DIVERSIFICATION BENEFITS FROM INVESTING IN COMMODITY SECTOR: THE CASE OF PRECIOUS METALS, INDUSTRIAL METALS & AGRICULTURAL PRODUCE

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Abstract

This paper explores benefits from investing in the commodity market by investigating the nature of the relationship between commodity market returns and stock market returns. Using Vector Auto Regression (VAR) we examine interdependence among Precious Metals, Industrial Metals, Agriculture Produce and equity market returns. Results suggest commodity market returns and equity market returns have little or no significant positive interdependence, thereby signaling diversification benefits from investing in the commodity sector.

Keywords: *VAR, Commodity markets, equity markets, portfolio management*

JEL Classification: G11, C32

1. Introduction

A topic of interest in investment literature is understanding integration of different asset classes, i.e. sectors of investing. As the regional and global convergence of business cycles progress, correlation of country specific fundamentals has increased, thereby reducing the benefits from country specific diversification. Therefore, investors are now focusing on the concept of diversifying across different asset classes. An understanding of the impact of investment constraints on the benefits; and, portfolio allocation of a sector based diversification are becoming essential for academicians, professionals and investors. As investor appetite for commodity investing grows, an understanding of the cross diversification benefit from commodities is becoming important.

Previous studies on commodities sector returns have failed to provide a coherent answer as to commodity investment diversification benefits. This is an important issue to academicians and practitioners. There are some studies on the issue, such as Gorton and Rouwenhorst, (2006), however, these have failed to provide conclusive evidence, and lack a systematic time series analysis. Econometricians caution on interpreting such results and suggest only a time series analysis for forecasting, interpretation and testing of hypothesis for studies which involve finance and economic data (Enders, 2004). Therefore the nature of relationship between the commodity market and the financial market remains inconclusive and requires further investigation. Understanding of commodities sector is becoming important. According to Cashin and McDermott (2002) approximately 25% of total world merchandise trade consists primarily of commodities. Many countries depend on one or more commodity trade for the bulk of their international trade. Barclays Bank PLC, a significant provider of commodity investment funds (IMF, 2006) estimates approximately US$ 100 billion is allocated in several commodity indices (BGINA, 2007).

A largely ignored fact regarding commodities as an alternate asset class is its stylized characteristics. Unlike capital market inventory (i.e. stocks and bonds) commodity quantities are usually planned commensurate to their anticipated future demand (Akey, 2005). Moreover, commodity contracts generally constitute a short-maturity, unlike the capital market contracts which are characterized by infinite life (Gorton and Rouwenhorst, 2006). Also, commodity valuations are characterized by the presence of a term structure relationship (future-spot price relationship), a convenience yield (choice of inventory consumption today versus investment for the future), and a storage cost (pure storage and/or financing cost of the underlying commodity or its investment) (Lautier, 2005). In the long term, these factors are likely to influence commodity markets to behave differently than capital markets under varying economic and market conditions. From a portfolio risk/return viewpoint this property is likely to be highly desirable because it has a potential to provide significant diversification opportunities. However, there exist several unanswered questions; namely, concerning diversification benefit from investing in the commodity sector.

This paper is positioned to fill the above mentioned voids in the current finance literature by investigating the following, i.e. examining the relationship among the *equity market returns* and *commodity market returns* focusing on precious metals, industrial metals and agriculture produce categories. In this paper we present a better understanding of the interdependence of the returns of these categories of commodities and the equity market returns. The remainder of the paper is organized as follows. Section 2 reviews the studies on the issues of commodities. Section 3 describes the data. Section 4 details the econometric methodology used, whereas section 5 reports the empirical findings and the results. Finally, section 6 concludes.

2. Literature Review

2.1 Interest in Commodities

Despite their formal trading in the U.S for over 100 years and even longer in other countries, such as Japan since the 18th century (Hamori *et al*., 2001), commodity trading is a largely unexplored and an under investigated asset class. Only recently has commodity trading started receiving attention by the practitioners and academicians. Among the principal reason for the recent interest in commodity trading is the observation of inherent comparative differences between commodities and other widely traded conventional assets such as capital assets, i.e. stocks and bonds.

According to Gorton and Rouwenhorst (2006) the principal differences between commodities and capital assets are: (a) commodities are usually traded on contracts or, as derivative securities, (b) unlike capital assets such as stocks, which are usually claims on long-life corporations, commodity contracts are mainly short term maturity claims on real underlying assets; and, (c) many commodities are known to exhibit pronounced seasonality in price levels and are created with expected future demand for an underlying raw material.

The recent surge in crude oil price and how it continues to impact the global economy has also prompted investors and researchers to reconsider commodities as an investing asset class (Vrugt *et al*., 2004). According to Matthies (2007) an upward trend in raw materials prices has continued since 2002, rebounding commodities from decades of historically weak prices. The principal factor for the upward trend is due to the ongoing global demand for commodities, particularly by fast expanding economies such as Brazil, Russia, India and China (BRIC countries). Further, recent changes in global macroeconomic factors influence the continuing underperformance of the traditional investment class, i.e. stocks and bonds. This underperformance has prompted investors to consider other asset classes such as commodities for investment diversification purposes.

Recent studies on the behavior of commodity price returns suggest that by adding commodities to a portfolio of traditional assets (such as stocks and bonds) overall portfolio risk may be reduced. This can be attributed to the stylized facts or characteristics of commodities, which have been noted to behave different than other asset classes, especially during periods of varying market conditions. For example, Jensen *et al*. (2002) examines the diversification benefits of adding managed and unmanaged commodity futures to a traditional portfolio during the 1973-1999 periods and conclude that by adding a commodity index portfolio performance is enhanced. Due to inherent characteristic differences with other asset class, if commodity markets do behave largely independent of the capital markets, then the general sector of investors (institutional and/or individual), who largely invest in capital markets, can benefit by diversifying in commodities. Investors' risk exposure may be mitigated by investing a portion of their portfolio in commodity markets.

Another reason to suspect that commodities may mitigate exposure during periods of short term volatility is the fact that they have been noted to be *inelastic* (Hirsh, 1951). Asset classes which are elastic tend to have high correlation between price and demand. For e.g. in capital markets an inverse relationship *usually* exists between price of stocks or bonds and their demand. This is possible as capital markets are *liquid*. Inelastic goods on other hand are usually necessity goods, i.e. changes in price tend to have limited effects on supply and demand. Most commodities are considered inelastic as these are usually essential raw material for industries or material used for day to day living. Though commodities are traded using contracts, commodity markets are generally considered *less* liquid than capital markets.

2.2 Commodities as an Asset Class

In a recent study to understand the properties of commodities as an asset class, Gorton and Rouwenhorst (2006) analyze commodity prices returns during the 1959-2004 periods. They observe commodity returns to be: (a) comparable to stock returns but with a lower volatility, (b) negatively correlated with the returns of stocks and bonds, and (c) positively correlated with inflation.

Low or negative correlation between commodity returns and the other asset classes are largely attributed to several stylized differences. However the authors fail to utilize a robust time series analysis and use a single index (and not individual commodity variables) for their study; therefore, results from their study remains inconclusive. Time series analysis is recommended for forecasting, interpretation and testing of hypothesis concerning finance and economic data (Enders, 2004). The behavior does not imply that commodity returns will go down in value when returns from stock go up. This simply implies that performance of commodity returns is worse than their long-term average when return from stocks report a better than average performance (Greer, 2000). Also, commodity quantities are usually planned commensurate to anticipated future demand (Akey, 2005) which implies that commodity prices often move independent of capital markets. This property is very desirable and provides an interesting diversification opportunity from a portfolio risk/return viewpoint.

There is a presence of *marginal convenience* based on the storage and consumption observed for commodity pricing. The theory of storage explains the difference between commodity spot and futures price. It takes into account forgone interest from purchasing and storing the commodity, relevant storage costs and the convenience yield on the stored inventory. This marginal convenience yield on inventory falls at a decreasing rate as inventory increases. Fama and French (1988) test this hypothesis by examining the relative variation of spot and futures prices for metals. The futures prices are less variable than the spot prices when inventory is low; but, spot and futures prices have similar variability when inventory is high. The implication is that the term structure of futures price volatility generally declines with time until expiration of the futures contract.

Another characteristic found in the pricing of commodities is the presence of *backwardation*. Backwardation occurs when distant futures prices are trading below the prevailing spot prices. According to Carter *et al*. (1983) it is normal for the future commodity price to trade lower than the prevailing price. This theory argues that this difference serves as an incentive to investors for taking long positions and can be considered as an insurance premium for the future commodity spot price. This reduces volatility in commodity markets since investors now earn a *processor margin* (insurance premium) and, the supplier of a commodity has an element of safety in the supply and maintenance of inventory levels for future delivery (Greer, 2000). For example, Litzenberger and Rabinowitz (1995) note, oil futures markets often exhibit backwardation. They characterize an oil well as an option and argue that backwardation is necessary to induce stable production, inventory level and delivery consummate to future demand. Production is shown to be non-increasing during times of the high volatility of future prices. The empirical analysis indicates that U.S. oil production is directly related to the backwardation and inversely related to the implied volatility.

Another principal argument for diversifying in commodities is the observation of how commodities behave during times of inflation. Few capital market assets, i.e. stocks and bonds benefit from inflation, particularly from unexpected inflation. The relationship between capital market returns and inflation has been extensively discussed in the finance literature. There is sufficient evidence that returns on stocks and bonds are negatively related to both expected and unexpected inflation (Bodie, 1976; Fama and Schwert, 1977; Schwert, 1981). However, under inflationary circumstances, commodities usually benefit. The underlying commodity material price usually rises with inflation. As the demand for goods rise, so does the price of related raw-materials which are used to produce these goods. A portfolio comprised of only stocks and bonds typically loses value during periods of inflation; however, when commodities are added, it has shown to provide a hedge against loss due to inflation (Bodie, 1983; Halpern and Warsager, 1998).

Because commodities influence the economies of several countries, Abanomey and Mathur (2001) test whether adding commodities to their foreign investment portfolio provides additional international diversification benefits. The authors find evidence that adding commodities to their international portfolio of stocks and bonds improves the efficiency of their portfolios. Namely due to these characteristics, it comes as no surprise as investors, especially institutional investors, are considering adding commodity-linked indices to their portfolio for diversification benefits. According to Akey (2005), as of September 2004, there is more than US$ 25 billion in investment portfolios linked to the Goldman Sachs Commodities Index (GSCI) which is an increase of US$ 8 billion since the year 2000. Further, approximately another US$ 8 billion are linked to the Dow Jones-AIG Commodity Index, up from US$ 200 million just a few years ago.

3. Data and Descriptive Statistics

For our study we obtain monthly data between January 1990 and April 2008. As a proxy for performance of equity market returns we use S&P500 returns.

To assess the financial performance of the commodity sector, we include corresponding monthly data for 12 commodities. These are Gold, Silver and Platinum for the precious metals category, Aluminum, Tin, Nickel, Lead and Zinc for the industrial metals category, and Cotton, Corn, Soy and Rubber for Agriculture produce sector. Our data is sourced from the Thompson Financials Datastream database. We compute the continuously compounded returns for all indices. Table 1 reports the descriptive statistics for variables. From the table we can observe that the mean returns for all the variables of interest are positive for the sample period. The positive average returns may be attributed to the overall growth. Further, all maximums are positive and minimums are negative. S&P500 maximum and minimums figures records are among the lowest of all variables. High returns among the commodities are consistent with the fact that the investors are being compensated for a higher risk. Commodity variables all report a higher Standard Deviation than the S&P500 returns. Largely the presence of negative skewness indicates a distribution with an asymmetric tail extending towards more negative values. Nickel, Lead, Silver, Cotton, Corn, Soy and S&P500 returns report negative skewness. Aluminum, Tin, Zinc, Gold, Platinum, Wheat and Rubber returns report positive skewness. A large Kurtosis figure (>3) is also observed, indicating a relatively peaked distribution. Except for Rubber returns all other variables of interest have a large Kurtosis figure. The presence of non-normal distribution in returns for the variables of interest is all the more reason why a time-series analysis is imperative for any meaningful interpretation.

Insert Table (1) about here

Table 2 reports the coefficients of correlation between commodity returns and S&P500 returns. The levels of correlation between sample commodities and S&P500 are moderately low or negative. These figures seem consistent with our earlier discussion that there are inherent differences between commodities and stocks. These differences prompt the two to perform differently during varying economic environments. Among commodities, the coefficients of correlation figures are low to moderate. Precious metals and industrial metals demonstrate a moderate correlation. Agriculture produce report a low to negative correlation. In summary, moderate to low correlations among these variables suggest that each variable represents unique expectations of their individual market participants which seems independent from each other.

Insert Table (2) about here

4. *Econometric Methodology*

Since the returns of commodity variables of interest and S&P500 returns may act as a system (Brown and Cliff, 2004 & 2005; Lee et al., 2002), we choose the VAR model developed by Sims (1980) as an appropriate econometric approach to investigate the postulated relationships, i.e. to understand the nature of the relationship between returns of the S&P500 and commodity variables.

The VAR model can be expressed as:

$$Z(t) = C + \sum_{s=1}^{m} A(s)Z(t-m) + \varepsilon(t) \qquad (1)$$

where, $Z(t)$ is a column vector of variables of interest, C is the deterministic component comprised of a constant, $A(s)$ is a matrix of coefficients, m is the lag length and $\varepsilon(t)$ is a vector of random error terms.

The VAR specification allows the researchers to do procedural simulations and integrate Monte Carlo methods to obtain confidence bands around the point estimates (Doan, 1988; Hamilton, 1994). The likely response of one variable to a one time unitary shock in another variable can be captured by impulse response functions. As such they represent the behavior of the series in response to pure shocks while keeping the effect of other variables constant. Since, impulse responses are highly non-linear functions of the estimated parameters, confidence bands are constructed around the mean response. Responses are considered statistically significant at the 95% confidence level when the upper and lower bands carry the same sign.

It is well known theoretically that traditional orthogonalized forecast error variance decomposition results based on the widely used Choleski factorization of VAR innovations may be sensitive to variable ordering (Pesaran and Shin, 1996; Koop, Pesaran and Potter, 1996; Pesaran and Shin, 1998). To alleviate such potential problems of misspecifications, we employ the recently developed *generalized impulses* technique as described by Pesaran and Shin (1998) in which an orthogonal set of innovations (some descriptive word is missing here) which does not depend on the VAR ordering.

5. Estimation Results

Before proceeding with the main results, we first check the time series properties of each variable by performing unit root tests using the Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979, 1981) and Phillips-Perron test (Phillips and Perron, 1998). Based on the consistent and asymptotically efficient *AIC* and *SIC* criteria (Diebold, 2003) and considering the loss in degrees of freedom, the appropriate number of lags is determined to be two. In the case of the ADF test and Phillips-Perron test, the null hypothesis of non-stationarity is rejected. The inclusion of drift/trend terms in the ADF test equations does not change these results (Dolado, Jenkinson, and Sosvilla-Rivero, 1990). Table 3 reports the result of the unit root tests.

Insert Table (3) about here

We construct the generalized impulse responses from the VAR model to trace the response of one variable to a one-standard-deviation shock to another variable in the system. We employ Monte Carlo methods to construct confidence bands around the mean response (Doan and Litterman, 1986). When the upper and lower bounds carry the same sign, the responses become statistically significant at the 95% confidence level. To analyze the effects of the S&P500 on commodity market returns we categorize the response results based on commodity categories, i.e. Industrial Metals (Aluminum, Tin, Zinc, Nickel, and Lead), Precious Metals (Gold, Silver and Platinum), and Agriculture Produce (Wheat, Cotton, Corn, Soy, and Rubber). We first estimate the responses of the S&P500 and Industrial Metals. Based on AIC and SIC, we analyze the VAR models with two lags.

Figure 1 plots the impulse responses of the Industrial Metal variable returns to a one time standard deviation increase in the S&P500. The effects of the S&P500 returns are positive and significant on Zinc and Nickel. The response of Nickel is positive and significant for first month and then become insignificant. The Zinc index return demonstrates a delayed positive, yet significant response to the S&P500 returns (becoming significant in the second month). The initially less and subsequently higher response for the case of Zinc implies that the market is efficient and investors incorporate all available information about the sector (sector specific) in their valuation decision. Aluminum, Tin, Lead returns on the other hand have no significant response to the S&P500 returns.

The interdependence of Nickel and Zinc to the S&P500 may be attributed to the fact that these are globally and widely used industrial metals which have application in many sectors, including construction, electricity and large-scale engineering projects. Lagged positive interdependence can be attributed to positive outlook trend of the stock market and increase in demand for industrial materials for production activity. Further, recent economic growth of the BRIC (Brazil, Russia, India and China) economies has also attributed to continued demand of industrial metals. As a result the demand for industrial metals has usually outpaced supply during recent years.

Insert Figure (1) about here

Our second VAR model for the Precious Metals category includes the following variables: Gold, Silver and Platinum. None of the precious metals index returns demonstrate a significant response to the S&P500. This result can be explained from the fact that Precious metals have been known to be a choice of alternative investment during uncertain market condition or anticipation of uncertain market conditions (Hammoudeh and Yuan, 2008). Taking into account precious metals sensitivities to news, especially during time of crises such as wars and period of high inflation makes them popular with investors who wish to hedge their risk. These arguments match results in this section which indicate that precious metal returns show no significant interdependence to the S&P500 returns.

Insert Figure (2) about here

Our third VAR model for Agriculture Produce category includes the following five variables: Wheat, Cotton, Corn, Soy and Rubber. Wheat demonstrates a negative and significant dependence in the second month which lasts until month three. The negative relationship between the stock market and agriculture produce, such as wheat can be attributed to inflation (Capehart and Richardson, 2008). As the rate of inflation increases, food grain prices such as wheat also increases. However, it is well documented in literature (e.g. Martin, 1980), that stock markets underperform under inflationary market conditions. Demand for wheat has also increased given alternative grains such as corn is being used for bio-fuel applications. The Rest of Agriculture Produce variables demonstrate no significant dependence on the S&P500 returns.

Insert Figure (3) about here

6. Conclusion

A largely ignored fact regarding commodities as an alternate asset class is its stylized characteristics and behavior which are different than other asset classes—such as capital markets. However, previous research has failed to explain the relationship between commodity market returns and capital market returns employing a systematic time series analysis. Therefore, the nature of the relationship between the commodity markets and financial markets remains inconclusive. The purpose of this paper was to fill this above void in the current finance literature by examining the nature of the relationship between the commodity market returns and the stock market returns.

We analyze this by means of using vector auto regression methodology on the S&P500 returns and returns of 13 commodity returns. The results of the generalized impulses generated from vector auto regression (VAR) models suggest that none of the included variables for the precious metals category, (i.e. Gold spot returns, Silver spot returns, and Platinum returns) exhibit positive interdependence to the stock market returns. Between Industrial Metals and the S&P500, the results suggest that Nickel and Zinc returns exhibit a significant positive interdependence to stock market returns. Other industrial metals in this category, i.e. Aluminum returns, Lead returns, and Tin returns do not exhibit a significant positive interdependence to stock market returns. Lastly, none of the Agriculture produce category, (i.e. Corn, Wheat, Soy and Rubber returns) exhibit positive interdependence to stock market returns.

These results from this paper have important implications for both investors and policymakers. Systematic time series evidence from this paper suggests that commodity market returns have low or no significant positive interdependence to stock market returns. A direct implication of this evidence is likely inclusion of commodities in investment portfolio for diversification benefits. Information regarding interdependence among different asset classes is a critical factor. An investor can maintain a desired rate of return from investment portfolio while reducing the risk level by combining assets that have negative or low correlation. Investors should be concerned about the potential of constructing a portfolio which provides equal or higher rate of return with lower risk. In this case, a direct implication of the results from this dissertation is that a portfolio with commodities is likely to dominate a portfolio without commodities investment.

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Table 1: Descriptive Statistics

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
ALUM	0.0049	0.0000	0.1602	-0.1794	0.0533	0.1721	3.3730
TIN	0.0079	0.0052	0.2321	-0.1532	0.0576	0.4330	4.5575
ZINC	0.0052	0.0032	0.2299	-0.2258	0.0698	0.0126	3.9417
NICKEL	0.0097	0.0100	0.3017	-0.3120	0.0974	-0.1918	3.5036
LEAD	0.0111	0.0109	0.2360	-0.1945	0.0769	-0.0482	3.2041
GOLD	0.0050	-0.0002	0.1895	-0.0947	0.0394	0.7185	5.1180
SILVER	0.0078	0.0050	0.1755	-0.2885	0.0712	-0.2342	4.2154
PLATINUM	0.0094	0.0066	0.2141	-0.1710	0.0523	0.2645	4.4875
WHEAT	0.0070	0.0023	0.2487	-0.2755	0.0724	0.0164	4.5608
COTTON	0.0011	-0.0005	0.2244	-0.2287	0.0801	-0.0113	3.2164
CORN	0.0049	0.0142	0.2715	-0.2701	0.0833	-0.7134	4.3096
SOY	0.0035	0.0051	0.2069	-0.4574	0.0802	-1.2216	8.9563
RUBBER	0.0077	-0.0007	0.2082	-0.1937	0.0735	0.2872	2.9618
SP500	0.0061	0.0101	0.1195	-0.1123	0.0386	-0.3770	3.4177

Table 2: Cross Correlations among variables of interest

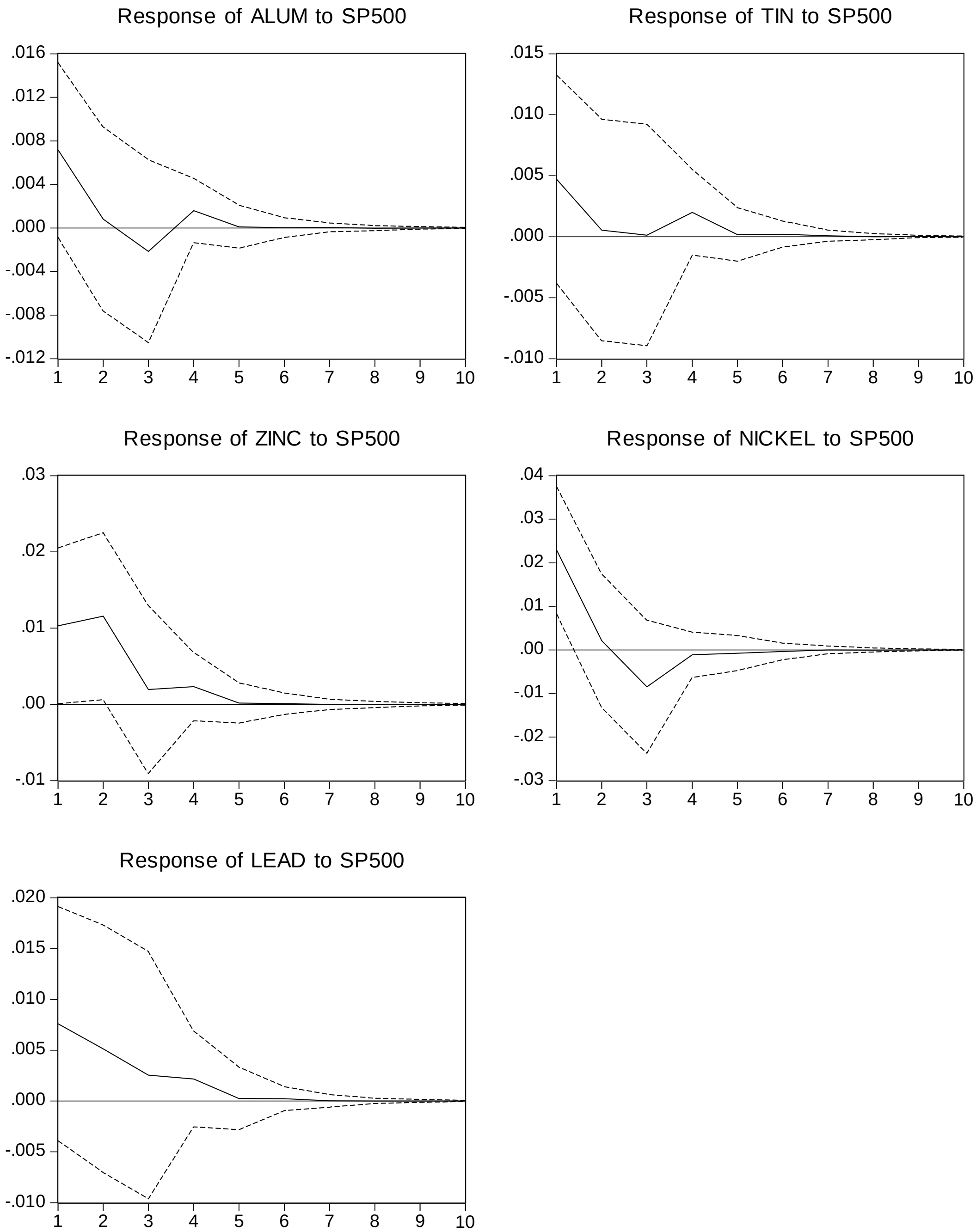
	ALUM	TIN	ZINC	NICKEL	LEAD	GOLD	SILVER	PLATINUM	WHEAT	COTTON	CORN	SOY	RUBBER	SP500
ALUM	1													
TIN	0.412	1												
ZINC	0.486***	0.293***	1											
NICKEL	0.469***	0.374***	0.451***	1										
LEAD	0.419***	0.295***	0.496***	0.356***	1									
GOLD	0.243***	0.220***	0.204***	0.252***	0.221***	1								
SILVER	0.265***	0.280***	0.301***	0.272***	0.323***	0.622***	1							
PLATINUM	0.278***	0.234***	0.265***	0.306***	0.255***	0.536***	0.506***	1						
WHEAT	0.076	0.069	0.123	0.020	0.073	0.209***	0.108	0.085	1					
COTTON	0.055	0.094	0.054	0.038	0.156	0.090	0.040	0.217***	0.053	1				
CORN	0.054	0.177*	0.091	0.093	0.004	0.068	0.076	0.048	0.364***	0.189*	1			
SOY	0.107	0.119	0.018	0.092	0.021	0.106	0.048	0.063	0.264**	0.351***	0.633***	1		
RUBBER	0.129*	0.018	0.015	0.137*	0.011	0.105	0.045	0.210***	-0.013	0.189**	0.015	0.104	1	
SP500	0.162**	0.101	0.170**	0.227***	0.138*	-0.061	0.076	0.070	0.001	-0.037	0.049	0.101	-0.070	1

Note: *, **, *** denote significance at 10%, 5% and 1% respectively

Table 3: Unit root results

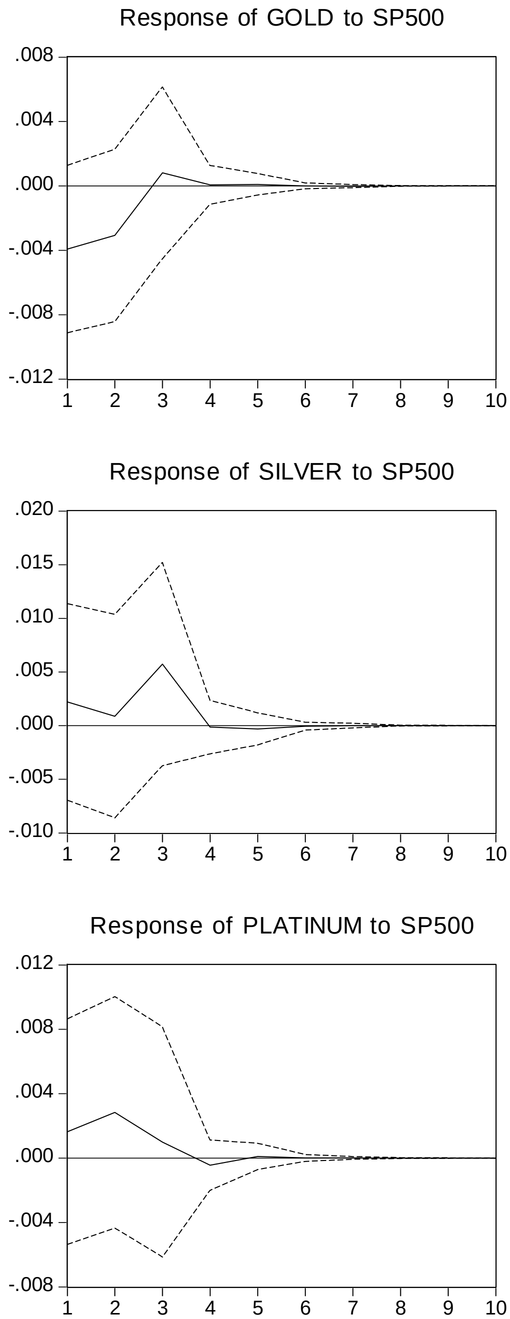
	ADF		PP	
	level	1st Diff	level	1st Diff
ALUM	-15.80	-11.44	-15.77	-108.73
TIN	-14.40	-10.61	-14.43	-102.76
ZINC	-14.27	-12.47	-14.54	-93.37
NICKEL	-14.26	-10.08	-14.27	-104.39
LEAD	-12.70	-12.92	-12.70	-79.10
GOLD	-15.30	-9.86	-15.30	-98.22
SILVER	-16.67	-11.26	-16.74	-96.19
PLATINUM	-14.90	-12.25	-14.92	-92.68
WHEAT	-14.04	-12.12	-14.04	-176.84
COTTON	-15.88	-15.24	-15.87	-37.80
CORN	-12.12	-16.86	-12.19	-67.94
SOY	-15.69	-11.20	-15.68	-199.85
RUBBER	-14.31	-9.58	-14.31	-89.01
SP500	-14.53	-10.25	-14.53	-94.19
1% Critical Value		-3.4389		-3.4388
5% Critical Value		-2.8645		-2.8645
10% Critical Value		-2.5684		-2.5684

Figure 1: Impulse response of Industrial Metal to S&P500



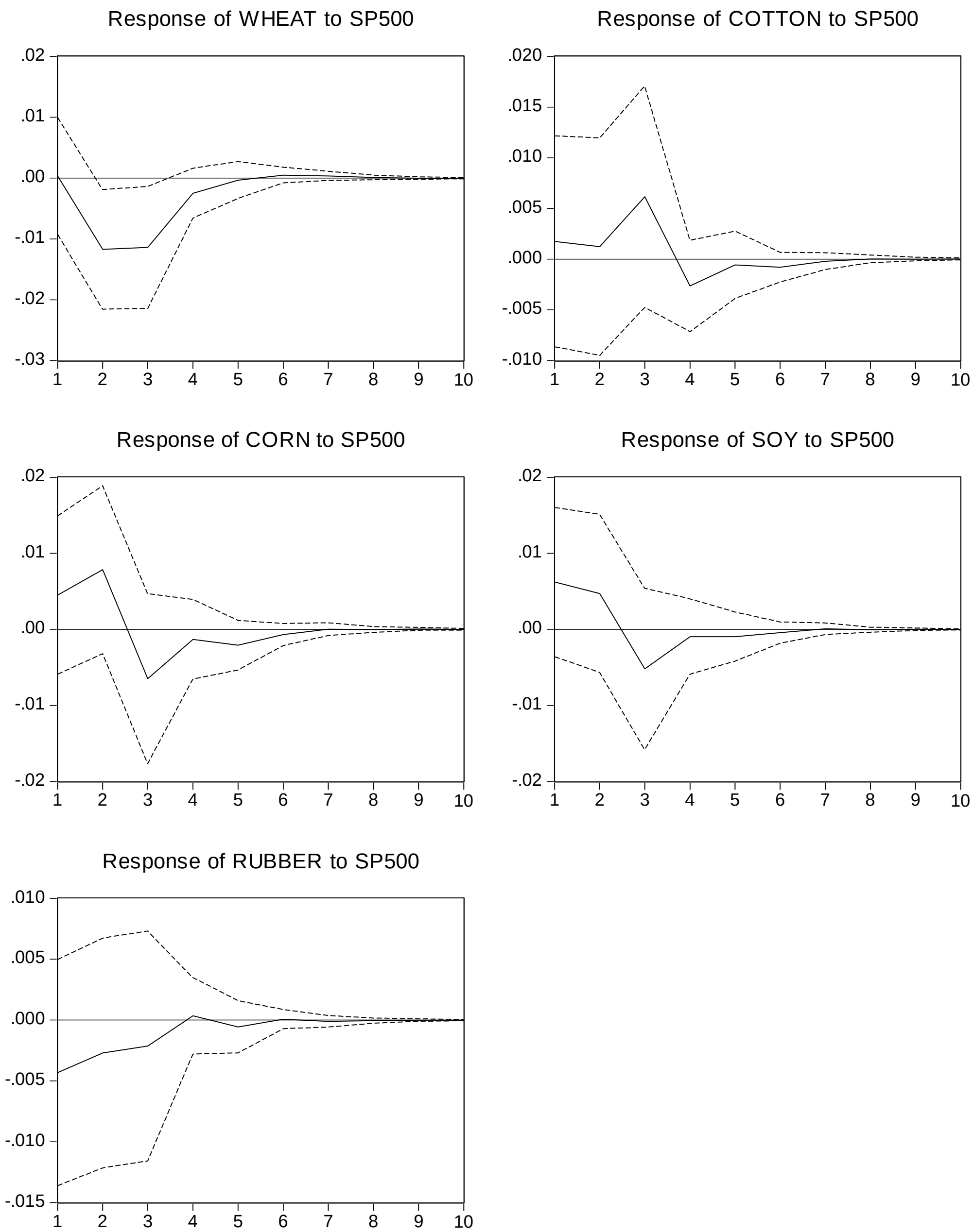
Note: The dashed lines on each graph represent the upper and lower 95% confidence bands. When the upper and lower bounds carry the same sign the response becomes statistically significant.

Figure 2: Impulse response of Precious Metals to S&P500



Note: The dashed lines on each graph represent the upper and lower 95% confidence bands. When the upper and lower bounds carry the same sign the response becomes statistically significant.

Figure 3: Impulse response of Agriculture Produce to S&P500



Note: The dashed lines on each graph represent the upper and lower 95% confidence bands. When the upper and lower bounds carry the same sign the response becomes statistically significant.