

# Hedgers' Reaction to Price Changes in Commodity Futures Markets: Evidence from Mixed-Frequency Data

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Regulation and Financialization”*

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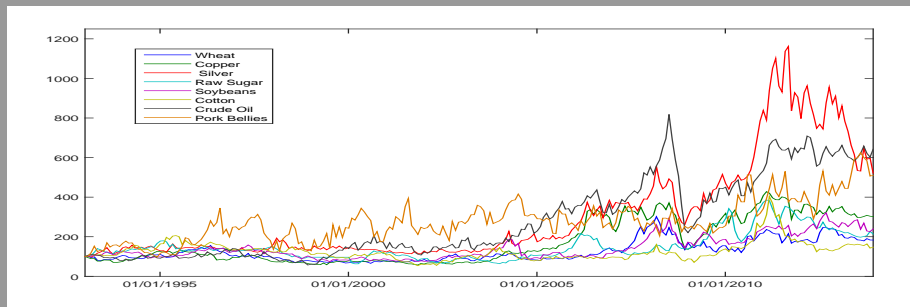
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# The price of oil (Cushing, OK WTI Spot Price FOB) in the last 20 years



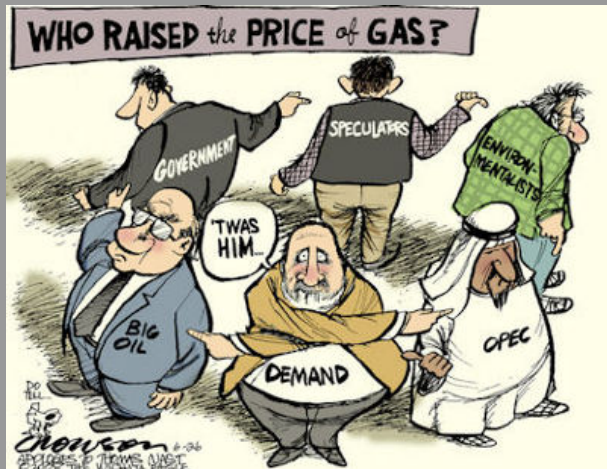
- July 3, 2008: \$145.31
- December 28, 2008: \$30.28

# The price of several commodities in the last 20 years



- After 2005: pronounced booms and busts

# Who raised the price of oil?

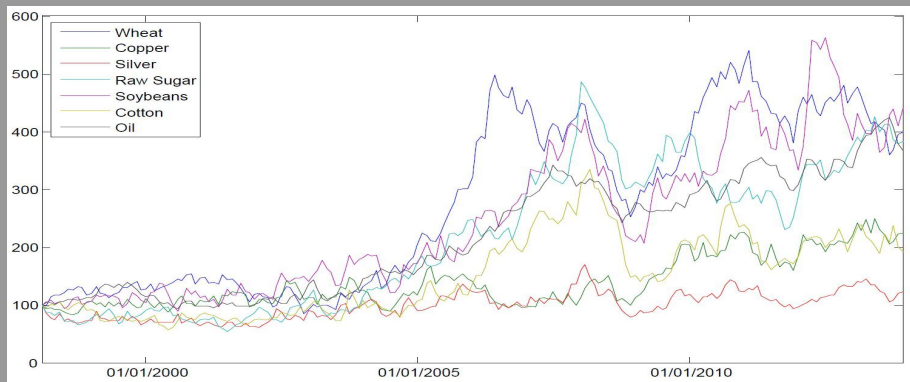


# Open Interest for the WTI futures contracts (NYMEX) over the 2000-2015 period



- September 25, 2001: 401,609
- August 13, 2013: 1,934,420

# Total Open Interest of several commodities in the last 20 years



# The Financialization of Commodity Markets

- Large increase of open interest in commodity futures markets since 2003-4.
- Significant increase of “non-commercial” participants (speculators) positions in commodity markets.
- Potential benefits from speculation are well-known:
  - ⇒ allow better risk-sharing
  - ⇒ liquidity provider (decrease risk premium) following Keynes’ theory of normal backwardation
  - ⇒ facilitate price discovery through better informational efficiency
- But ...

# The Financialization of Commodity Markets

- Serious concerns about the impact of speculative trading on energy prices after the 2008 boom-and-bust (Master's Hypothesis).
- This is the central issue of the recent flow of contributions about the financialization of commodity markets:
  - See Büyükşahin and Harris (2011), Tang and Xiong (2012), Fattouh et al. (2013), Acharya et al. (2013), Alquist and Gervais (2013), Basak and Pavlova (2014), Cheng and Xiong (2014a,b), Büyükşahin and Robe (2014), Manera et al. (2014), Juvenal and Petrella (2015), Le Pen and Sévi (2015), Cheng et al. (2015), Knittel and Pindyck (2015).
- To the question: How have speculative positions influenced prices?
  - ⇒ the empirical responses have been rather negative.



# The Dodd-Frank Act and the position limits issue

Chairman Tim Massad did not commit to a particular course of action, but emphasized that the CFTC is not trying to attack *bona fide* hedgers or “drive speculators out of the market.” He explained that Congress, in drafting Dodd-Frank, “directed us to implement limits to address the risk of excessive speculation,” but he stressed that he is “very committed” to making sure that the markets work for participants and making sure that people “can still engage in bona fide hedging.” (February 26, 2015, Public Meeting organized by CFTC).



# The issue of position limits

- Still a very hot topic for regulators despite the 2008-2009 boom-bust is almost 7 years old.
- Popular view is that if speculators have to be alleged to influence prices then speculators should be imposed position limits to deal with excessive speculation.

# Our paper

- To ascertain the idea that CFTC should apply position limits to some categories of traders, we should improve our understanding of the respective behaviors of these traders in commodity markets.
- In particular:

**What is the response of hedgers (and speculators) to changes in futures prices?**

- This is the inverse issue of the literature dealing with the Masters' Hypothesis.

# Early existing work

- Sanders, Boris and Manfredo (2004)
  - ⇒ consider 4 energy commodities over the 1992-1999 period (weekly observations)
  - ⇒ “commercials” vs. “non-commercials” using the standard COT provided by the CFTC
  - ⇒ show that speculators follow momentum strategies while hedgers trade as contrarians
- Wang (2003)
  - ⇒ similar evidence for 15 U.S. futures markets controlling for sentiment and financial conditions
  - ⇒ consider the 1992-2000 period (monthly observations)
- Sanders, Irwin and Merrin (2009)
  - ⇒ similar evidence for 10 agricultural commodities
  - ⇒ study the 1995-2006 period using weekly data

## Recent existing work

- Kang, Rouwenhorst and Tang (2014) make use of Fama-MacBeth regressions to study the liquidity provision issue for 26 commodities over the 1994-2012 (weekly observations)
  - ⇒ also show that speculators follow momentum strategies while hedgers trade as contrarians
  - ⇒ present hedgers as liquidity providers and speculators as liquidity consumers
- Fishe, Janzen and Smith (2014) provide similar evidence for 6 agricultural commodities
  - ⇒ use weekly data for the 2006-2012 period from DCOT
- Cheng and Xiong (2014) provide similar evidence for 4 agricultural commodities using monthly data computed using the DCOT. 2007-2011 (monthly data)
  - ⇒ also show that the level of hedging activity is far beyond what could be expected from variations in expected output
  - ⇒ and that changes in hedging positions cannot be explained by changes in expected output

# Contribution

- No existing work (to our knowledge) about the impact of prices on positions:
  - ⇒ dealing with the **mixed frequency** feature of prices (daily) and positions (weekly) data
    - loss of information when aggregating daily data at the weekly or monthly frequency
  - ⇒ looking at long and short positions separately
    - considering the net long position only may hide interesting characteristics of traders' practices
  - ⇒ asymmetric effect of positive and negative returns

# Results

- We show that all these characteristics are essential for our understanding of trading in commodity futures markets:
  - ⇒ Mi(xed) Da(ta) S(ampling) (MIDAS, Ghysels et al. (2005, 2006)) regression bring insights into the understanding of the relationship between returns and positions.
  - ⇒ long and short traders reaction to price changes
  - ⇒ hedgers, as a group, do not behave in energy futures markets as they do in other commodity markets
- To summarize our results:
  - ⇒ hedgers (in aggregate) trade as contrarians for agricultural and metal commodities
  - ⇒ no relationship between prices and hedgers' positions for energy commodities
  - ⇒ opposite result to Sanders et al. (2004): energy financial markets have evolved!

# Positions of market participants

- Publicly available from CFTC through the weekly (each Friday for the previous Tuesday) Commitments of Traders (COT) reports
- Aggregate long, short and spread positions of market participants above a given threshold (350 for oil, 150 for wheat, 100 for cotton...)
- In the genuine COT reports, traders are classified according to their (commercial) interest: commercials, non-commercials, other non-reportable
- From 2006/2007 on, a finer partitioning of aggregate position from the Disaggregate Commitment of Traders (DCOT)
- Commercials divided between:  
(Producers/Merchants/Processors/Users) and (Swap dealers)
- Non-Commercials divided between:  
(Managed money) and (other reportable)



- 8 commodities
  - ⇒ energy: crude oil, natural gas
  - ⇒ softs: coffee, sugar
  - ⇒ metals: gold, silver
  - ⇒ grains: corn, wheat
- Daily returns and weekly positions (CFTC data)
  - Producers/Merchants/Processors/Users: hedgers
  - Managed money: speculators
- Sample period
  - ⇒ June 2006- February 2015 for crude oil, natural gas, corn, wheat, gold and silver
  - ⇒ August 2007- February 2015 for coffee and sugar

# MIDAS: Mi(xed) Da(ta) S(ampling)

- MIDAS (Ghysels et al. (2005, 2006)) regression combines data sampled at different frequencies
  - Avoid the loss of information in the aggregation process
  - Still a tractable regression thanks to parsimonious functional lags
- $\Delta POS_t = \frac{Q_t - Q_{t-1}}{OI_{t-1}}$ : weekly variation of the position  $Q_t$  normalized by open interest  $OI_{t-1}$  (the low frequency variable)
- $t$ : the time unit of the lower frequency variable  $Q_t$  (week)
- $R_t^{(m)}$ : **daily** return (the higher frequency variable sampled  $m$  times between  $t-1$  and  $t$ )
- $R_{t-d}^{(m)}$  return  $d$  days before week  $t$

# MIDAS Regression

$$\Delta POS_t = c + \beta \sum_{d=0}^{D-1} b_d(\theta_1, \theta_2) R_{t-d}^{(m)} + \sum_{p=1}^P \phi_p \Delta POS_{t-p} + \varepsilon_t$$

with the weights (exponential almon lag):

$$b_{j-1}(\theta_1, \theta_2) = \frac{\exp(\theta_1 j + \theta_2 j^2)}{\sum_{j=1}^D \exp(\theta_1 j + \theta_2 j^2)}$$

$$\sum_{j=1}^D b_j(\theta_1, \theta_2) = 1$$

The  $D$  coefficients  $b_j(\theta_1, \theta_2)$  of daily returns depend only on  $\theta_1, \theta_2$

# Estimation procedure

- Maximum number of contemporaneous and lagged daily returns  $D=15$  (robustness check with  $D=20$  lags)
- Choice of the AR lag  $p = \{1, \dots, 4\}$  by minimizing the BIC criterion in the symmetric model
- Nonlinear least squares estimation
- Numerical optimization with 50 random draws of the initial values of the parameters
- Estimated standard errors robust to HAC

# Estimation results: symmetric MIDAS

## Table: Hedgers

### LONG POSITIONS

	Oil	Natural Gas	Coffee	Sugar	Gold	Silver	Corn	Wheat
const.	0.0003 (0.001)	0.0000 (0.001)	0.0006 (0.002)	0.0002 (0.002)	0.0002 (0.001)	0.0003 (0.001)	0.0002 (0.001)	0.0001 (0.001)
$\beta$	0.194 (0.172)	-0.0741 (0.082)	-0.7351*** (0.277)	-0.2702 (0.218)	-0.6578* (0.379)	-0.3605 (0.224)	-0.316* (0.168)	-0.3548** (0.151)
$R^2$	0.06	0.02	0.12	0.12	0.06	0.04	0.12	0.07
LM.flat	5.37 [0.02]	6.01 [0.01]	35.31 [0.00]	12.19 [0.00]	10.62 [0.00]	3.68 [0.06]	33.26 [0.00]	16.68 [0.00]

### SHORT POSITIONS

	Oil	Natural Gas	Coffee	Sugar	Gold	Silver	Corn	Wheat
const.	0.0002 (0.001)	0.0000 (0.001)	-0.0012 (0.002)	0.0001 (0.002)	-0.0010 (0.002)	-0.0002 (0.002)	-0.0004 (0.001)	-0.0009 (0.001)
$\beta$	0.2213 (0.274)	0.1476 (0.108)	2.5743*** (0.702)	1.1241** (0.478)	2.7436*** (0.731)	1.15*** (0.385)	1.2438*** (0.247)	1.4536*** (0.295)
$R^2$	0.01	0.03	0.39	0.19	0.30	0.22	0.48	0.41
LM.flat	3.27 [0.07]	4.28 [0.04]	61.20 [0.00]	37.79 [0.00]	67.96 [0.00]	35.55 [0.00]	79.81 [0.00]	108.29 [0.00]

Notes: \*\*\*, \*\* and \* respectively denotes rejection of the null hypothesis of no significance at 1%, 5 % and 10 % levels.

# Estimation results: symmetric MIDAS

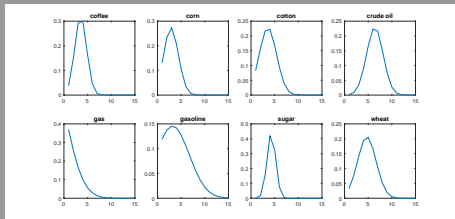
## Table: Speculators

LONG POSITIONS								
	oil	gas	coffee	sugar	gold	silver	corn	wheat
const.	0.0004 (0.001)	0.0003 (0.001)	-0.0005 (0.001)	0.0000 (0.001)	-0.0009 (0.002)	-0.0001 (0.002)	-0.0001 (0.001)	-0.0002 (0.001)
$\beta$	0.3679* (0.199)	0.2294* (0.138)	1.4263*** (0.55)	0.5877** (0.266)	3.1372*** (0.781)	1.3092*** (0.493)	0.836*** (0.215)	0.6429*** (0.185)
$R^2$	0.15	0.07	0.31	0.20	0.37	0.30	0.30	0.23
LM flat	41.21 [0.00]	22.79 [0.00]	50.86 [0.00]	37.41 [0.00]	93.57 [0.00]	72.50 [0.00]	47.93 [0.00]	52.25 [0.00]
SHORT POSITIONS								
const.	0.0000 (0.001)	0.0005 (0.001)	0.0008 (0.001)	0.0004 (0.001)	0.0007 (0.001)	0.0005 (0.001)	0.0004 (0.001)	0.0007 (0.002)
$\beta$	-0.4097** (0.187)	-0.4867*** (0.181)	-1.6392*** (0.407)	-0.7115*** (0.26)	-1.5198*** (0.482)	-0.6468*** (0.251)	-0.7425*** (0.229)	-1.1452*** (0.364)
$R^2$	0.13	0.16	0.38	0.25	0.20	0.21	0.28	0.27
LM flat	20.36 [0.00]	44.52 [0.00]	56.50 [0.00]	44.05 [0.00]	36.82 [0.00]	25.69 [0.00]	36.69 [0.00]	49.21 [0.00]

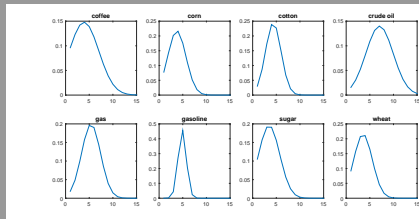
Notes: \*\*\*, \*\* and \* respectively denotes rejection of the null hypothesis of no significance at 1%, 5 % and 10 % levels.

# Estimated weights

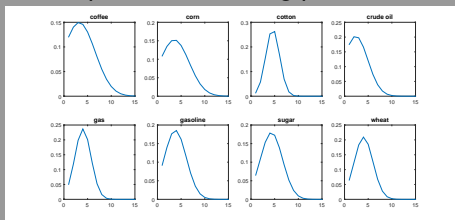
## Hedgers - Long position



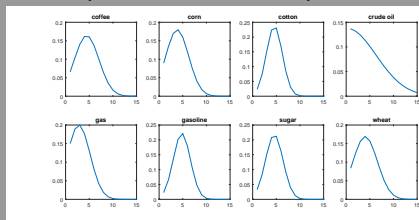
## Hedgers - Short position



## Speculators - Long position



## Speculators - Short position



# Comments on symmetric MIDAS

- Hedgers
  - trade agricultural commodities and metals as contrarians:  $\beta < 0$  for long positions and  $\beta > 0$  for short positions
  - no impact of past and contemporaneous prices on their long and short positions for energy commodities:  $\beta$  not significant
- Speculators
  - trade all commodities as trend-followers:  $\beta > 0$  for long positions and  $\beta < 0$  for short positions
- Flat aggregation scheme rejected and persistence of the impact of prices up to 10 days
- Improved  $R^2$  relative to the reference literature



Is the response of position the same for an increase or a decrease in prices?

MIDAS regression with asymmetric effect

$$\Delta POS_t = c + \beta^+ \sum_{d=0}^{D-1} b_d(\theta_1^+, \theta_2^+) R_{t-d}^{(m)} \times I(R_{t-d}^{(m)} \geq 0) + \beta^- \sum_{d=0}^{D-1} b_d(\theta_1^-, \theta_2^-) R_{t-d}^{(m)} \times I(R_{t-d}^{(m)} < 0) + \sum_{p=1}^P \phi_p Y_{t-p} + \varepsilon_t$$

- Two lag structures for positive and negative returns (exponential almon lag)
- $I(\cdot)$ : indicator variable which separate positive and negative returns

# Estimation results: asymmetric MIDAS

## Table: Hedgers

LONG POSITIONS								
	oil	gas	coffee	sugar	gold	silver	corn	wheat
const.	-0.0002 (0.002)	-0.0001 (0.001)	-0.0026 (0.005)	0.0026 (0.003)	0.0006 (0.005)	0.0003 (0.003)	-0.0017 (0.002)	-0.0007 (0.003)
$\beta^+$	0.2509 (0.231)	-0.0611 (0.42)	-0.5457 (0.353)	-0.5432* (0.33)	-0.8168 (0.894)	-0.3846 (0.289)	-0.1661 (0.197)	-0.3007* (0.182)
$\beta^-$	0.181 (0.192)	-0.0597 (0.064)	-0.9799** (0.436)	-0.2237 (0.257)	-0.7368* (0.384)	-0.387* (0.227)	-0.4191** (0.207)	-0.4005* (0.225)
$R^2$	0.07	0.02	0.12	0.13	0.07	0.05	0.13	0.07
LM_flat	6.47 [0.01]	9.09 [0.00]	34.94 [0.00]	13.58 [0.00]	12.91 [0.00]	6.97 [0.01]	36.30 [0.00]	18.14 [0.00]
F_asym	1.32 [0.25]	3.17 [0.08]	1.94 [0.16]	3.57 [0.06]	2.43 [0.12]	3.39 [0.07]	3.87 [0.05]	1.96 [0.16]
SHORT POSITIONS								
const.	-0.0017 (0.002)	0.0000 (0.002)	0.0026 (0.007)	0.0065 (0.006)	-0.0017 (0.005)	0.0022 (0.004)	0.0030 (0.003)	-0.0018 (0.004)
$\beta^+$	0.3352 (0.241)	0.1328 (0.092)	2.3245*** (0.76)	0.6438 (0.474)	2.9956*** (1.095)	1.0233** (0.493)	1.0603*** (0.318)	1.5282*** (0.424)
$\beta^-$	0.0983 (0.175)	0.1152 (0.118)	2.8347*** (0.819)	1.5255** (0.6)	2.8997*** (0.986)	1.3173*** (0.423)	1.5067*** (0.391)	1.4099*** (0.357)
$R^2$	0.02	0.05	0.40	0.22	0.31	0.23	0.49	0.41
LM_flat	5.57 [0.02]	11.92 [0.00]	58.93 [0.00]	48.37 [0.00]	72.04 [0.00]	38.97 [0.00]	82.01 [0.00]	110.54 [0.00]
F_asym	5.07 [0.02]	8.06 [0.00]	3.47 [0.06]	17.19 [0.00]	6.02 [0.01]	6.18 [0.01]	6.72 [0.01]	3.14 [0.08]

# Estimation results: asymmetric MIDAS

## Table: Speculators

LONG POSITIONS								
	oil	gas	coffee	sugar	gold	silver	corn	wheat
const.	0.0002 (0.002)	0.0019 (0.002)	0.0085 (0.005)	0.0035 (0.003)	0.0030 (0.005)	0.0072* (0.004)	0.0022 (0.003)	0.0003 (0.003)
$\beta^+$	0.405* (0.223)	0.2205 (0.139)	1.0277* (0.565)	0.3158 (0.221)	2.7516*** (0.913)	0.8524 (0.556)	0.7006** (0.272)	0.6649*** (0.246)
$\beta^-$	0.3864* (0.2)	0.3486* (0.198)	2.2186*** (0.639)	0.7943** (0.364)	3.5856*** (1.013)	1.7419*** (0.52)	0.9993*** (0.282)	0.7285*** (0.254)
$R^2$	0.16	0.10	0.35	0.21	0.38	0.34	0.32	0.23
LM_flat	41.87 [0.00]	33.90 [0.00]	58.64 [0.00]	41.68 [0.00]	95.95 [0.00]	89.26 [0.00]	55.92 [0.00]	55.78 [0.00]
F_asym	1.50 [0.22]	13.15 [0.00]	22.99 [0.00]	8.46 [0.00]	3.83 [0.05]	28.61 [0.00]	10.83 [0.00]	5.00 [0.03]
SHORT POSITIONS								
const.	0.0013 (0.002)	-0.0002 (0.003)	0.0039 (0.005)	0.0024 (0.003)	0.0040 (0.003)	0.0059 (0.004)	0.0019 (0.003)	0.0055 (0.005)
$\beta^+$	-0.5108** (0.203)	-0.4648** (0.205)	-1.8206*** (0.524)	-0.8417** (0.368)	-1.9547*** (0.651)	-0.9231** (0.389)	-0.9858*** (0.323)	-1.4199*** (0.427)
$\beta^-$	-0.3384** (0.155)	-0.5292** (0.248)	-1.4149** (0.55)	-0.5713* (0.301)	-1.2363** (0.481)	-0.2495** (0.112)	-0.7871*** (0.265)	-0.8219** (0.41)
$R^2$	0.15	0.16	0.39	0.27	0.21	0.24	0.29	0.28
LM_flat	23.14 [0.00]	45.89 [0.00]	63.53 [0.00]	50.74 [0.00]	38.29 [0.00]	32.64 [0.00]	44.55 [0.00]	54.12 [0.00]
F_asym	10.38 [0.00]	1.52 [0.22]	8.40 [0.00]	10.16 [0.00]	8.14 [0.00]	14.93 [0.00]	11.06 [0.00]	6.70 [0.01]

# Comments on asymmetric MIDAS

- Hedgers
  - long hedging positions react more to price drop than price increase for grains, softs, metals.
  - short hedging positions react differently to upward and downward movements in prices  $\Rightarrow$  larger impact of price drops for grains, softs, metals.
  - no impact of price changes for short hedging positions in energy futures markets.
- Speculators
  - still behave as momentum traders
  - evidence of asymmetric impact of returns on position
- Evidence in favor of asymmetry in most cases

# Summary of the results

- For grains, softs and metals of our sample: hedgers have a contrarian strategy and speculators a momentum strategy
  - We show that financial practices in energy futures markets are distinct from practices in other commodity markets:
    - hedgers' positions changes do not respond to past or contemporaneous returns.
- ⇒ this calls into question the empirical approach in Kang et al (1994)
- different from the one studied in Sanders et al. (2004) using 1992-1999 data where positions are positively correlated with past returns.

# Discussion of the results

- Momentum and contrarian strategies possibly emerge for inexperienced traders who are prone to behavioral bias such as the disposition effect or believe in reversal effect.
- Experiments have shown that learning and experience were likely to remove such behaviors (Weber and Camerer (1998), List (2003), Haigh and List (2005), Feng and Seasholes (2005)).
- Are the energy markets populated with more experienced traders?
  - ⇒ more banks, more hedge funds, etc.
  - ⇒ large energy firms have dedicated department for trading
  - ⇒ relevancy of the CFTC classification

# Possible extensions

- Looking at firm-level positions as in Ederington and Lee (2002)
- Using Mixed frequency VAR (Ghysels (2012)) and testing for causality (Ghysels et al. (2012)) to:
  - ⇒ model interactions between group of traders
  - ⇒ model spillovers between several commodity markets
  - ⇒ estimate IRF to gauge the importance of price changes for various kinds of traders