



"Determinants of Commodities Co-volatility"

Niaz Bashiri Behmiri
Matteo Manera

Fondazione Eni Enrico Mattei-FEEM
University of Bicocca and FEEM

Determinants of Commodities Co-volatility

This study is about:

Investigating co-volatility between energy and non-energy commodities and estimating the determinant factors which influence those co-volatilities.

- ✓ Co-volatilities are examined between agricultures and metals with energy commodities.
- ✓ The determinant factors that we consider are, macroeconomics fundamentals, physical supply-demand fundamentals and financial market fundamentals.

Determinants of Commodities Co-volatility

Importance:

- ✓ Understanding the origins of volatility has been a topic of considerable interest for both policymakers and market practitioners.
- ✓ To increase the forecasting accuracy of commodity markets co-movements.
- ✓ This results are substantial on hedging strategies, optimal portfolio allocation, and risk management.
- ✓ The price volatility in energy markets is expanding to non-energy commodity markets.
- ✓ With the substitution of fossil fuels by biofuel and hedge strategies against inflation induced by high oil prices, the links have increased.

Determinants of Commodities Co-volatility

Contributions of this study:

- ✓ The importance of financialization in commodity markets.
- ✓ The importance of liquidity in commodity markets.
- ✓ The effect of macroeconomics factors in commodity markets.
- ✓ How uncertainty in stock market transmits to commodity markets.

Determinants of Commodities Co-volatility

Methodology

This analysis is based on two steps:

- ✓ First, a Dynamic Conditional Correlation GARCH (DCC-GARCH) model of Engle (2002) to examine the time-varying conditional correlation between returns of ten commodities.

- ✓ Second, an investigation on determinant factors behind those co-volatilities, using the ARDL approach of Pesaran et al. (1999).

Determinants of Commodities Co-volatility

- **The commodities are:**

- ✓ Energy crops: corn, soybean and wheat.
- ✓ Grains: oats and rice.
- ✓ Metals: gold silver and copper.
- ✓ Fossil fuels: WTI and NG.

- **We categorized the DCC estimations to four panels:**

- ✓ Panel A: Energy Crops-Fossil Fuels.
- ✓ Panel B: Grains-Fossil Fuels.
- ✓ Panel C: Metals-Energy Crops.
- ✓ Panel D: Metals-Fossil Fuels.

Determinants of Commodities Co-volatility

Step 1: Co-volatilities estimations:

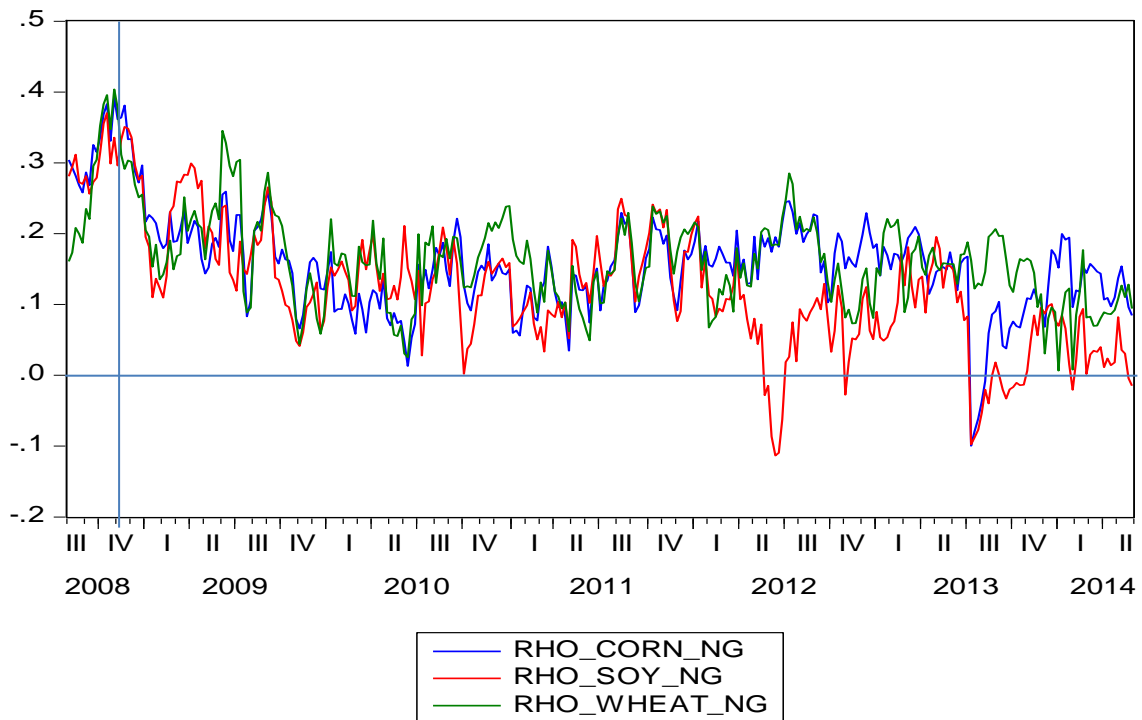
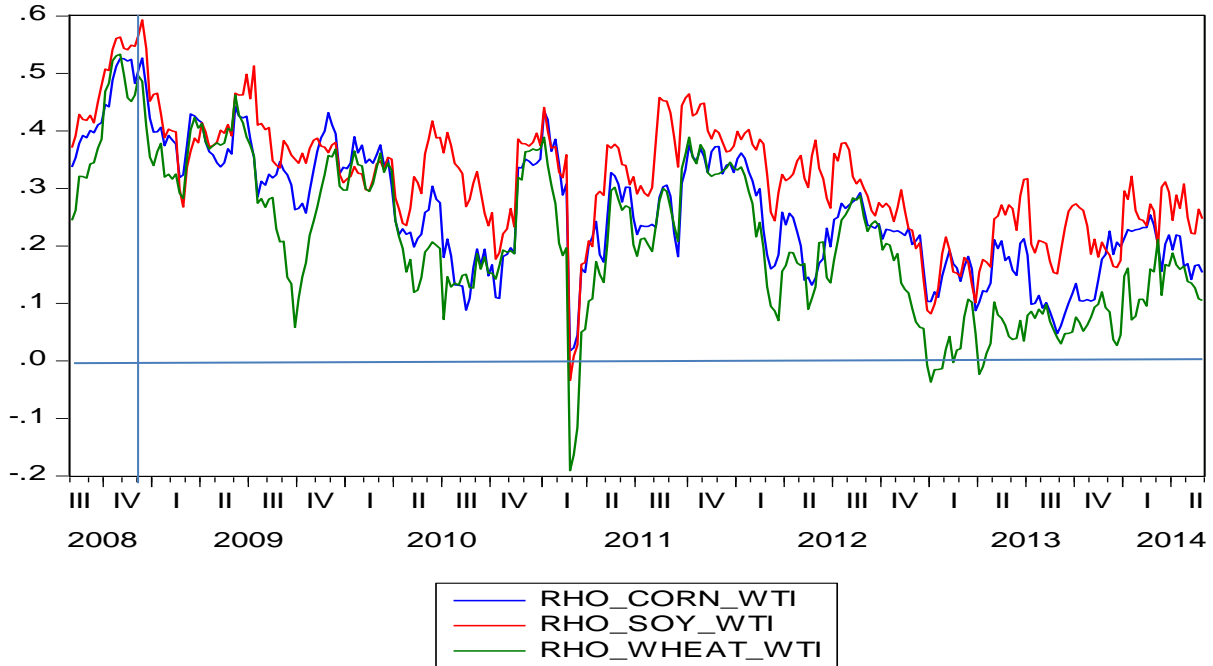
DCC-GARCH Model:

- ✓ The DCC model approximates a dynamic conditional correlation matrix.
- ✓ A DCC model permits us to evaluate whether the level of interdependence between markets changes across the time.
- ✓ This approach is based on two steps:
 1. **GARCH** estimations; to obtain the volatility series.
 2. **DCC** estimations; to obtain the co-volatility or conditional correlations series.

Determinants of Commodities Co-volatility

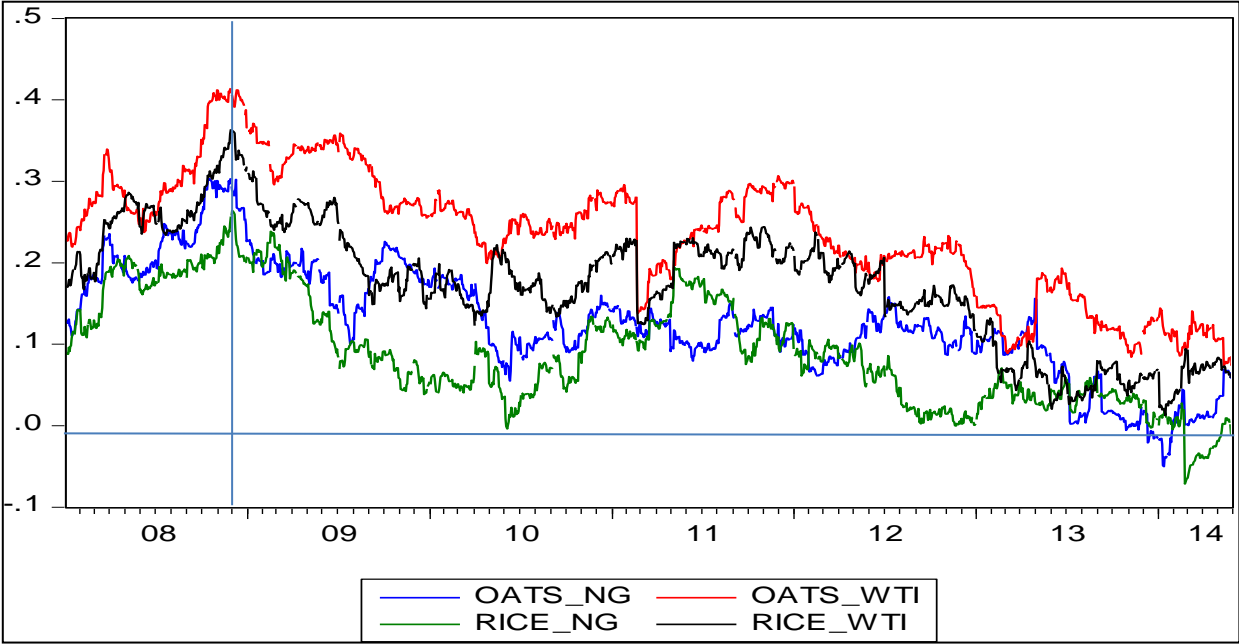
The series of Conditional correlations among commodities, obtained from DCC estimations:

Panel A. Energy Crops-Fossil Fuels



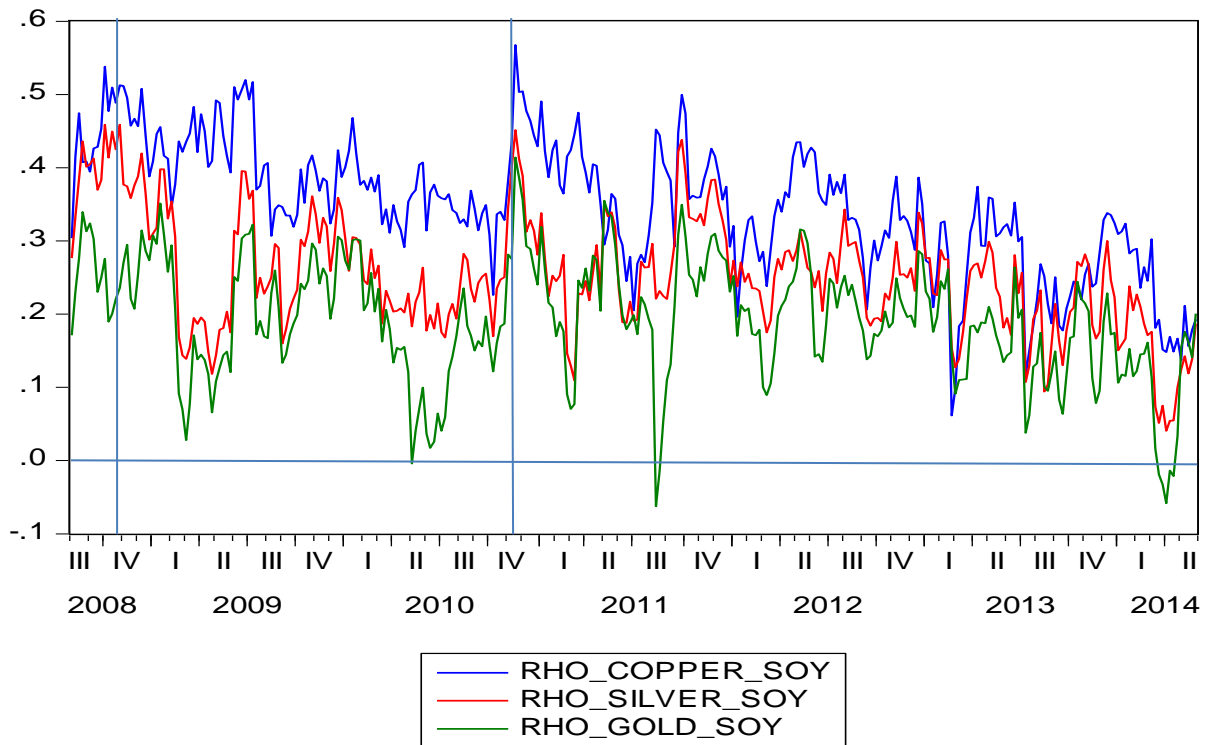
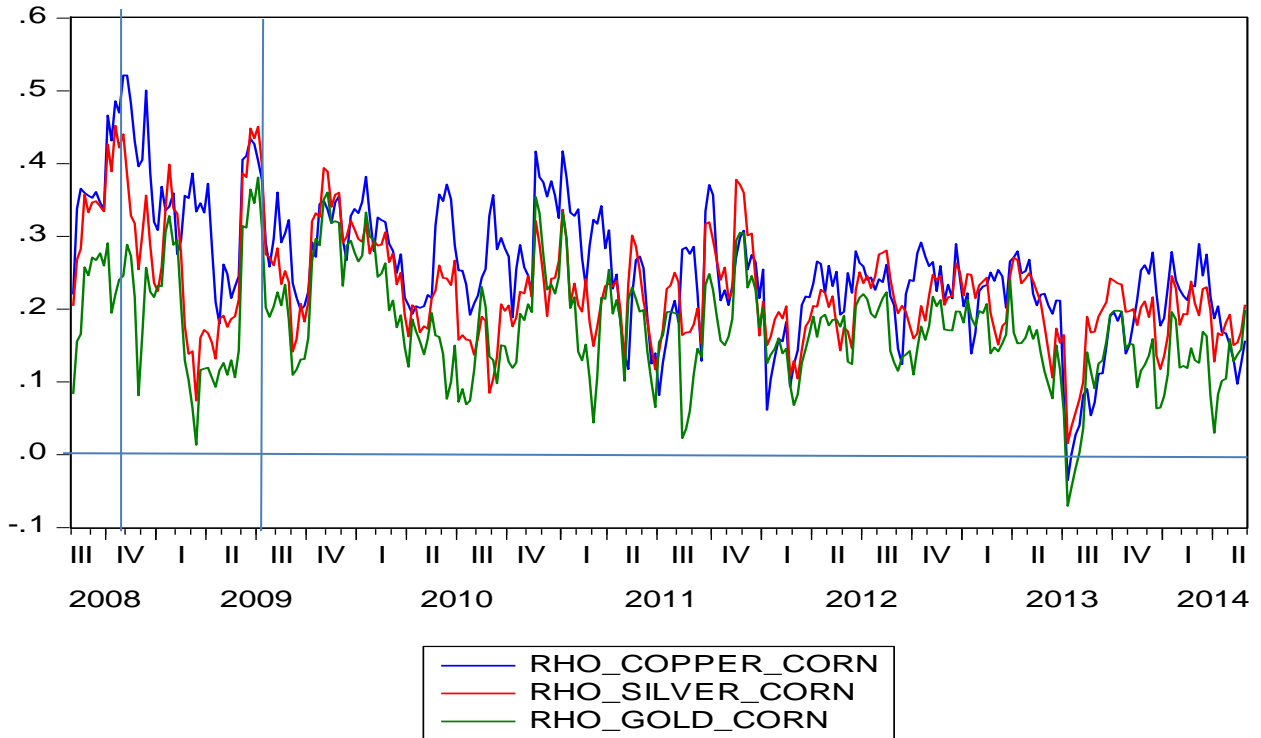
Determinants of Commodities Co-volatility

Panel B. Grains-Fossil Fuels



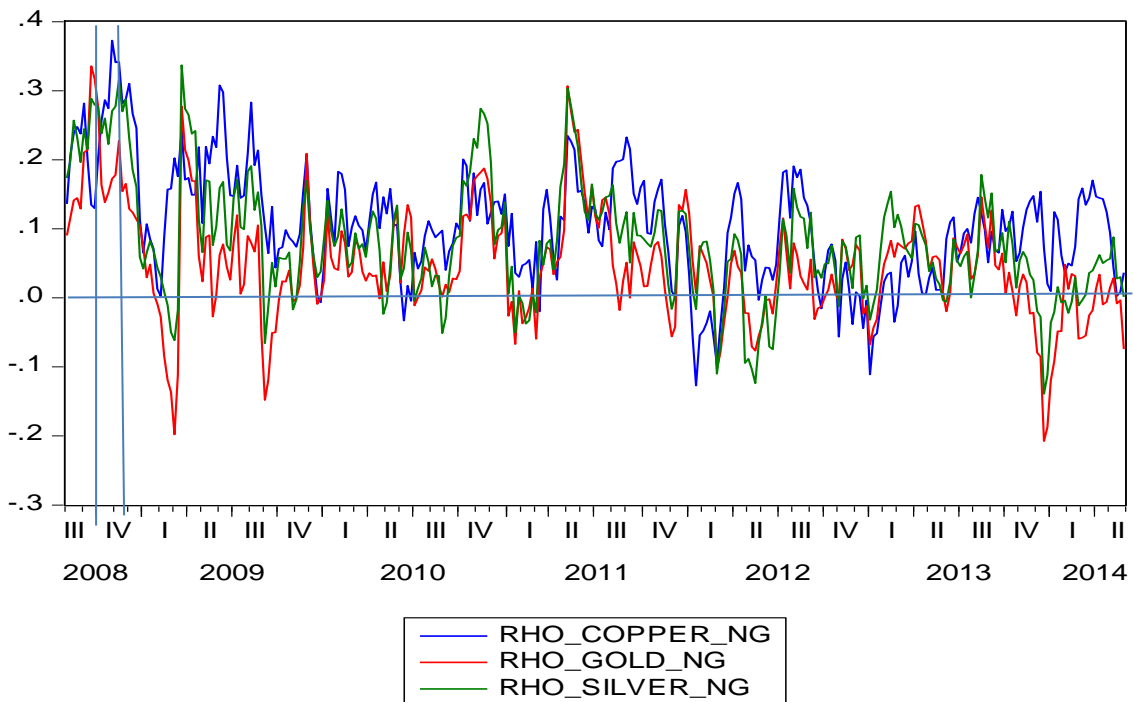
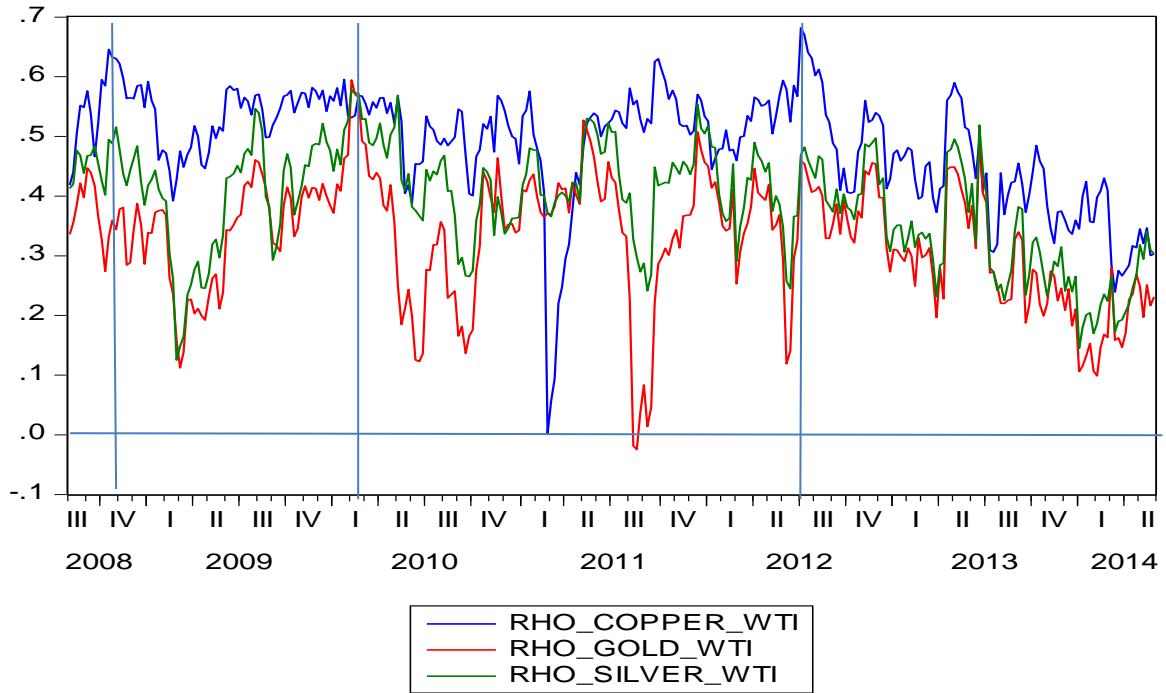
Determinants of Commodities Co-volatility

Panel C. Metals-Energy crops



Determinants of Commodities Co-volatility

Panel D. Metals-Fossil Fuels



Determinants of Commodities Co-volatility

Step 2: Determinants of commodities co-volatility:

The ARDL Bounds testing model:

We demonstrate an analysis to measure determinant factors behind those co-volatilities, using ARDL approach of Pesaran et al. (1999).

✓ Dependent variable:

DCC: Conditional correlation or co-volatility of commodities.

✓ Independent variables:

W: intercept

X: Vector of determinant factors.

L_D: Post Lehman period, as dummy variable, from September 2008-March 2010.

D: Seasonal dummies and time trend.

Determinants of Commodities Co-volatility

X, Vector of determinant factors:

The determinant factors which might effect on markets co-volatilities, as X , is categorized under three groups:

- a) Macroeconomics Fundamentals.**
- b) Physical supply and demand fundamentals.**
- c) Financial market fundamentals.**

Determinants of Commodities Co-volatility

X, Vector of determinant factors:

a) Macroeconomics Fundamentals:

ADS: Aruoba-Diebold-Scotti Business Conditions Index. From Federal reserve Bank of Philadelphia. This index is designed to track real business conditions of US at high frequency.

TR3: Three Months Treasury Bills, obtained from FRED.

EX: Trade weighted US Dollar Index, Broad Index, obtained from FRED.

INF: online data of retailers prices, obtained from PriceStat.

Determinants of Commodities Co-volatility

X, Vector of determinant factors:

b) Physical supply and demand fundamentals:

- ✓ **Avr-Inv:** Average of markets inventories.

c) Financial market fundamentals:

- ✓ **Avr-T:** Average of markets speculations (Working-T index).
- ✓ **Avr-Liq:** Average of markets liquidities (Trading Volume/Open Interest).
- ✓ **VIX:** The fear index, which is a measure of the implied volatility of S&P 500 index options. Market's expectation of stock market volatility over the next 30 days period.

Determinants of Commodities Co-volatility

The results of the ARDL estimations:

Panel A.

Energy Crops_Fossil Fuels									
	Macroeconomics Fundamentals				Supply-Demand Fundamental	Financial Market Fundamentals			Events
	ADS	TR3	Ex	INF	Avr_Inv	Avr_Liq	Avr_T	VIX	Lehman
Corn_WTI				0.12 (0.02)	-2.6e-6 (0.00)		-0.86 (0.01)	0.00 (0.00)	0.11 (0.00)
Corn_NG	-0.05 (0.00)				-1.5e-5 (0.02)				
Soybean_WTI					-4.3e-6 (0.00)			0.00 (0.00)	
Soybean_NG	-0.03 (0.09)							0.00 (0.05)	
Wheat_WTI						-0.09 (0.02)	-1.08 (0.08)		0.12 (0.00)
Wheat_NG	-0.03 (0.01)								

Panel B.

Grains_Fossil Fuels									
	Macroeconomics Fundamentals				Supply-Demand Fundamental	Financial Market Fundamentals			Events
	ADS	TR3	Ex	INF	Avr_Inv	Avr_Liq	Avr_T	VIX	Lehman
Rice_WTI				-0.00 (0.00)	-0.00 (0.00)			0.00 (0.00)	
Rice_NG	-0.05 (0.00)			-0.00 (0.00)	-0.00 (0.00)			0.00 (0.01)	-0.05 (0.00)
Oats_WTI				-0.01 (0.00)	-0.02 (0.04)	-0.03 (0.08)	0.62 (0.01)	0.00 (0.00)	0.04 (0.06)
Oats_NG	-0.02 (0.07)			-0.00 (0.05)					0.06 (0.02)

Determinants of Commodities Co-volatility

The results of the ARDL estimations:

Panel C.

Metals_Energy Crops									
	Macroeconomics Fundamentals				Supply-Demand Fundamental	Financial Market Fundamentals			Events
	ADS	TR3	Ex	INF	Avr_Inv	Avr_Liq	Avr_T	VIX	Lehman
Copper_Corn			0.00 (0.01)	0.07 (0.01)	-0.00 (0.00)		-1.07 (0.00)	0.00 (0.08)	0.04 (0.00)
Copper_Soybean	-0.03 (0.01)	-0.00 (0.07)		0.10 (0.01)			-0.89 (0.00)	0.00 (0.02)	0.03 (0.07)
Gold_Corn			-0.00 (0.07)	-0.00			-0.67 (0.00)		0.07 (0.00)
Gold_Soybean	0.02 (0.01)		0.00 (0.01)	0.05 (0.00)					-0.02 (0.05)
Silver_Corn			-0.00 (0.06)			-0.02 (0.05)	-0.46 (0.08)		0.08 (0.00)
Silver_Soybean	-0.03 (0.00)		-0.00 (0.01)						

Panel D.

Metals_Fossil Fuels									
	Macroeconomics Fundamentals				Supply-Demand Fundamental	Financial Market Fundamentals			Events
	ADS	TR3	Ex	INF	Avr_Inv	Avr_Liq	Avr_T	VIX	Lehman
Copper_WTI			-0.01 (0.00)	-0.15 (0.02)	0.00 (0.04)				0.08 (0.06)
Copper_NG				0.08 (0.05)	-0.00 (0.01)	-0.02 (0.08)		0.00 (0.00)	
Gold_WTI		0.00 (0.03)			0.00 (0.01)			-0.00 (0.04)	0.15 (0.00)
Gold_NG	-0.03 (0.07)								
Silver_WTI		0.00 (0.02)			-0.00 (0.01)			-0.00 (0.09)	
Silver_NG		0.00 (0.05)	-0.01 (0.02)			-0.04 (0.00)			-0.08 (0.04)

Determinants of Commodities Co-volatility

Discussion the results:

ADS:

- ✓ The coefficient of ADS is consistently negative, when it is statistically significant, for eight DCCs series.
- ✓ This confirms the intuition that cross-market correlations increase in globally bad economic times.

TR3:

- ✓ No effect from TR3 is found on DCCs for panels of agricultures-fossil fuels, and three negative effects on DCCs of panels of metals-energies.

Determinants of Commodities Co-volatility

Discussion the results:

US exchange rate:

- ✓ Strengthening the US exchange rate calms the markets.
- ✓ This leads to a consistently negative relation between DCCs and the US exchange rate for nine cases.

Inflation:

- ✓ Higher inflation has effect on five DCCs, and is a mixture of positive and negative effects.

Determinants of Commodities Co-volatility

Discussion the results:

Inventory:

- ✓ Higher inventory level calms the commodity markets and lower inventory level leads to an instability in commodity markets.
- ✓ Therefore, increasing average of inventories leads to a lower co-volatility for nine DCCs as a result of less volatile markets.
- ✓ For two cases it strengthens the co-volatilities (copper-WTI and gold-WTI), this is due to the inventory interaction effect from WTI to copper and gold volatilities.

Determinants of Commodities Co-volatility

Discussion the results:

Liquidity:

- ✓ It shows significant effect on five DCCs.
- ✓ They are consistently negative.
- ✓ A more liquid market is less volatile and less correlated.

Speculation:

- ✓ The effect of speculation on volatility of commodities is not very well known.
- ✓ Our results confirm that there is a negative relation between speculations and DCCs for six cases, and positive for one DCC, suggesting that increasing speculation decreases cross market correlations.
- ✓ However, the effect is not strong.

Determinants of Commodities Co-volatility

Discussion the results:

VIX:

- ✓ Higher uncertainty in stock market consistently increases co-volatility of commodities.
- ✓ Higher fear leads to more volatile and correlated markets.

Lehman crash:

- ✓ Leads to increasing of ten DCCs, suggesting that cross-market correlations increase in bad economic situations.

Determinants of Commodities Co-volatility

Summary:

1. Inventories show the highest evidence of significance. However TR3 and liquidity has the least effects.
2. The US business cycles and the US exchange rate show the highest evidence of significance.
3. VIX, show the highest evidence of significance. There are some evidences of the reverse effects from speculation and liquidity to intensity of co-volatilities. But not highly evidenced.

Determinants of Commodities Co-volatility

The future works:

- ✓ Investigating the asymmetric effects of the determinant factors on co-volatilities.
- ✓ Examining those effects on other markets, such as Europe and emerging markets.
- ✓ Conducting a comparative study among the net oil exporting and net oil importing nations.