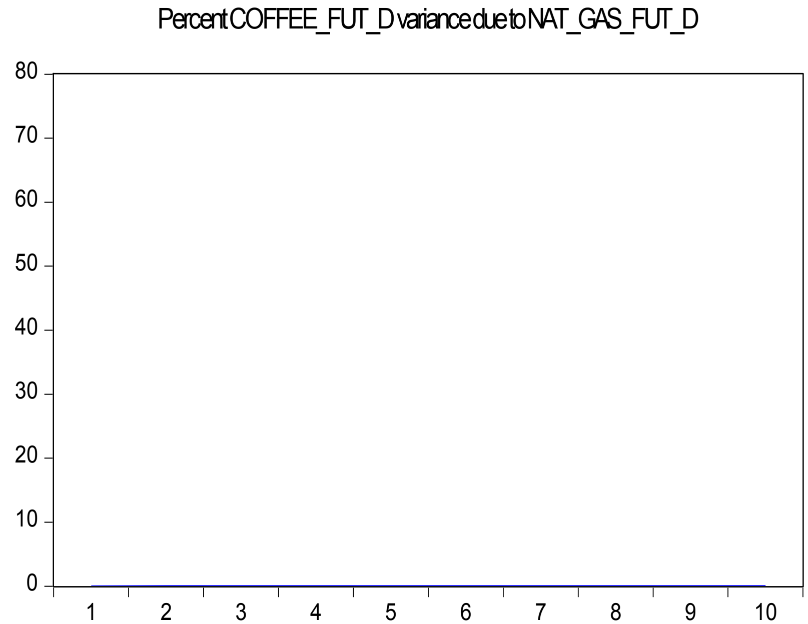
Percent COFFEE_FUT_D variance due to NAT_GAS_FUT_D
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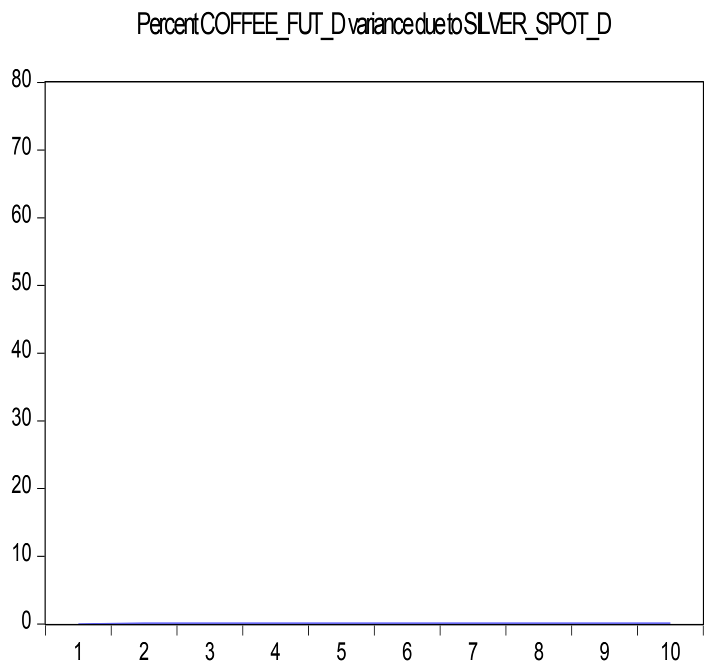
Percent COFFEE_FUT_D variance due to SILVER_SPOT_D
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10
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3
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7
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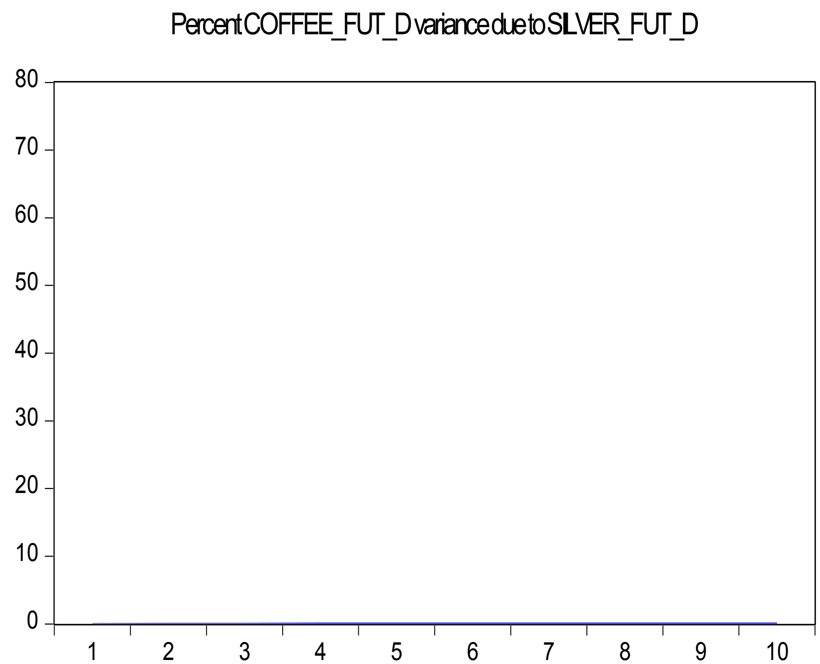
Percent COFFEE_FUT_D variance due to SILVER_FUT_D
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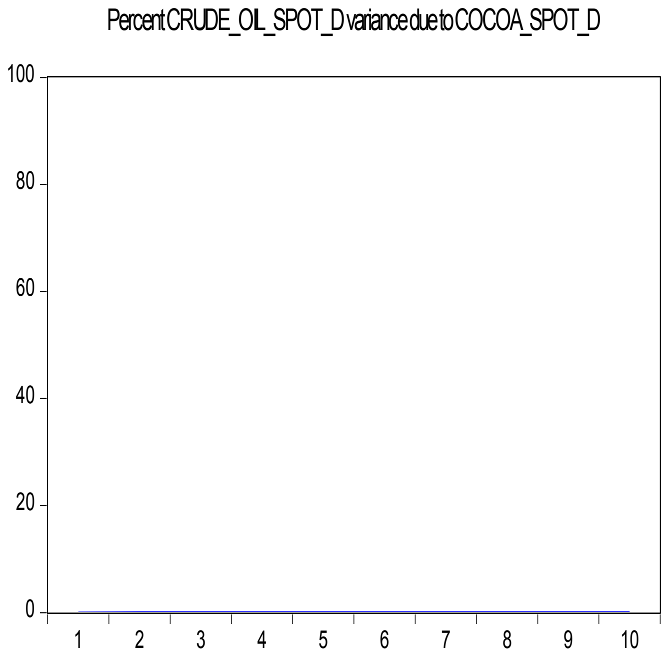
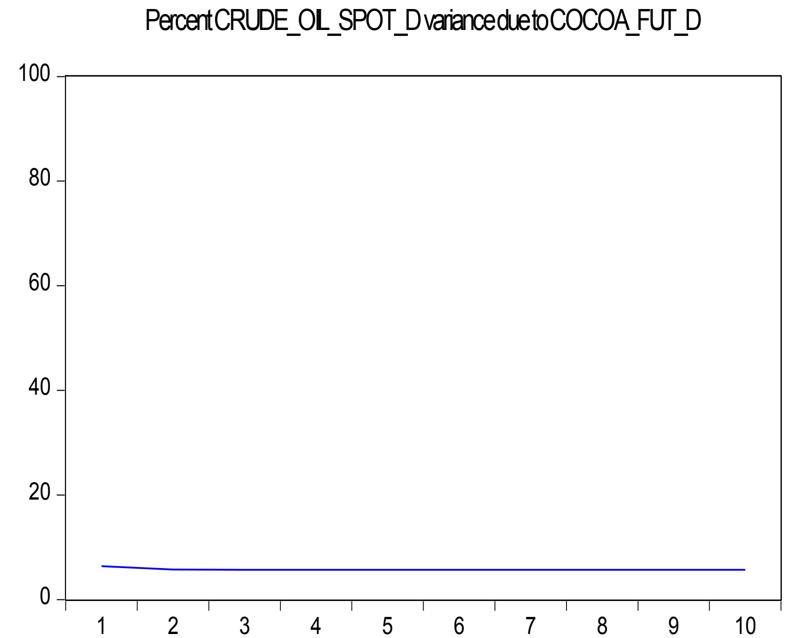

Percent CRUDE_OIL_SPOT_D variance due to COCOA_SPOT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10


Percent CRUDE_OIL_SPOT_D variance due to COCOA_FUT_D
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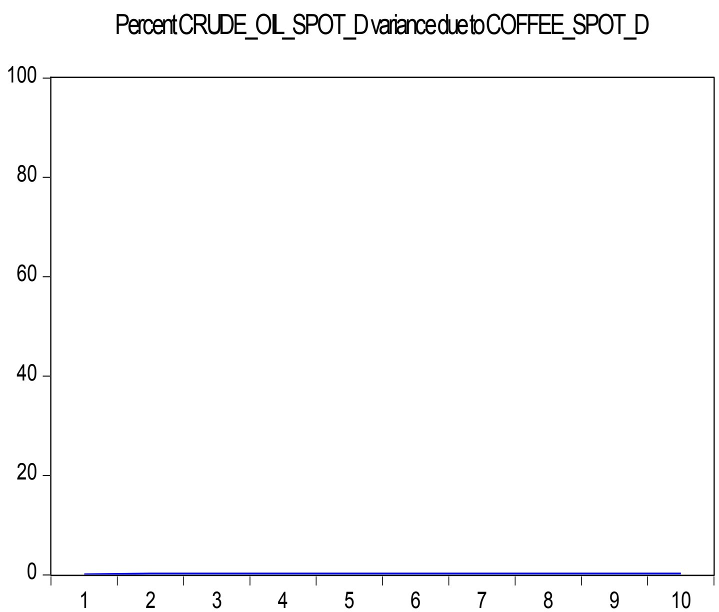
60
40
20
0
1 2 3 4 5 6 7 8 9 10


Percent CRUDE_OIL_SPOT_D variance due to COFFEE_SPOT_D
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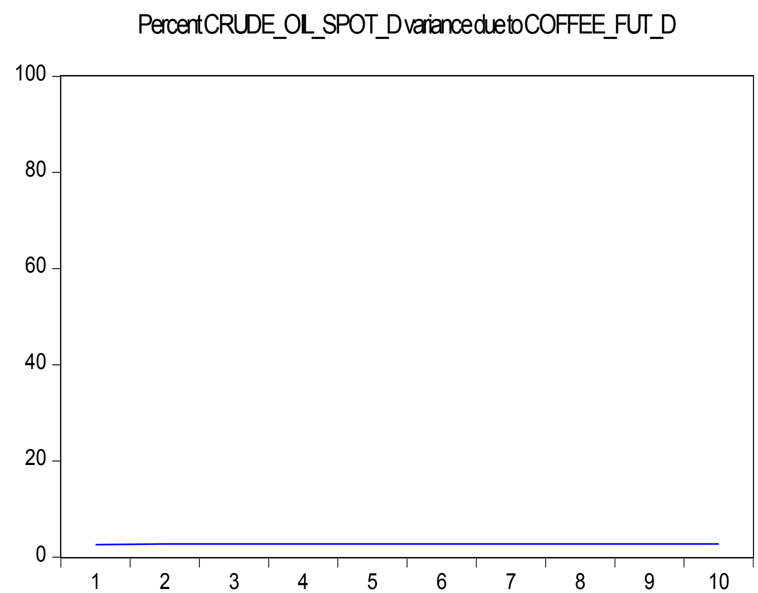
60
40
20
0
1 2 3 4 5 6 7 8 9 10


Percent CRUDE_OIL_SPOT_D variance due to COFFEE_FUT_D
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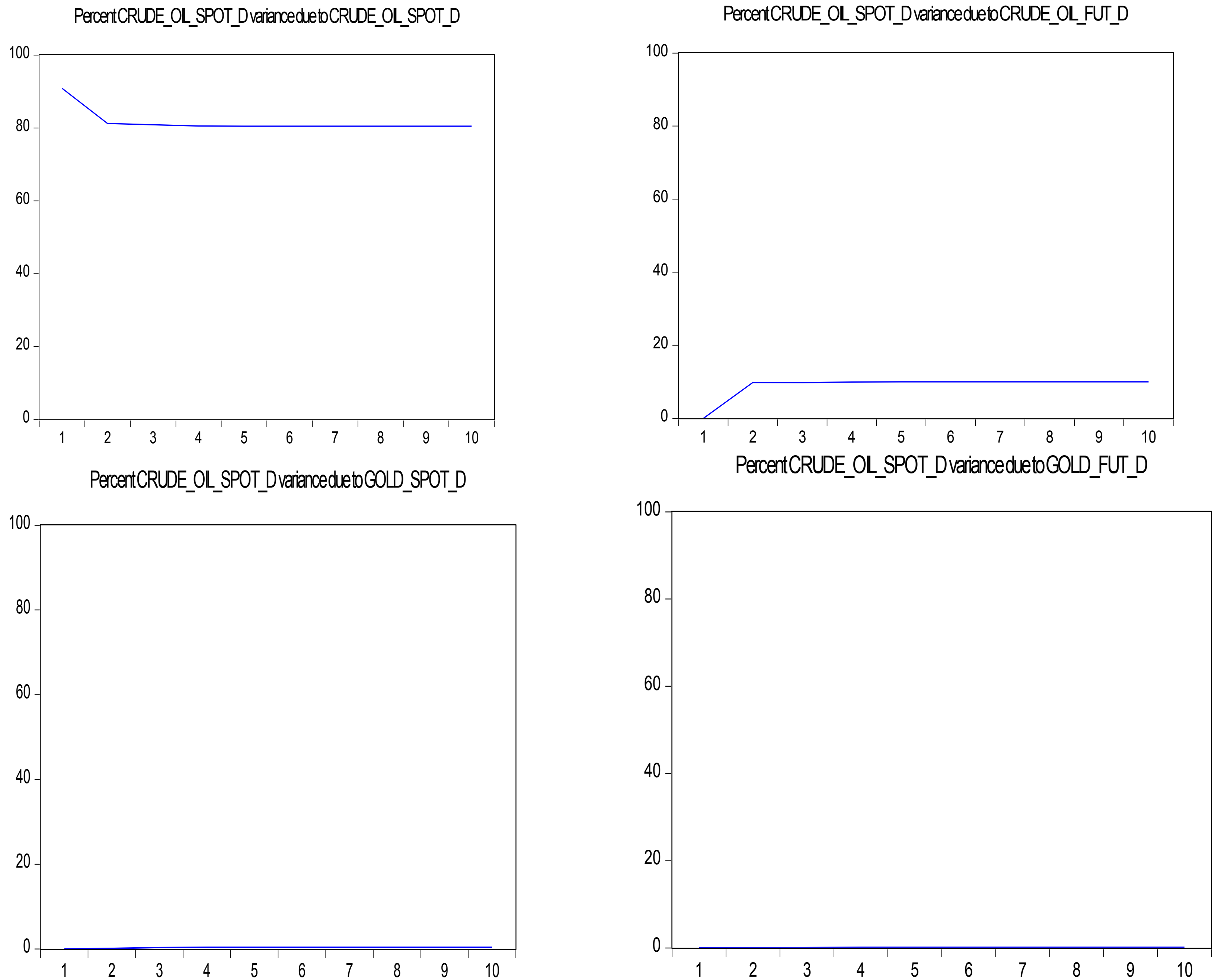
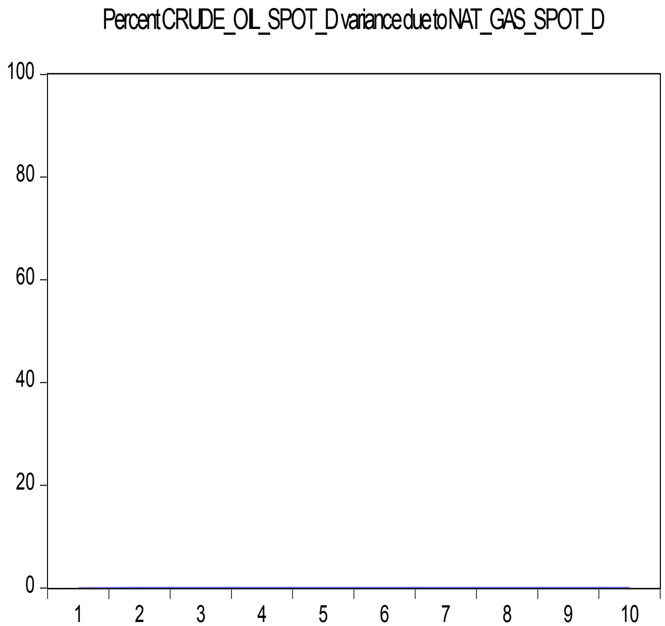
60
40
20
0
1 2 3 4 5 6 7 8 9 10


Percent CRUDE_OIL_SPOT_D variance due to CRUDE_OIL_SPOT_D
Percent CRUDE_OIL_SPOT_D variance due to CRUDE_OIL_FUT_D
Percent CRUDE_OIL_SPOT_D variance due to GOLD_SPOT_D
Percent CRUDE_OIL_SPOT_D variance due to GOLD_FUT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10


Percent CRUDE_OIL_SPOT_D variance due to NAT_GAS_SPOT_D
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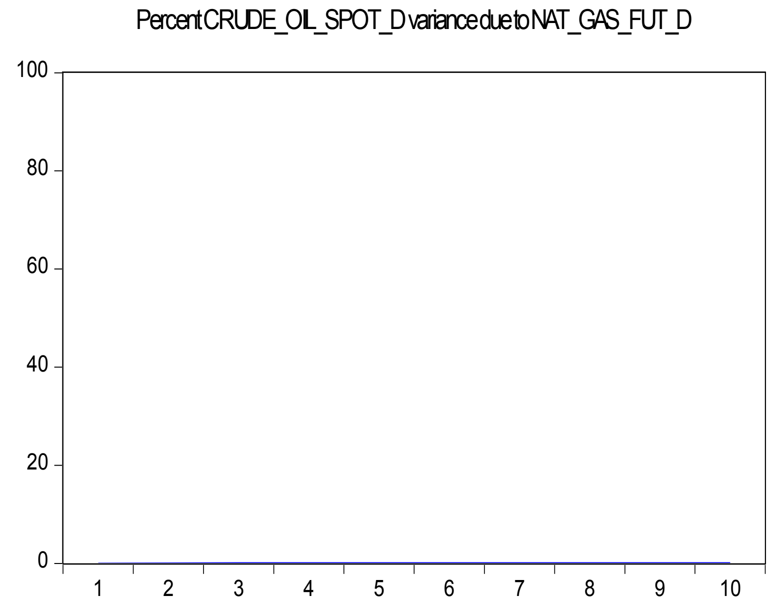
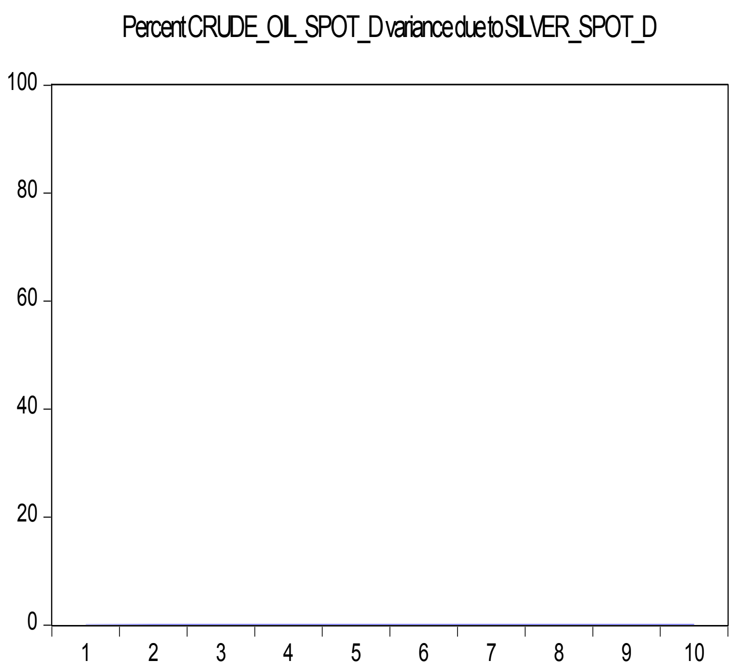
60
40
20
0
1 2 3 4 5 6 7 8 9 10


Percent CRUDE_OIL_SPOT_D variance due to NAT_GAS_FUT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10


Percent CRUDE_OIL_SPOT_D variance due to SILVER_SPOT_D
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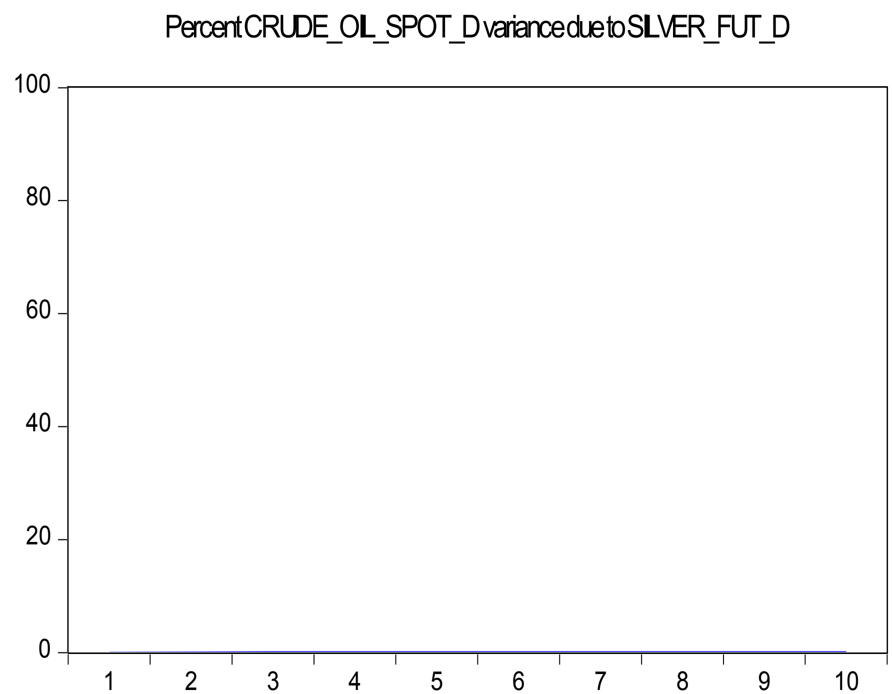
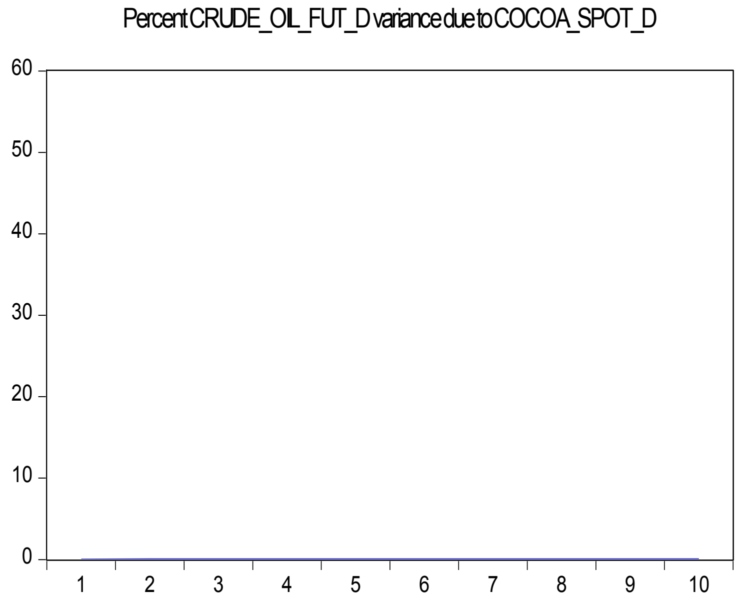
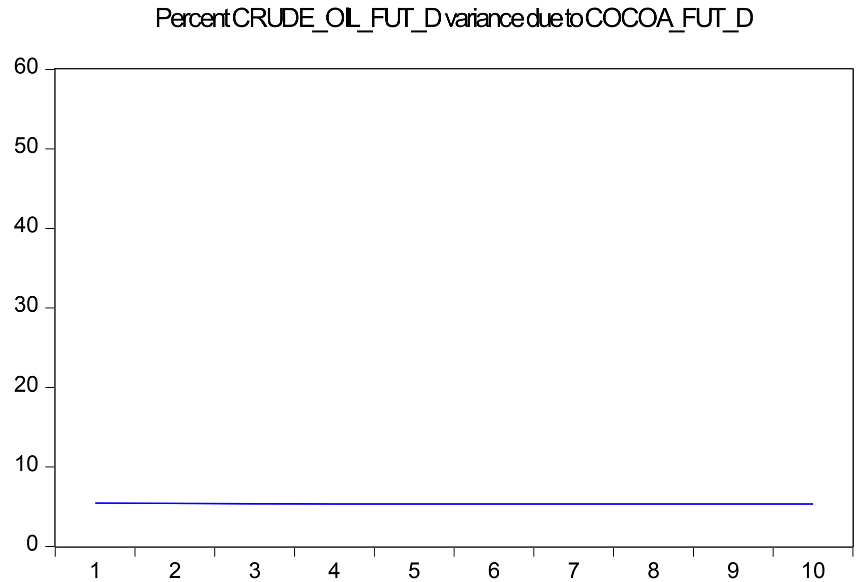
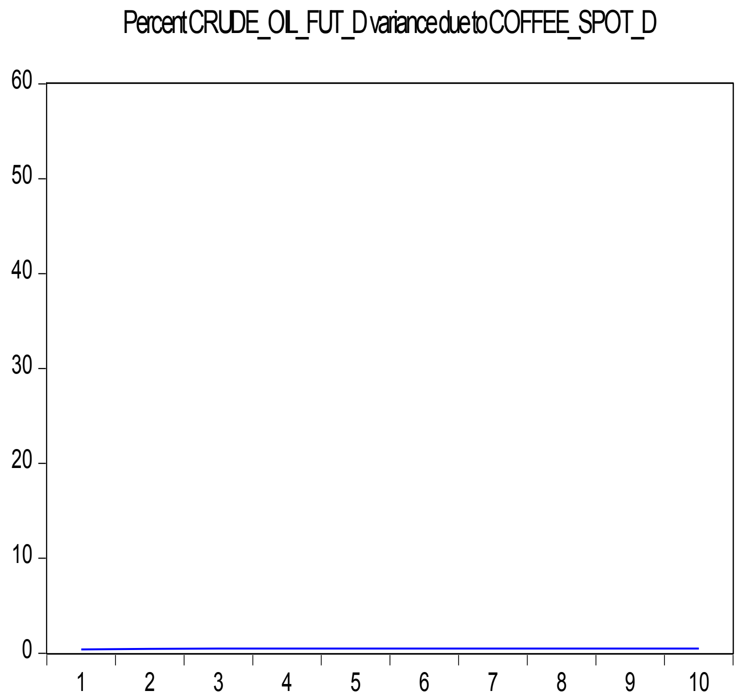
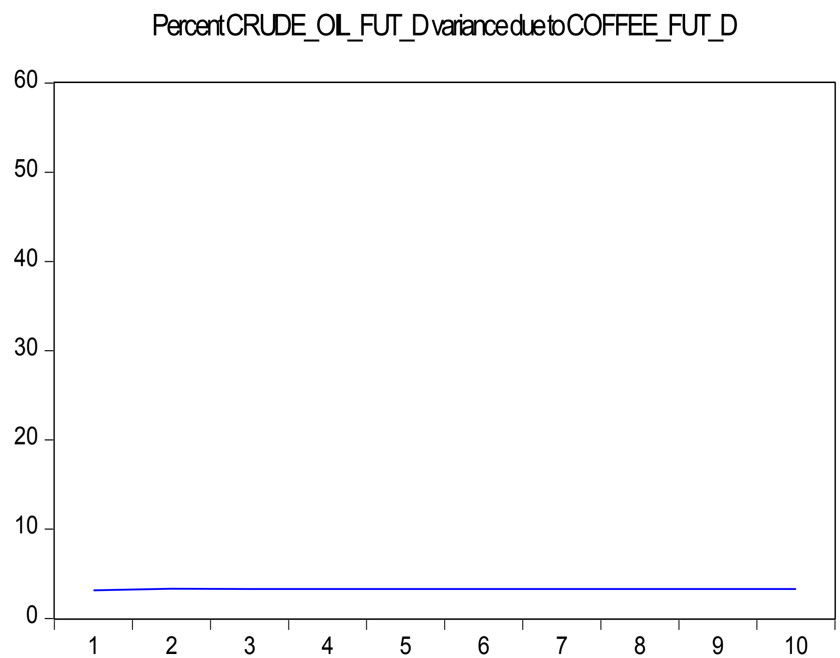
60
40
20
0
1 2 3 4 5 6 7 8 9 10

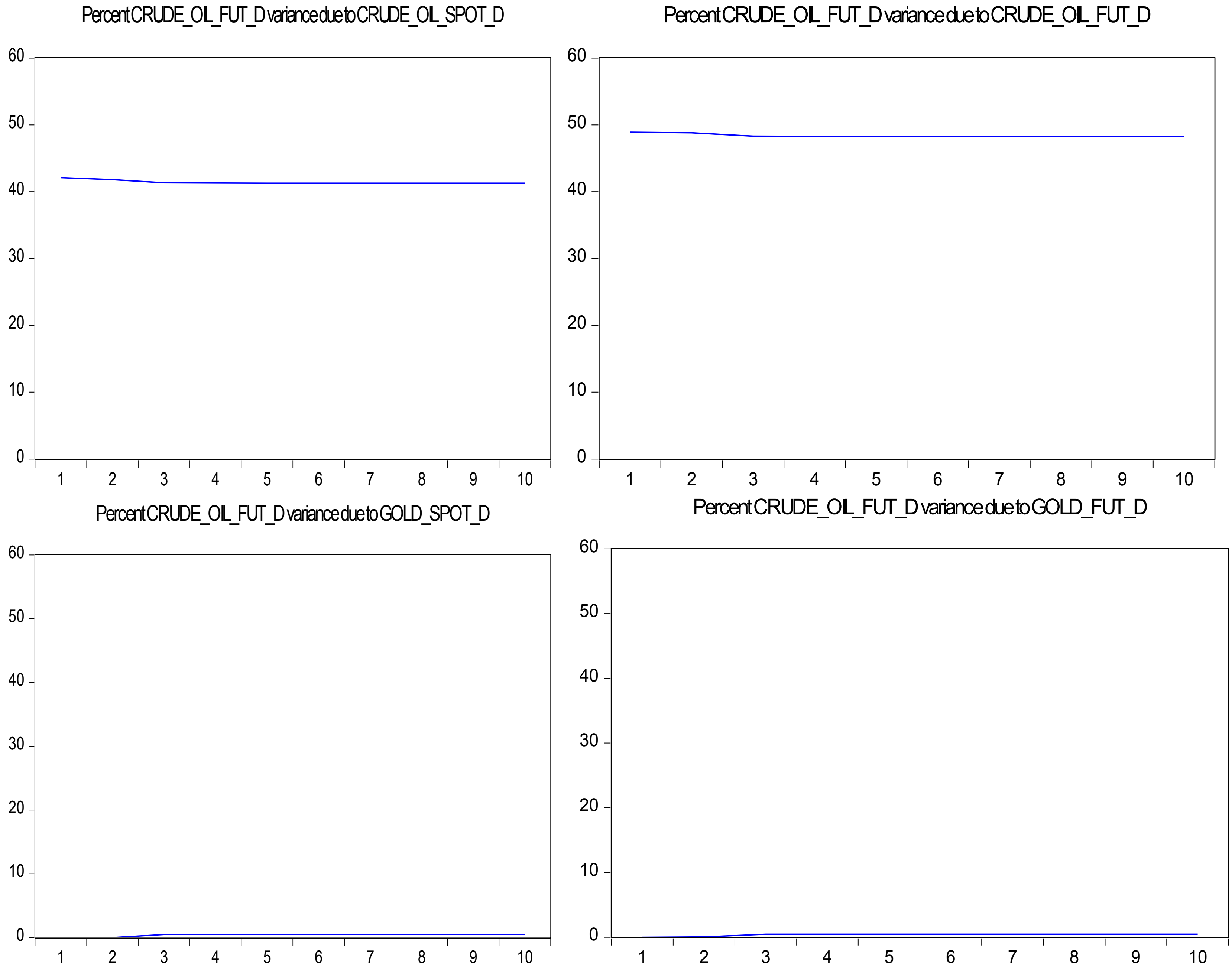

Percent CRUDE_OIL_SPOT_D variance due to SILVER_FUT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10


Percent CRUDE_OIL_FUT_D variance due to COCOA_SPOT_D


Percent CRUDE_OIL_FUT_D variance due to COCOA_FUT_D


Percent CRUDE_OIL_FUT_D variance due to COFFEE_SPOT_D


Percent CRUDE_OIL_FUT_D variance due to COFFEE_FUT_D


Percent CRUDE_OIL_FUT_D variance due to CRUDE_OIL_SPOT_D
Percent CRUDE_OIL_FUT_D variance due to CRUDE_OIL_FUT_D
Percent CRUDE_OIL_FUT_D variance due to GOLD_SPOT_D
Percent CRUDE_OIL_FUT_D variance due to GOLD_FUT_D
0
10
20
30
40
50
60
1
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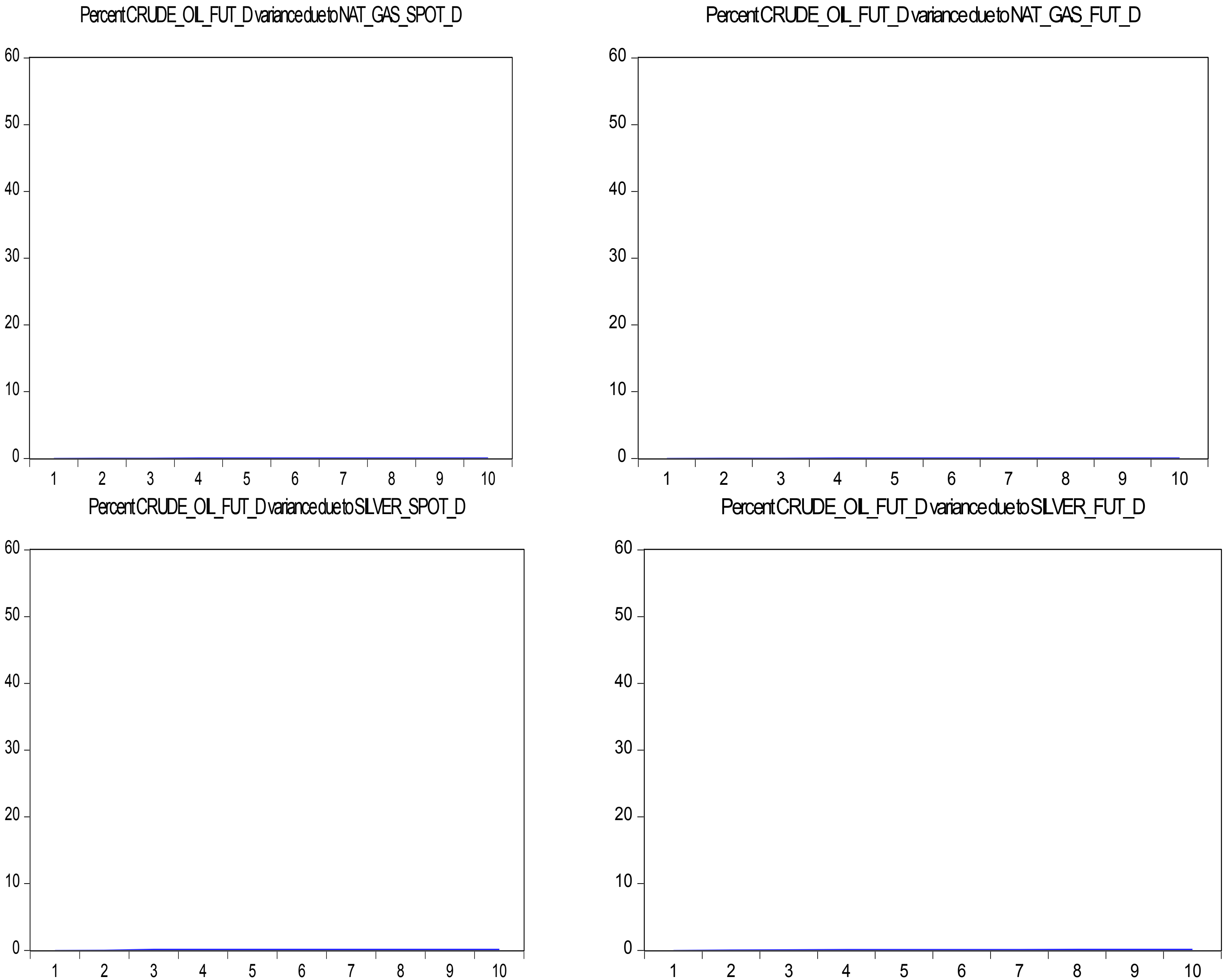
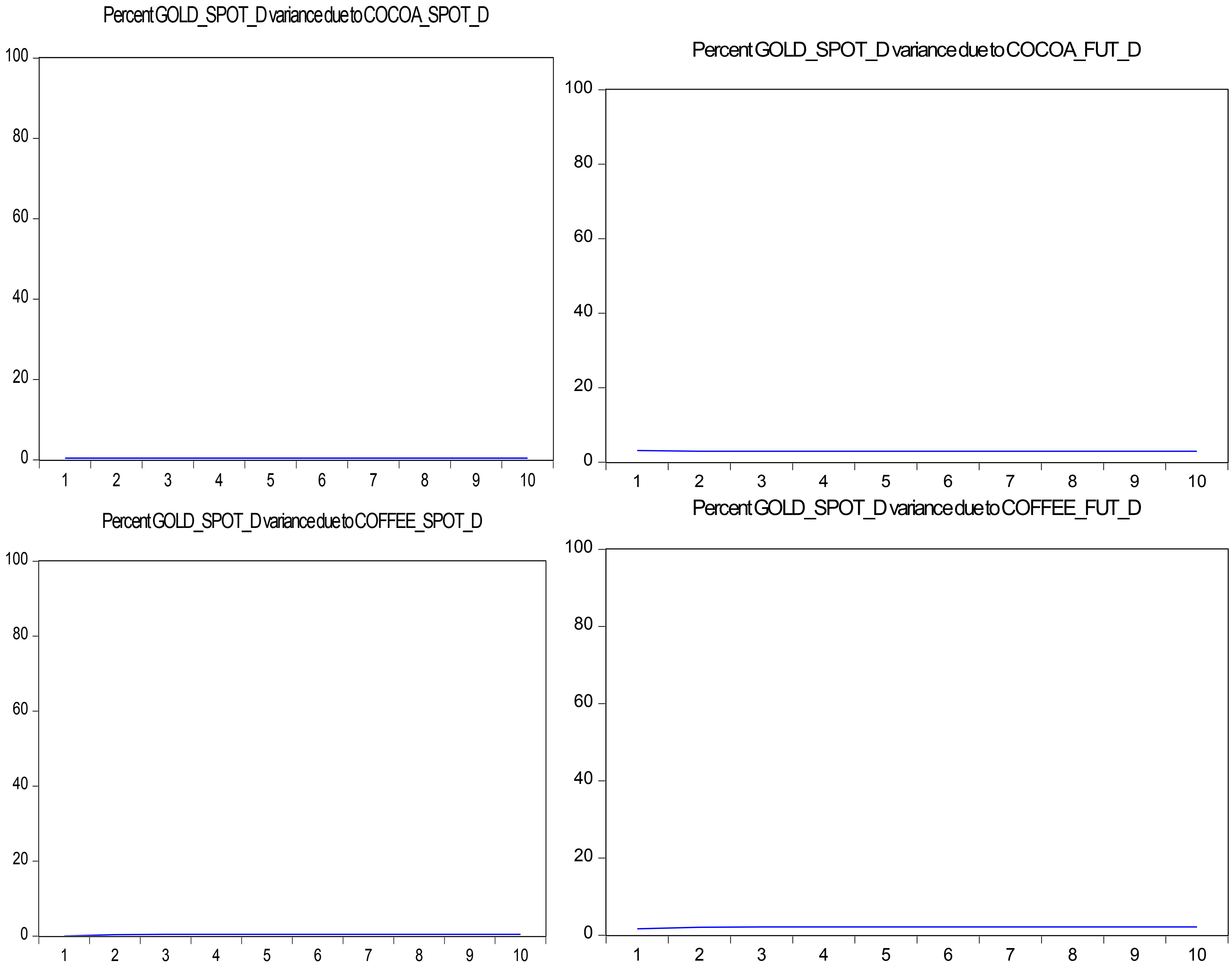
6
7
8
9
10


Percent CRUDE_OIL_FUT_D variance due to NAT_GAS_SPOT_D
Percent CRUDE_OIL_FUT_D variance due to NAT_GAS_FUT_D
Percent CRUDE_OIL_FUT_D variance due to SILVER_SPOT_D
Percent CRUDE_OIL_FUT_D variance due to SILVER_FUT_D
0
10
20
30
40
50
60
1
2
3
4
5
6
7
8
9
10


Percent GOLD_SPOT_D variance due to COCOA_SPOT_D
Percent GOLD_SPOT_D variance due to COCOA_FUT_D
Percent GOLD_SPOT_D variance due to COFFEE_SPOT_D
Percent GOLD_SPOT_D variance due to COFFEE_FUT_D
0
20
40
60
80
100
1
2
3
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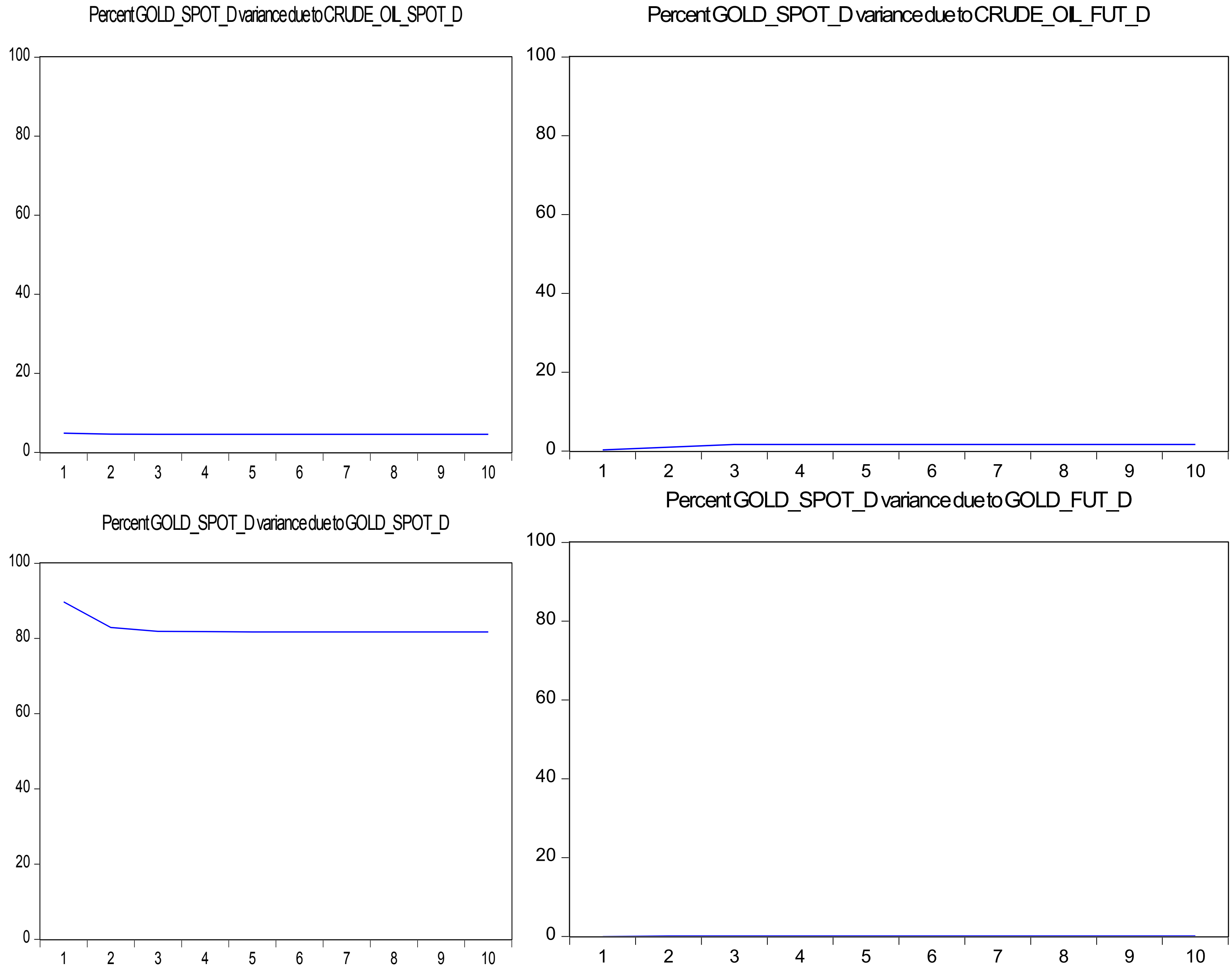
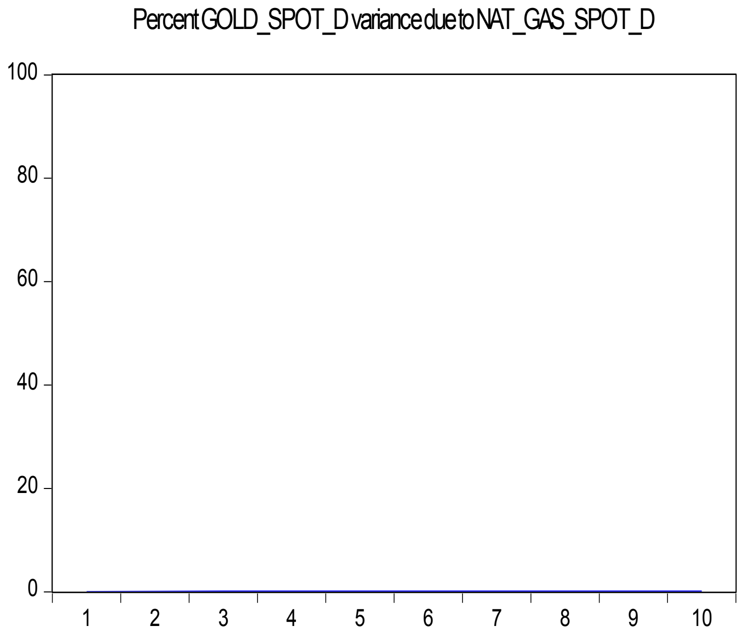
6
7
8
9
10


Percent GOLD_SPOT_D variance due to CRUDE_OIL_SPOT_D
Percent GOLD_SPOT_D variance due to CRUDE_OIL_FUT_D
Percent GOLD_SPOT_D variance due to GOLD_SPOT_D
Percent GOLD_SPOT_D variance due to GOLD_FUT_D
0
20
40
60
80
100
1 2 3 4 5 6 7 8 9 10


Percent GOLD_SPOT_D variance due to NAT_GAS_SPOT_D
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1
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3
4
5
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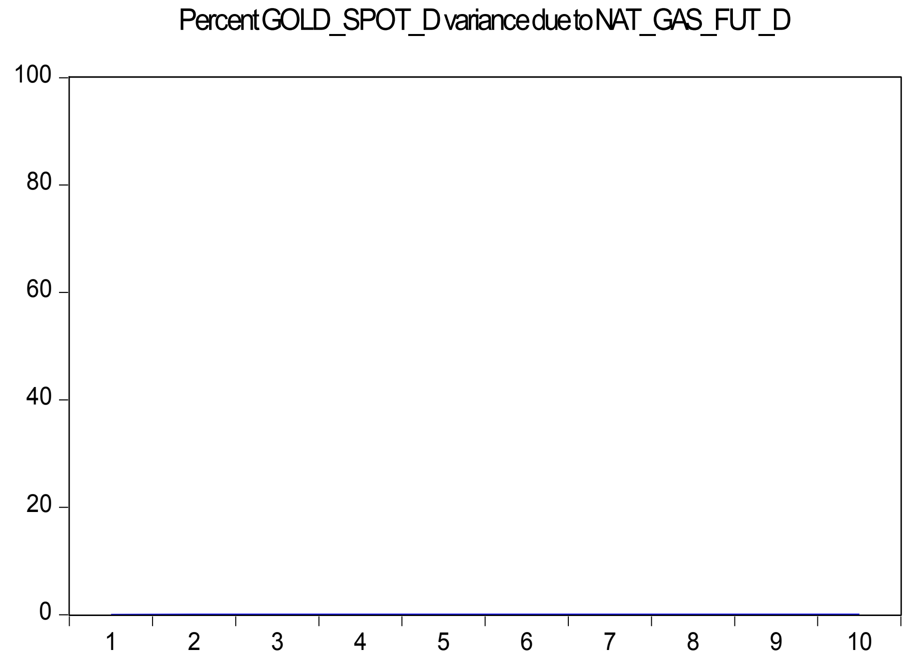
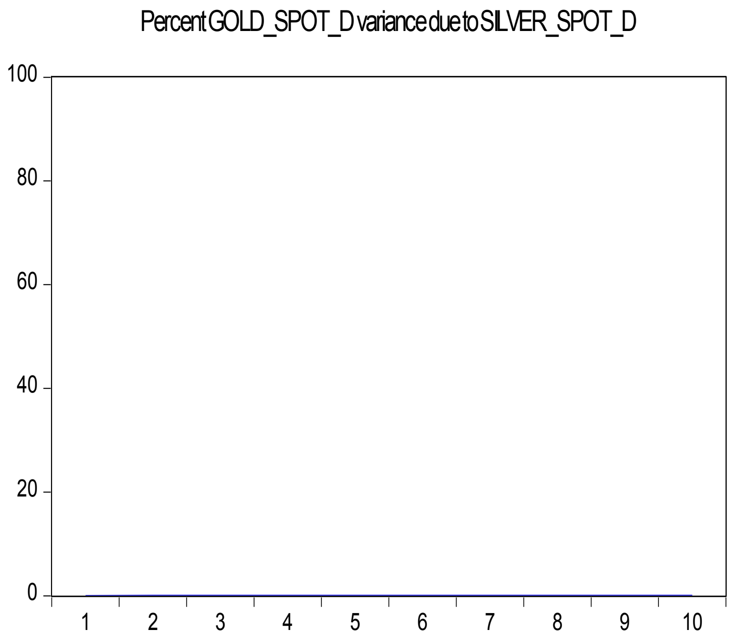
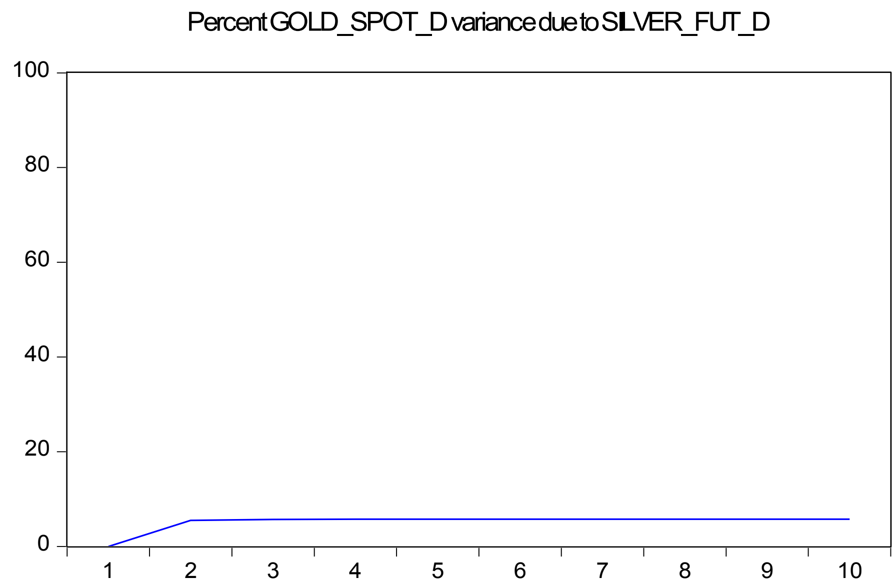
7
8
9
10


Percent GOLD_SPOT_D variance due to NAT_GAS_FUT_D
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10


Percent GOLD_SPOT_D variance due to SILVER_SPOT_D
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10


Percent GOLD_SPOT_D variance due to SILVER_FUT_D
100
80
60
40
20
0
1
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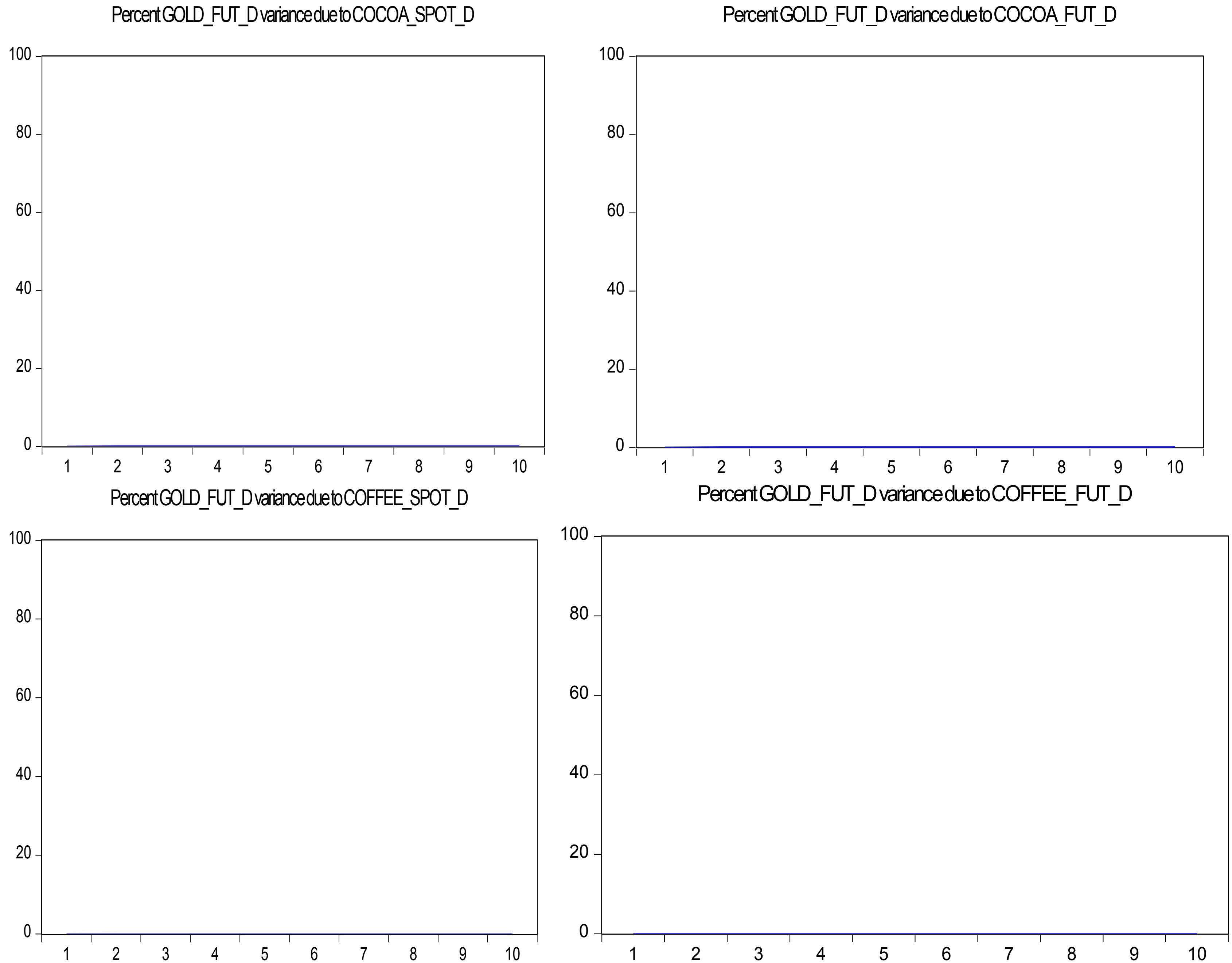
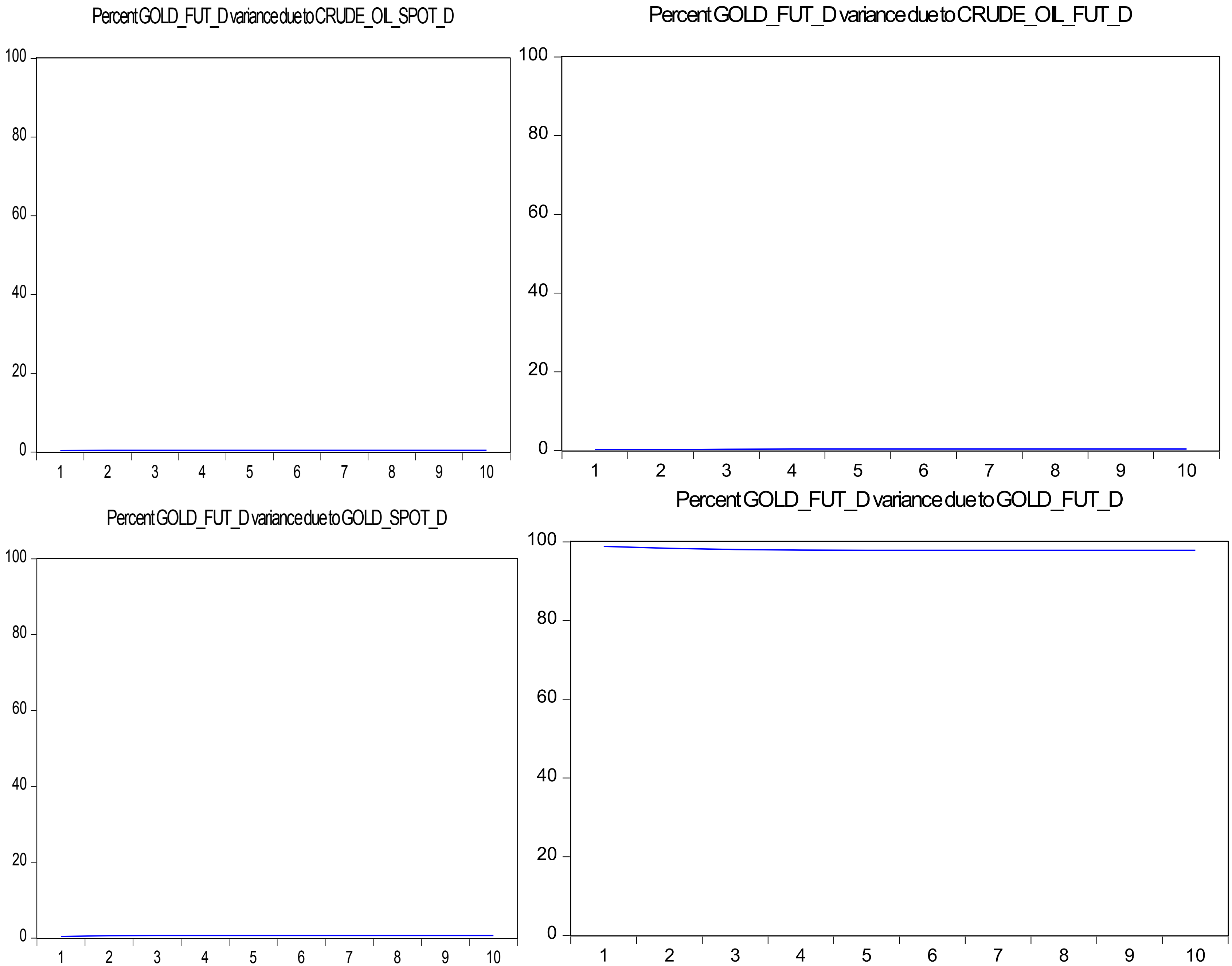
3
4
5
6
7
8
9
10


Percent GOLD_FUT_D variance due to COCOA_SPOT_D
Percent GOLD_FUT_D variance due to COCOA_FUT_D
Percent GOLD_FUT_D variance due to COFFEE_SPOT_D
Percent GOLD_FUT_D variance due to COFFEE_FUT_D


Percent GOLD_FUT_D variance due to CRUDE_OIL_SPOT_D
Percent GOLD_FUT_D variance due to CRUDE_OIL_FUT_D
Percent GOLD_FUT_D variance due to GOLD_SPOT_D
Percent GOLD_FUT_D variance due to GOLD_FUT_D
0
20
40
60
80
100
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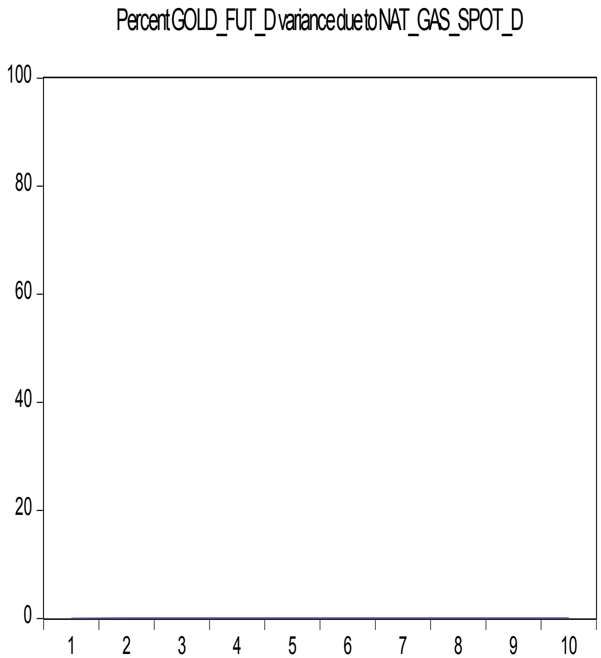
6
7
8
9
10


Percent GOLD_FUT_D variance due to NAT_GAS_SPOT_D
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40
20
0
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2
3
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9
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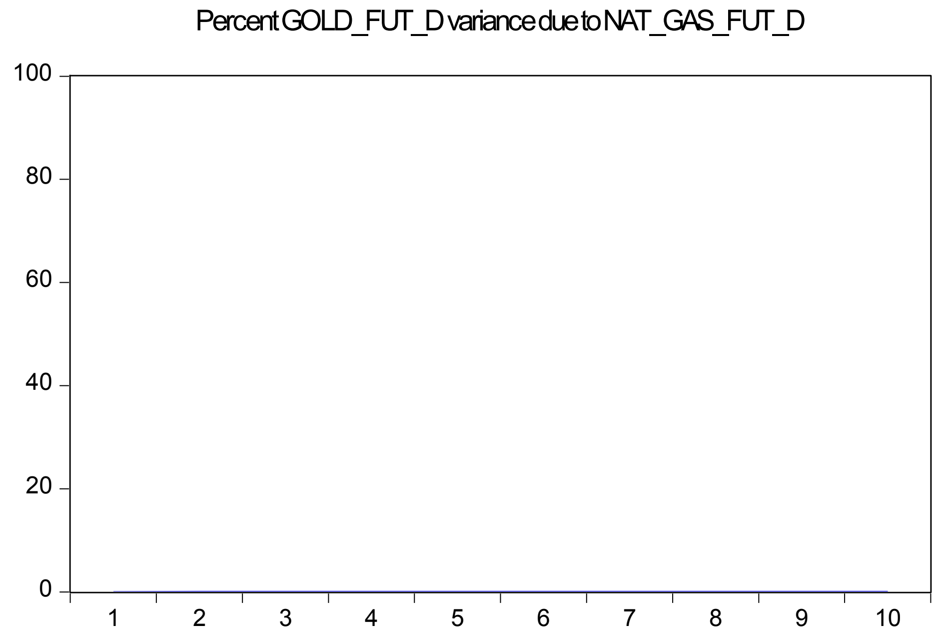
Percent GOLD_FUT_D variance due to NAT_GAS_FUT_D
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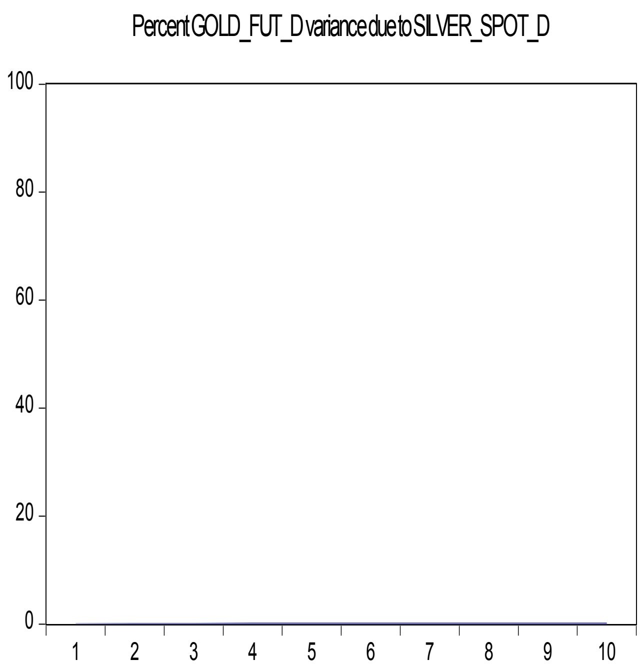
Percent GOLD_FUT_D variance due to SILVER_SPOT_D
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20
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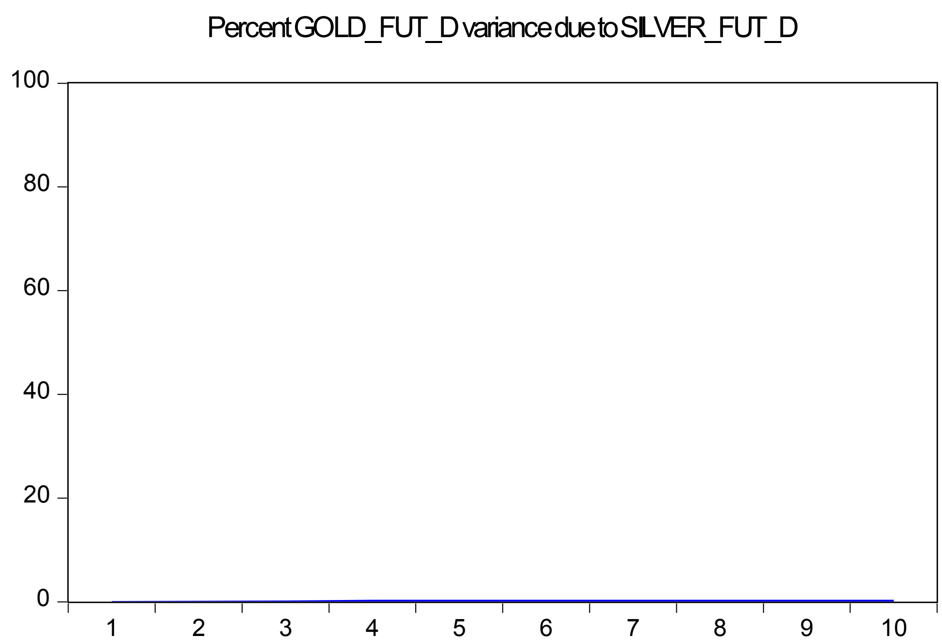
2
3
4
5
6
7
8
9
10


Percent GOLD_FUT_D variance due to SILVER_FUT_D
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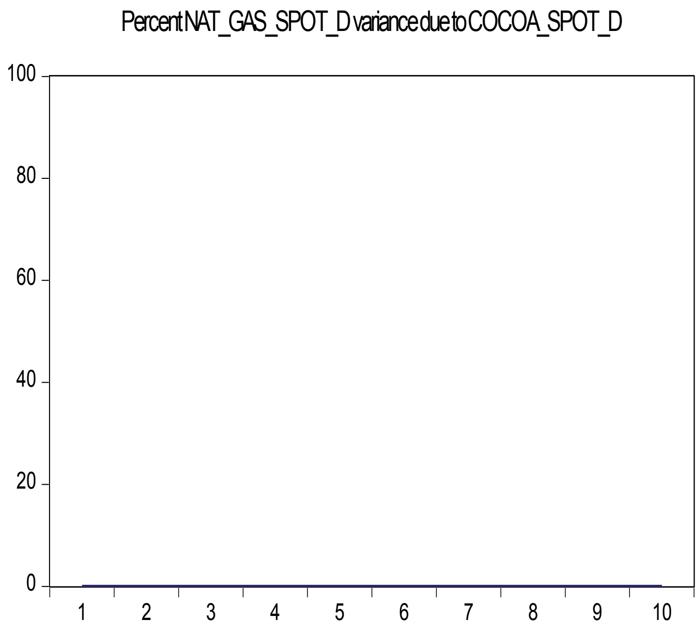
Percent NAT_GAS_SPOT_D variance due to COCOA_SPOT_D
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60
40
20
0
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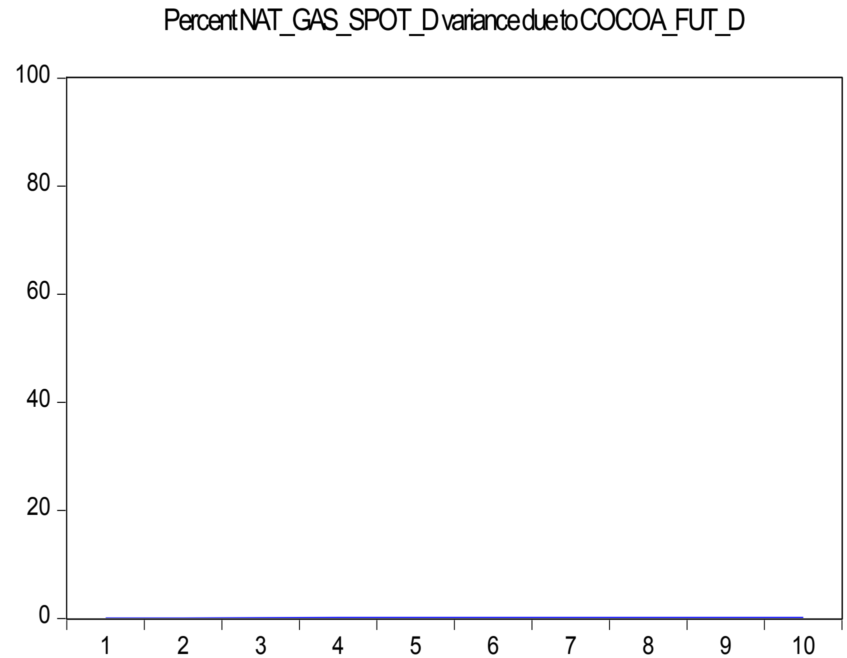
Percent NAT_GAS_SPOT_D variance due to COCOA_FUT_D
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60
40
20
0
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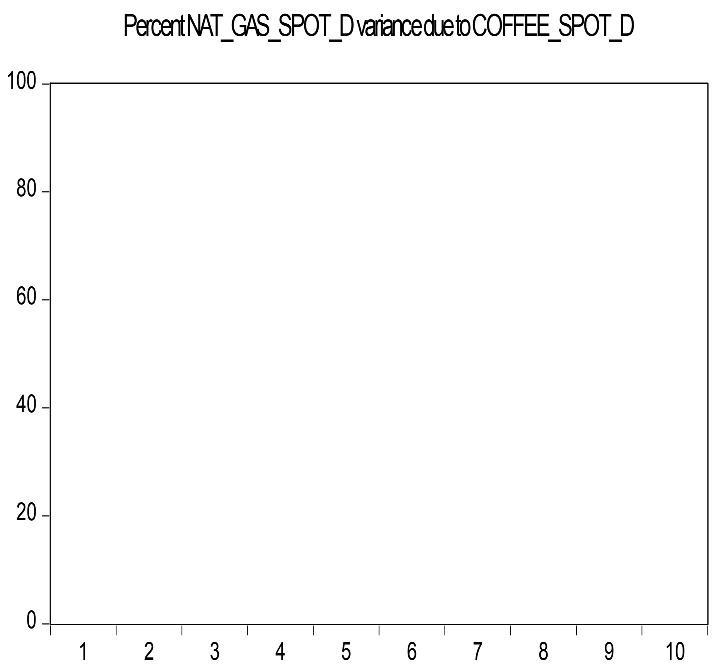
Percent NAT_GAS_SPOT_D variance due to COFFEE_SPOT_D
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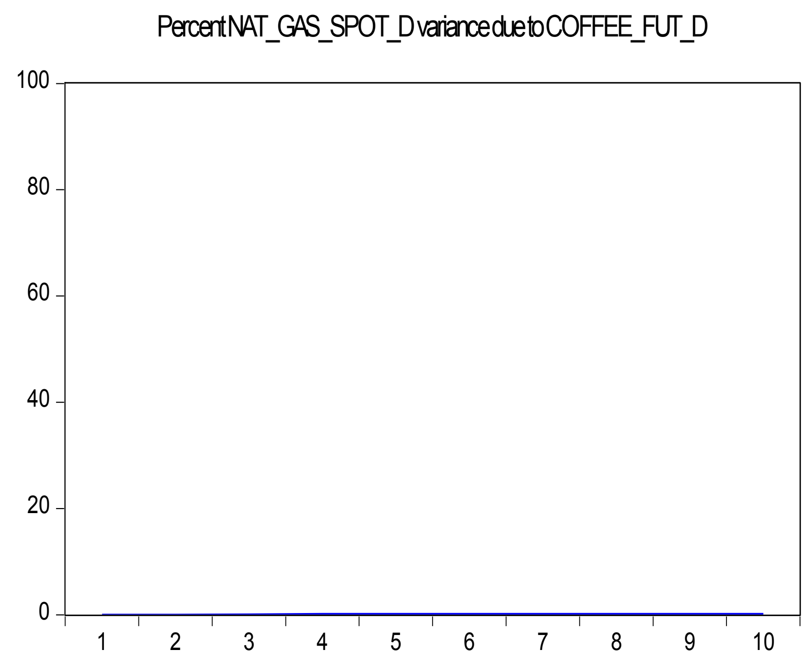
60
40
20
0
1 2 3 4 5 6 7 8 9 10


Percent NAT_GAS_SPOT_D variance due to COFFEE_FUT_D
100
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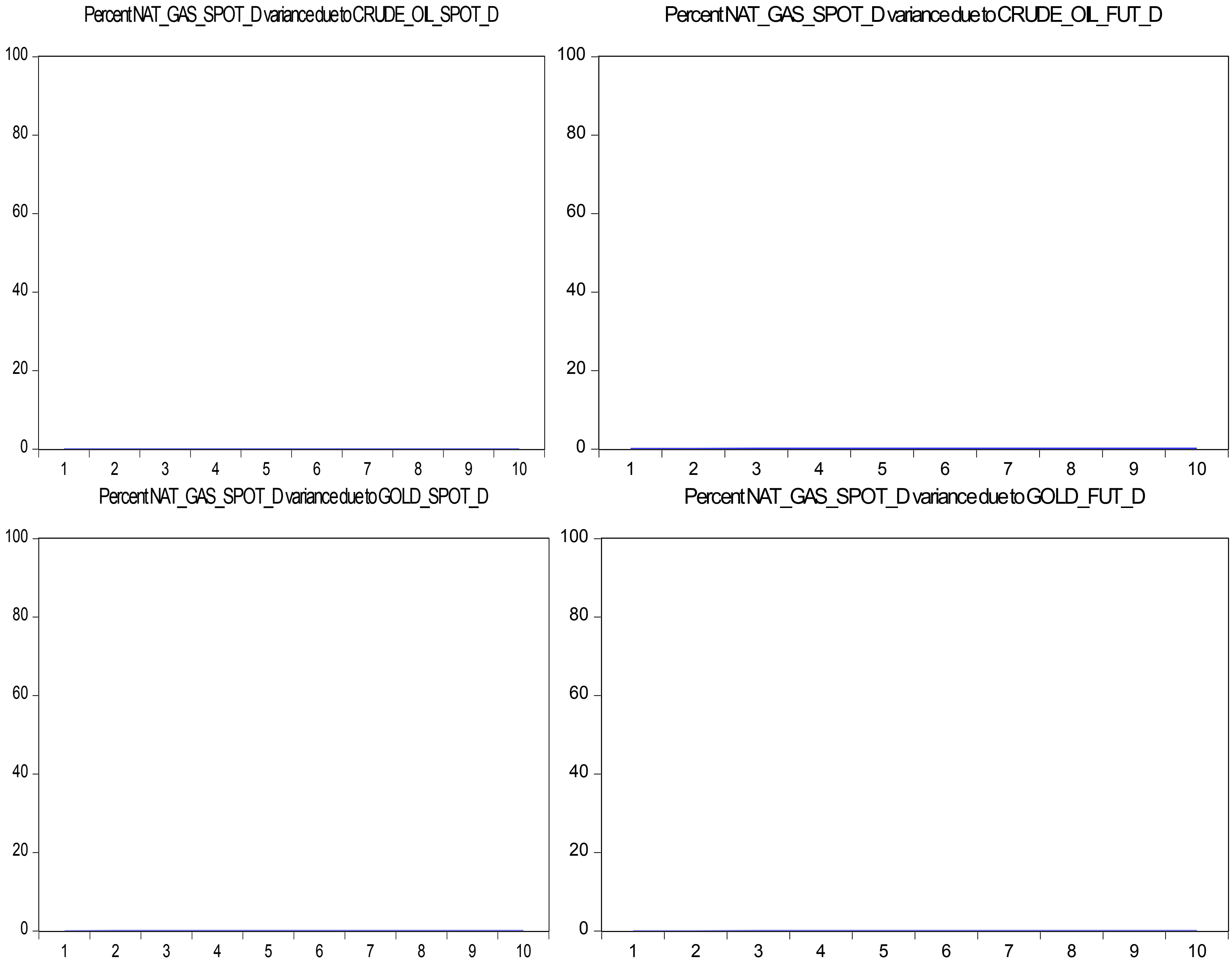
60
40
20
0
1 2 3 4 5 6 7 8 9 10


Percent NAT_GAS_SPOT_D variance due to CRUDE_OIL_SPOT_D
Percent NAT_GAS_SPOT_D variance due to CRUDE_OIL_FUT_D
Percent NAT_GAS_SPOT_D variance due to GOLD_SPOT_D
Percent NAT_GAS_SPOT_D variance due to GOLD_FUT_D
0
20
40
60
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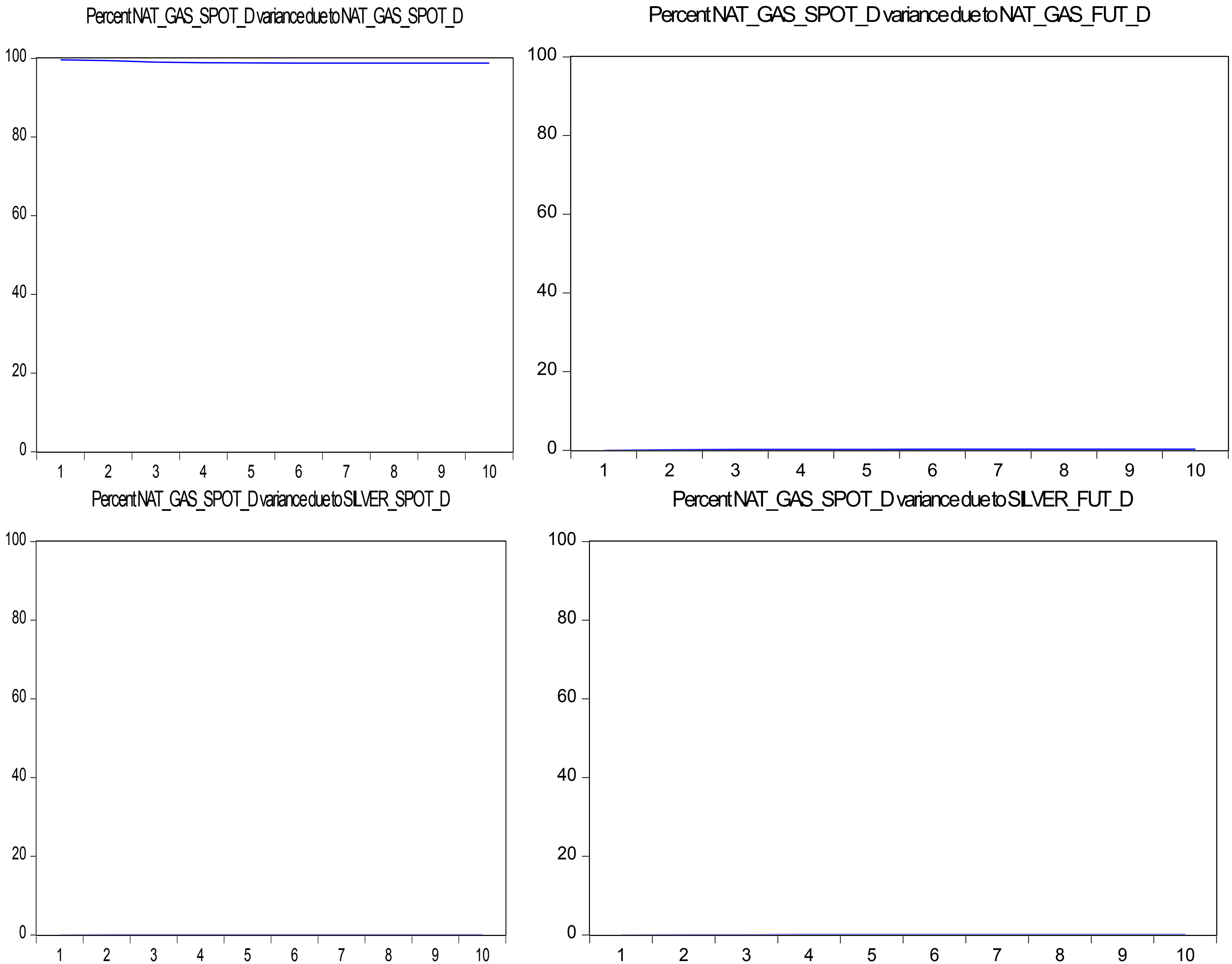
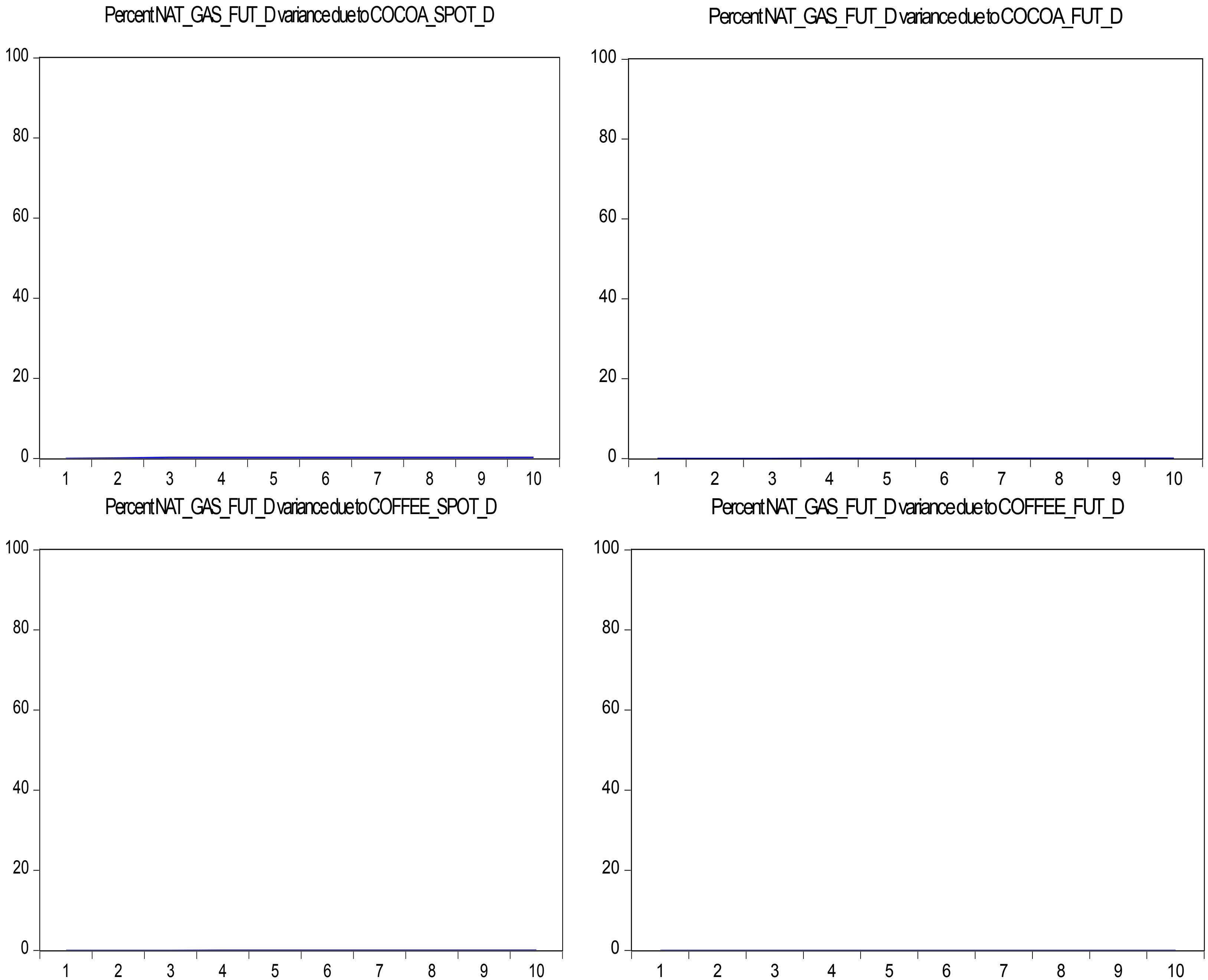
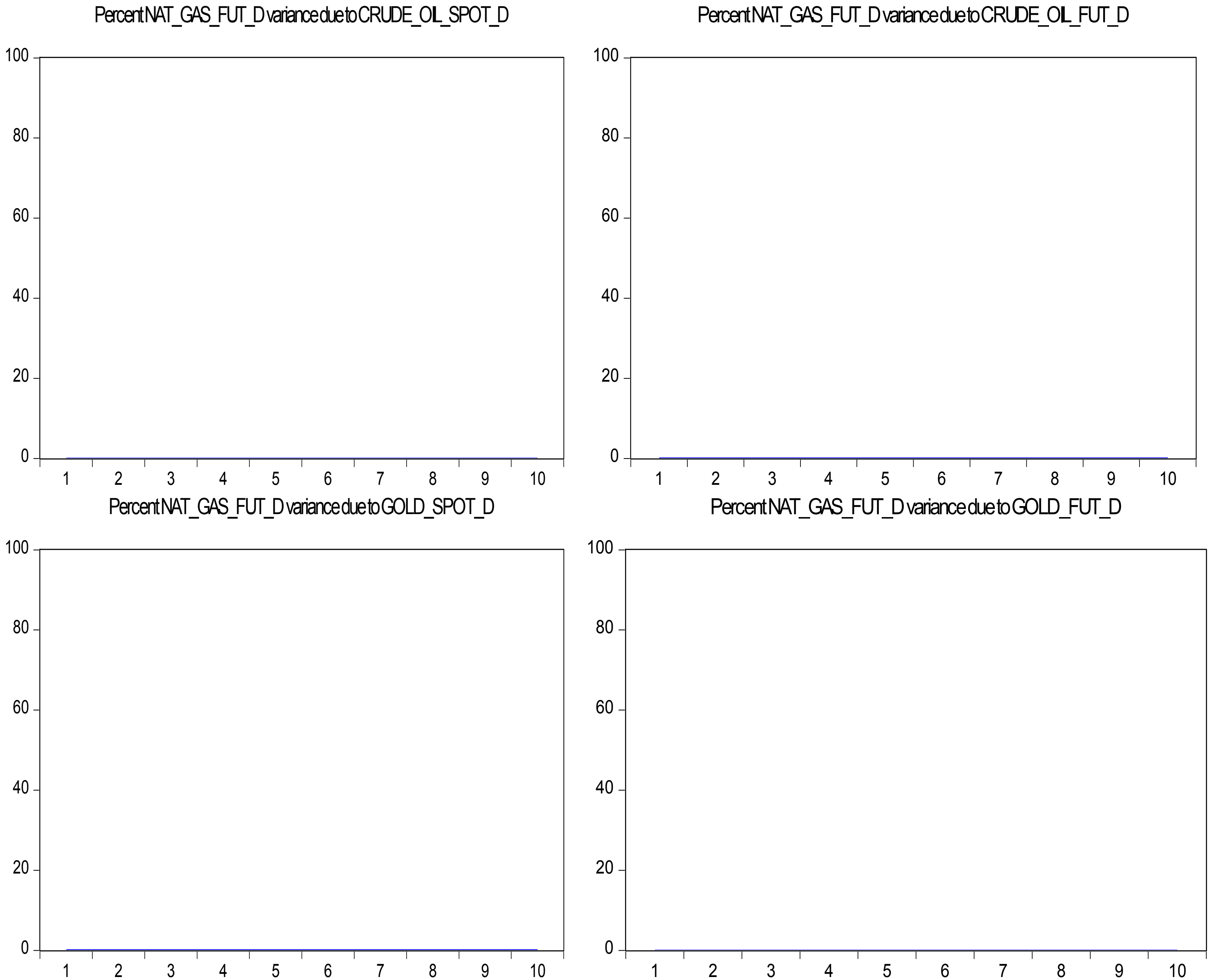
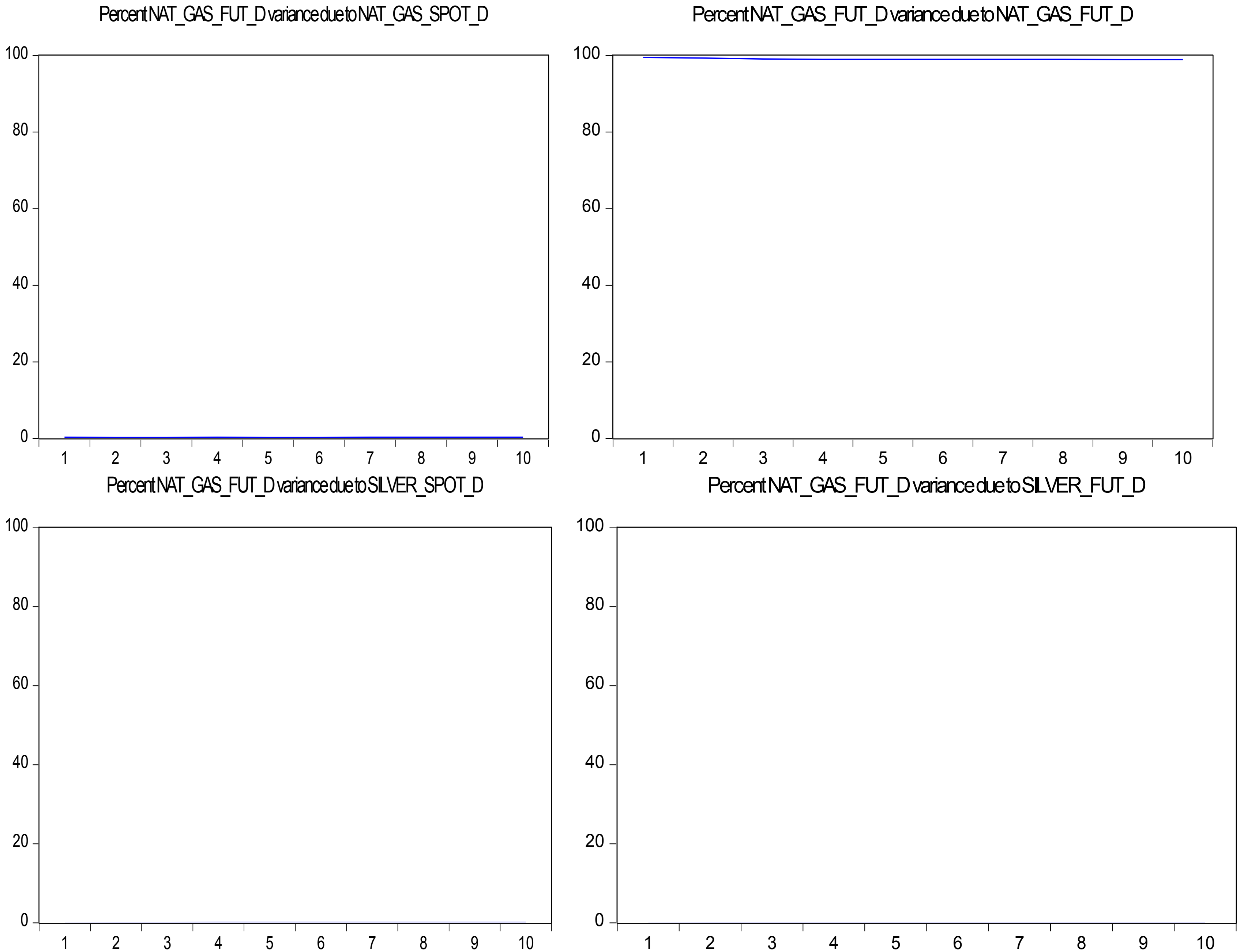
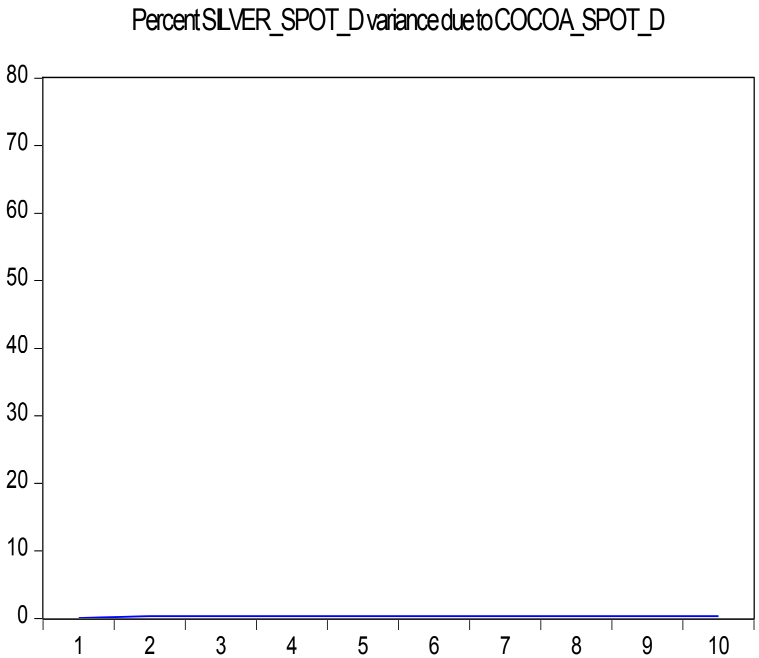
7
8
9
10

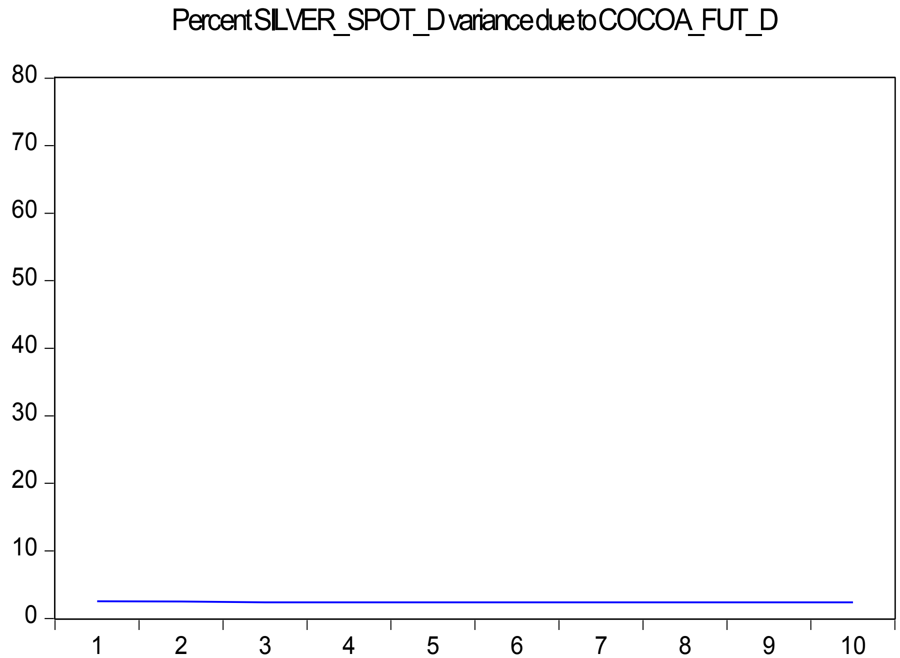

Percent NAT_GAS_SPOT_D variance due to NAT_GAS_SPOT_D
Percent NAT_GAS_SPOT_D variance due to NAT_GAS_FUT_D
Percent NAT_GAS_SPOT_D variance due to SILVER_SPOT_D
Percent NAT_GAS_SPOT_D variance due to SILVER_FUT_D
0
20
40
60
80
100
1 2 3 4 5 6 7 8 9 10

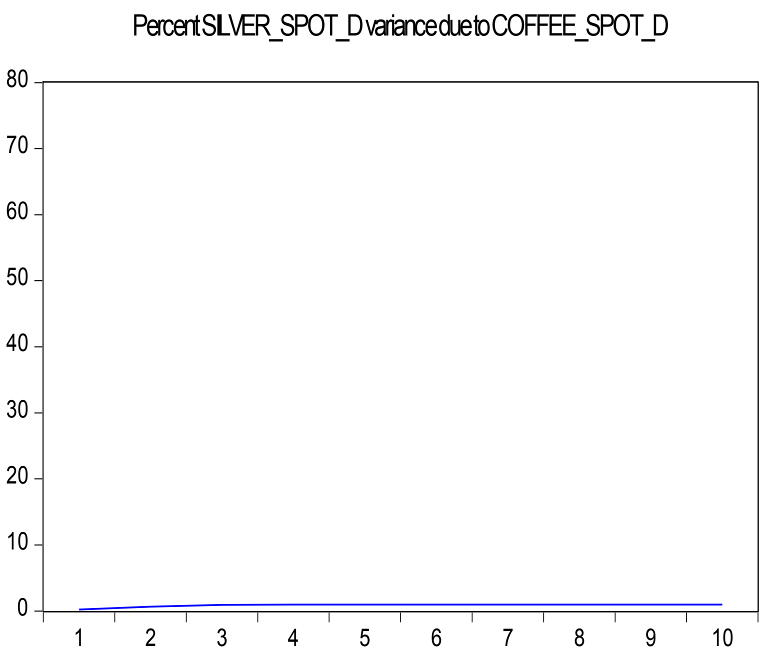

Percent NAT_GAS_FUT_D variance due to COCOA_SPOT_D
Percent NAT_GAS_FUT_D variance due to COCOA_FUT_D
Percent NAT_GAS_FUT_D variance due to COFFEE_SPOT_D
Percent NAT_GAS_FUT_D variance due to COFFEE_FUT_D
0
20
40
60
80
100
1 2 3 4 5 6 7 8 9 10

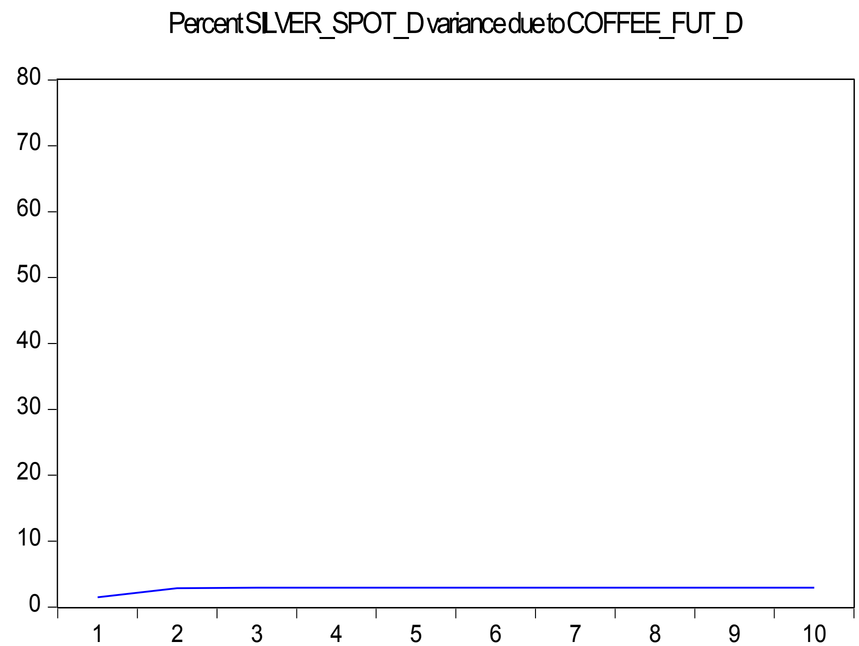

Percent NAT_GAS_FUT_D variance due to CRUDE_OIL_SPOT_D
Percent NAT_GAS_FUT_D variance due to CRUDE_OIL_FUT_D
Percent NAT_GAS_FUT_D variance due to GOLD_SPOT_D
Percent NAT_GAS_FUT_D variance due to GOLD_FUT_D
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10


Percent NAT_GAS_FUT_D variance due to NAT_GAS_SPOT_D
Percent NAT_GAS_FUT_D variance due to NAT_GAS_FUT_D
Percent NAT_GAS_FUT_D variance due to SILVER_SPOT_D
Percent NAT_GAS_FUT_D variance due to SILVER_FUT_D
0
20
40
60
80
100
1
2
3
4
5
6
7
8
9
10


Percent SILVER_SPOT_D variance due to COCOA_SPOT_D
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
8
9
10


Percent SILVER_SPOT_D variance due to COCOA_FUT_D
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
8
9
10


Percent SILVER_SPOT_D variance due to COFFEE_SPOT_D
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
8
9
10


Percent SILVER_SPOT_D variance due to COFFEE_FUT_D
0
10
20
30
40
50
60
70
80
1
2
3
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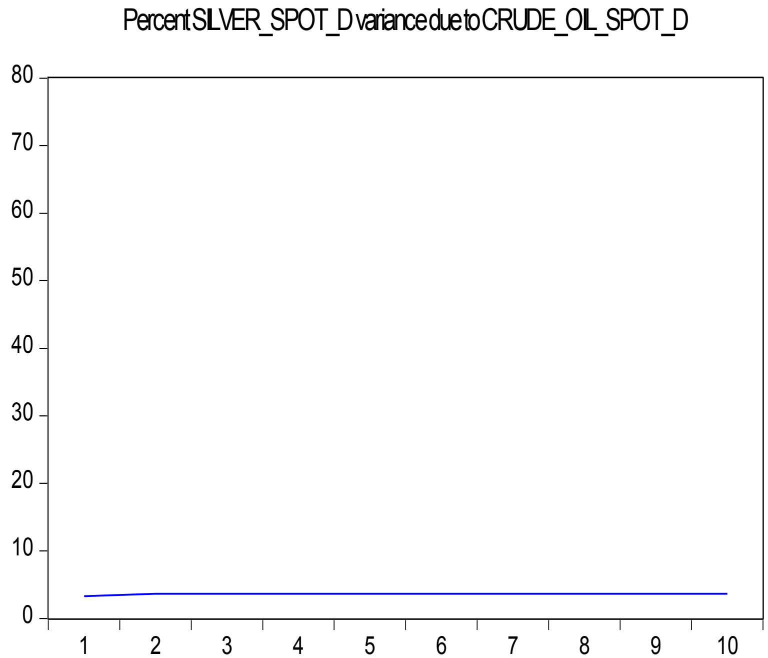
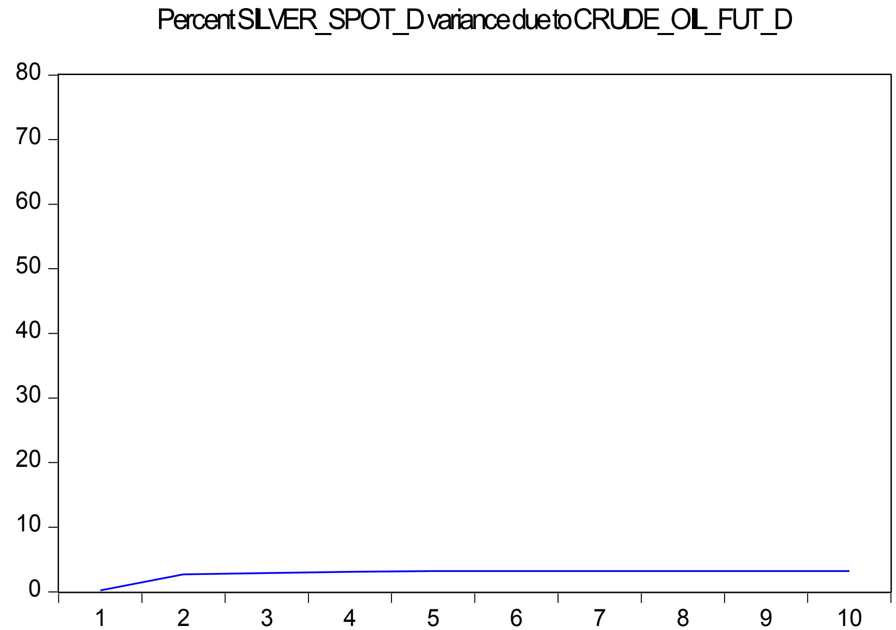
6
7
8
9
10


Percent SILVER_SPOT_D variance due to CRUDE_OIL_SPOT_D
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10


Percent SILVER_SPOT_D variance due to CRUDE_OIL_FUT_D
80
70
60
50
40
30
20
10
0
1
2
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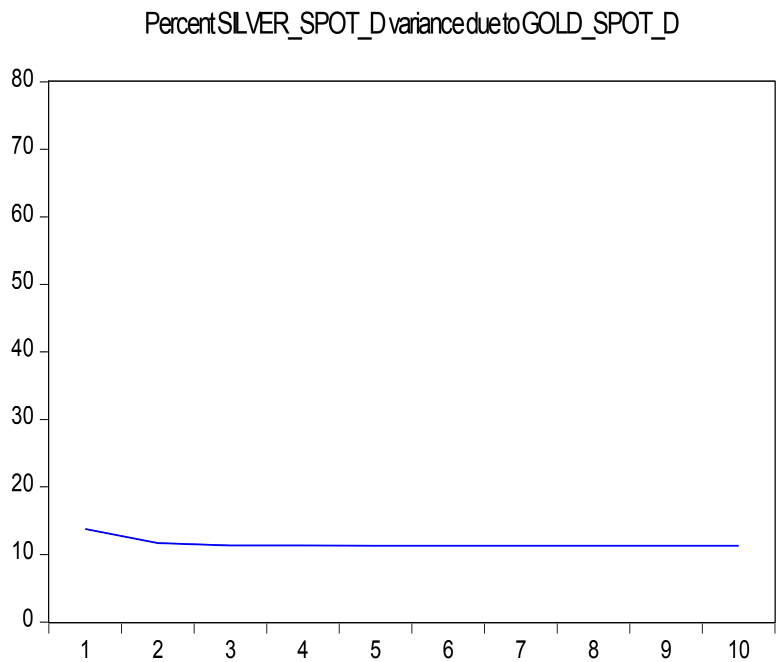
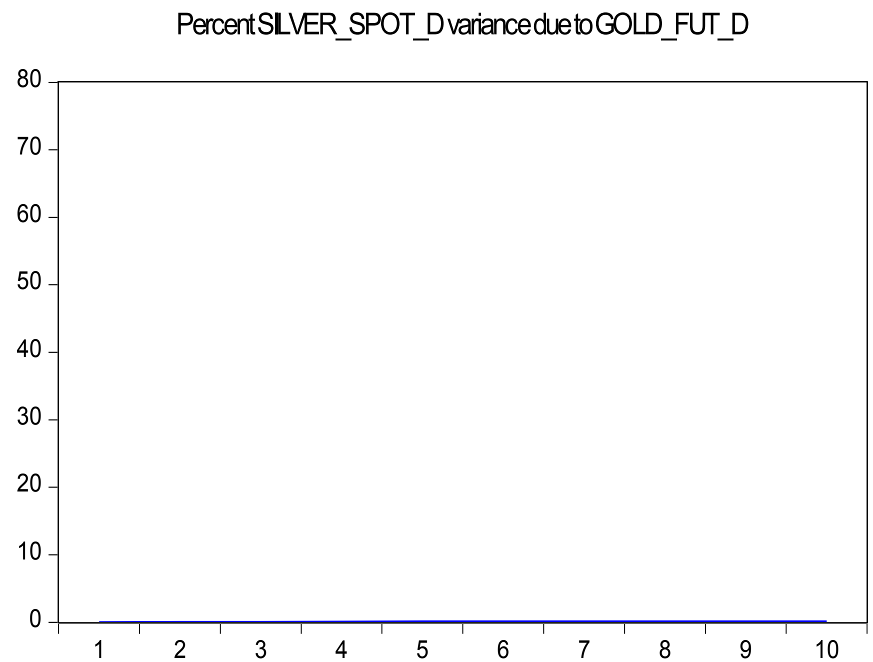
6
7
8
9
10


Percent SILVER_SPOT_D variance due to GOLD_SPOT_D
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10


Percent SILVER_SPOT_D variance due to GOLD_FUT_D
80
70
60
50
40
30
20
10
0
1
2
3
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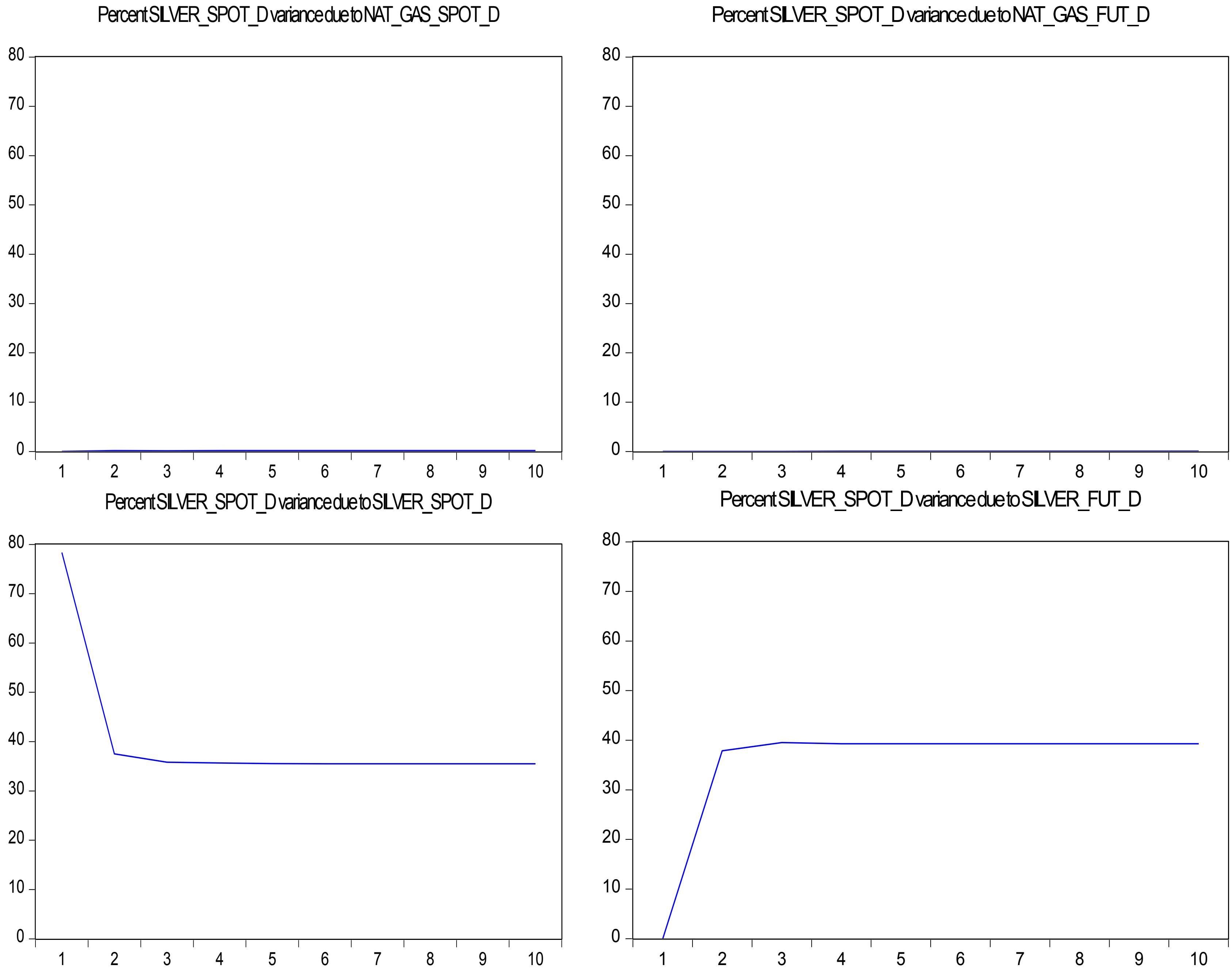
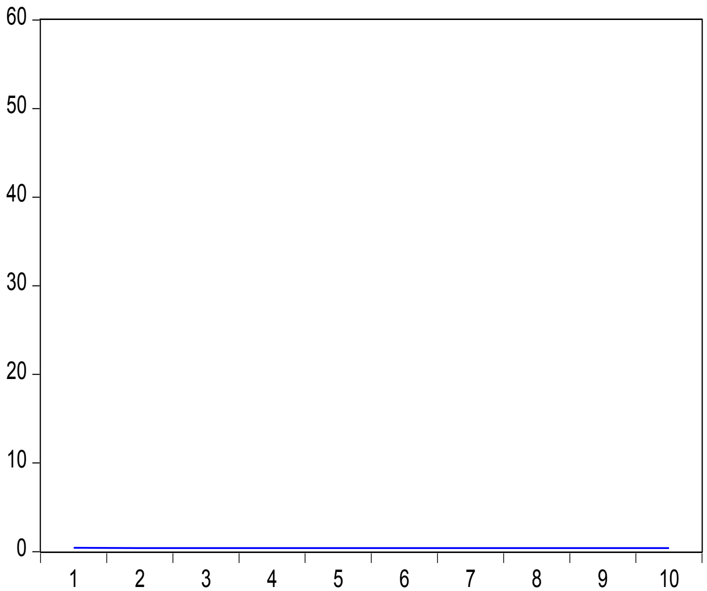
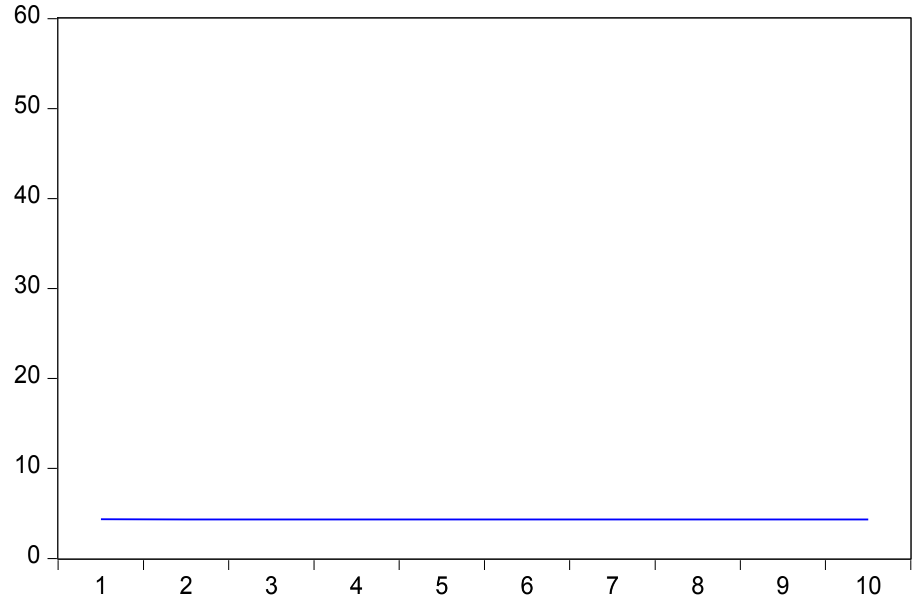
6
7
8
9
10


Percent SILVER_SPOT_D variance due to NAT_GAS_SPOT_D
Percent SILVER_SPOT_D variance due to NAT_GAS_FUT_D
Percent SILVER_SPOT_D variance due to SILVER_SPOT_D
Percent SILVER_SPOT_D variance due to SILVER_FUT_D
0 10 20 30 40 50 60 70 80
1 2 3 4 5 6 7 8 9 10

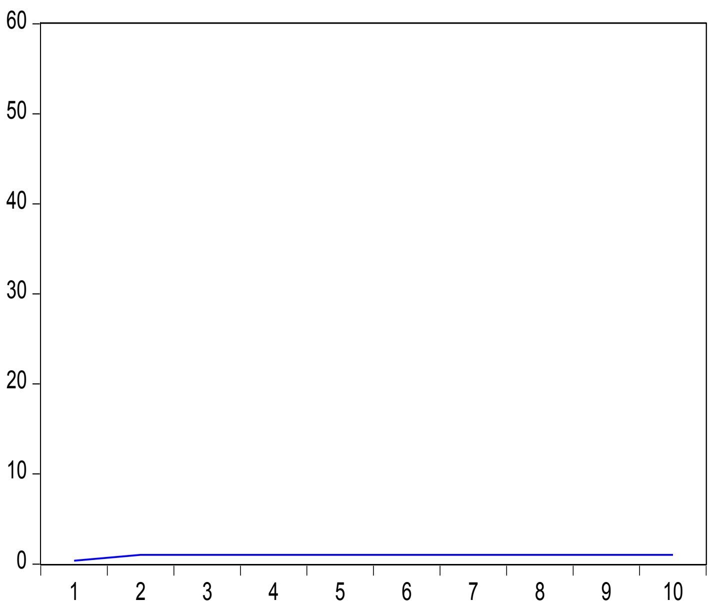
Percent SILVER_FUT_D variance due to COCOA_SPOT_D



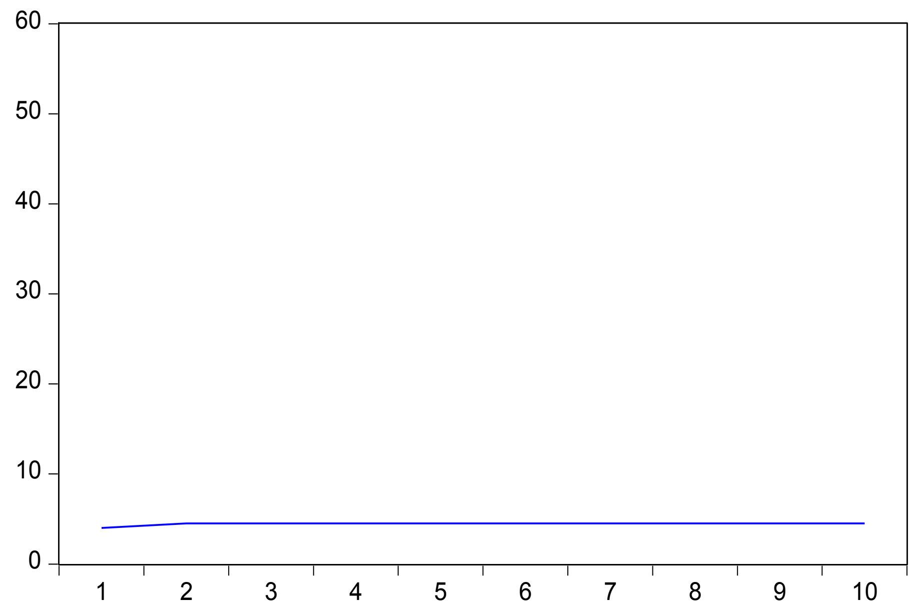
Percent SILVER_FUT_D variance due to COCOA_FUT_D

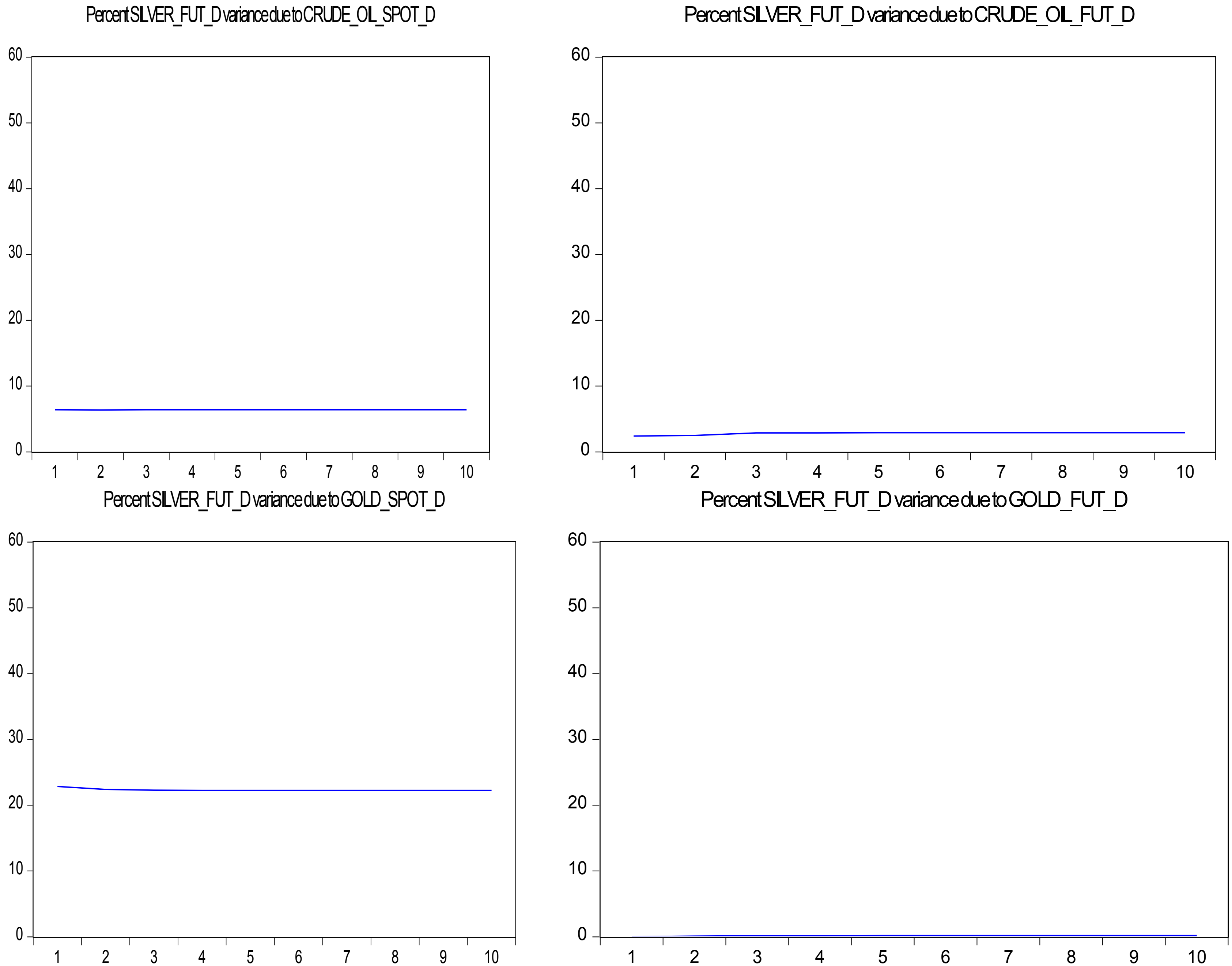


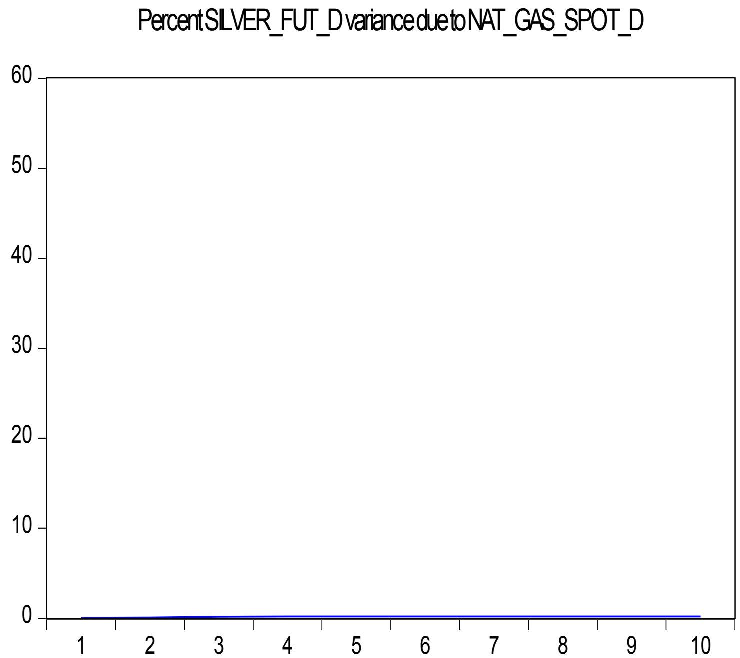
Percent SILVER_FUT_D variance due to COFFEE_SPOT_D

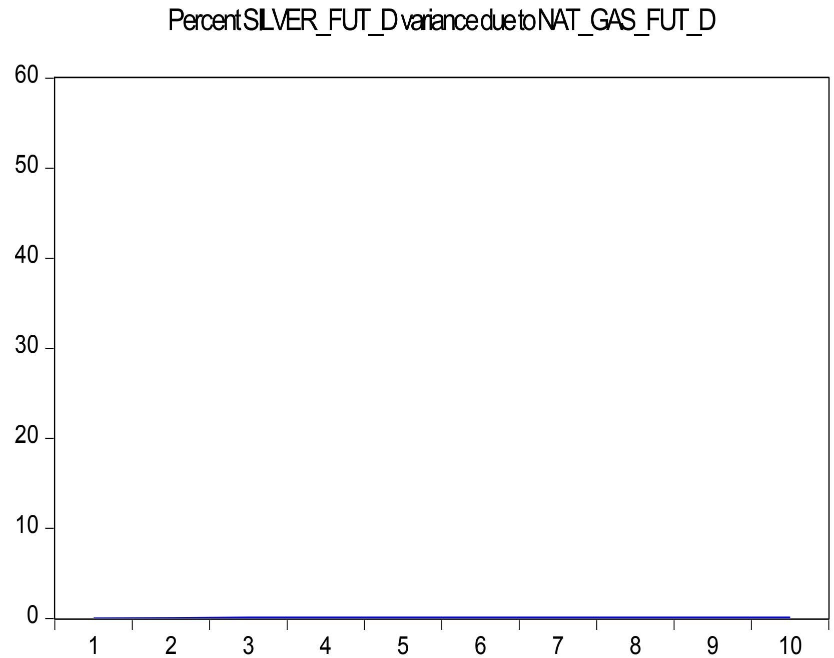


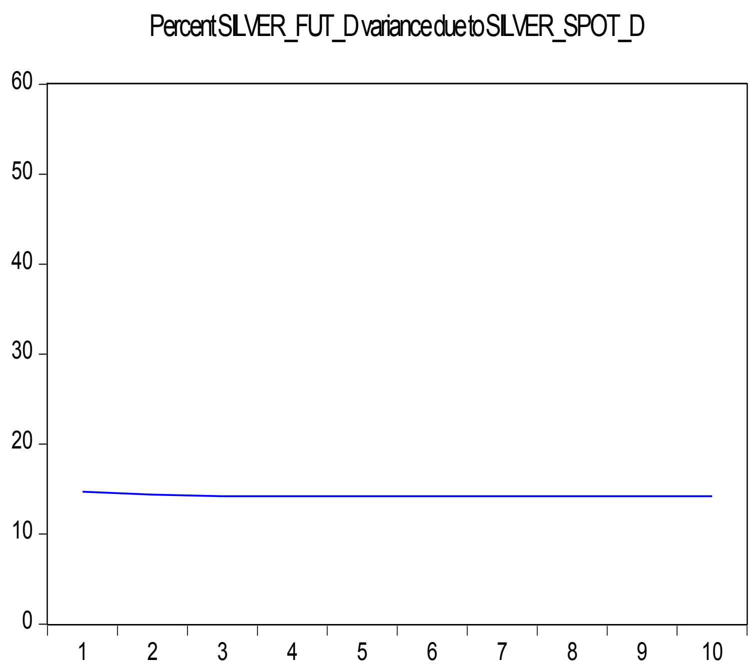
Percent SILVER_FUT_D variance due to COFFEE_FUT_D

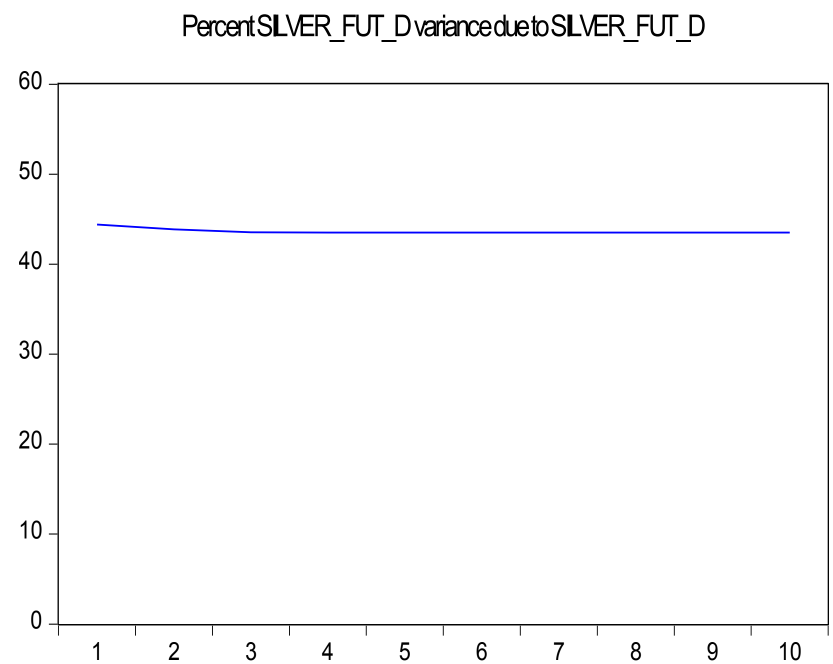



Percent SILVER_FUT_D variance due to CRUDE_OIL_SPOT_D
Percent SILVER_FUT_D variance due to CRUDE_OIL_FUT_D
Percent SILVER_FUT_D variance due to GOLD_SPOT_D
Percent SILVER_FUT_D variance due to GOLD_FUT_D


Percent SILVER_FUT_D variance due to NAT_GAS_SPOT_D
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10


Percent SILVER_FUT_D variance due to NAT_GAS_FUT_D
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10


Percent SILVER_FUT_D variance due to SILVER_SPOT_D
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10


Percent SILVER_FUT_D variance due to SILVER_FUT_D
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10