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THE IMPACT OF TRADING ACTIVITY ON AGRICULTURAL FUTURES MARKETS

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Background

- The anomalous fluctuations in prices experienced by agricultural markets affect the stability of farm income and the level of uncertainty in farmer production decisions and along the food supply chain.
- Possible future scenarios of price volatility are forcing policy makers to research the determinants of the spikes in order to identify appropriate regulation to prevent them.
- The boom and bust of 2008 agricultural commodities' prices has been investigated by researchers, market analysts and policy makers without reaching a common interpretation of such a dynamic and a unique explanation of the main determinant.
- Despite the researches on demand and supply determinants of the spikes, other authors disputed the role of market speculation: financial activity increased its participation in commodity future markets (mostly in the form of index funds used by swap dealers).

Objectives

- Preceding research has led us to concentrate the analysis on the relationship between **trading activity and volatility**. Using the Granger-causality approach we couldn't find any influence between trading activity and price direction.

- The analysis is carried out following the approach proposed by Irwin and Sanders (2010) adding some relevant innovations and extensions:
  - An extended time series;
  - A procedure to check outliers inside the dataset;
  - The standardization of each variable included in the model;
  - A test of the inverse relationships, considering the market factor as the causal variable;
  - Estimation of the Granger-causality with and without the independent variable at contemporaneous time.

Data *(frequency, parameters)*

The frequency of data used exerts a noticeable influence on the results . Using weekly data, also if referred to traders groups, there is no evidence of a relationship. On the contrary, a daily frequency of information gives statistical evidence to phenomena that exhaust their effects within the week.

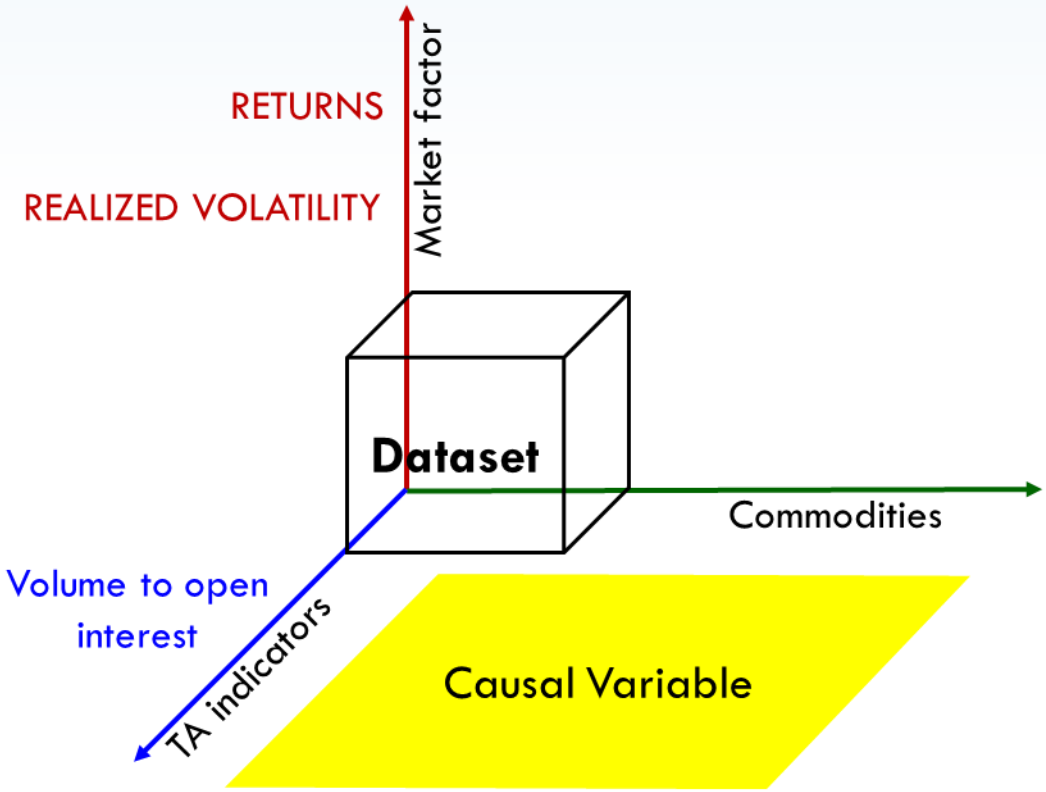
The market factor adopted is the **Realized Volatility (=RV)** computed as the absolute value of daily returns

The trading activity parameter is the **Volume to Open Interest Ratio (=VOIR)** computed as the ratio between the number of contracts traded during the day and the open interest at the end of the day.

The dataset starts on January 3, 1995 to February 27, 2014.

Daily dataset

The relationships between market factors and the Volume to Open Interest (VOIR) can be estimated using **daily data**.



Commodities and Markets

The commodities and the Exchanges considered in the analysis are almost the same proposed by Irwin and Sanders (2010), excluding Wheat HRW (KCBT). More specifically:

No.	Code	Commodity	Futures Exchange
1	AN	Cocoa	NYBT
2	CC	Corn	CBOT
3	DK	HRW Wheat	KCBT
4	EC	Feeder Cattle	CME
5	GC	Lean Hogs	CME
6	HN	Coffee	NYBT
7	LC	Live Cattle	CME
8	NN	Cotton	NYBT
9	OC	Soybean Oil	CBOT
10	SC	Soybeans	CBOT
11	WC	SRW Wheat	CBOT
12	ZN	Sugar	NYBT

Causality Evaluation Strategy

- Models are tested considering:

Causal variables as independent and dependent variables

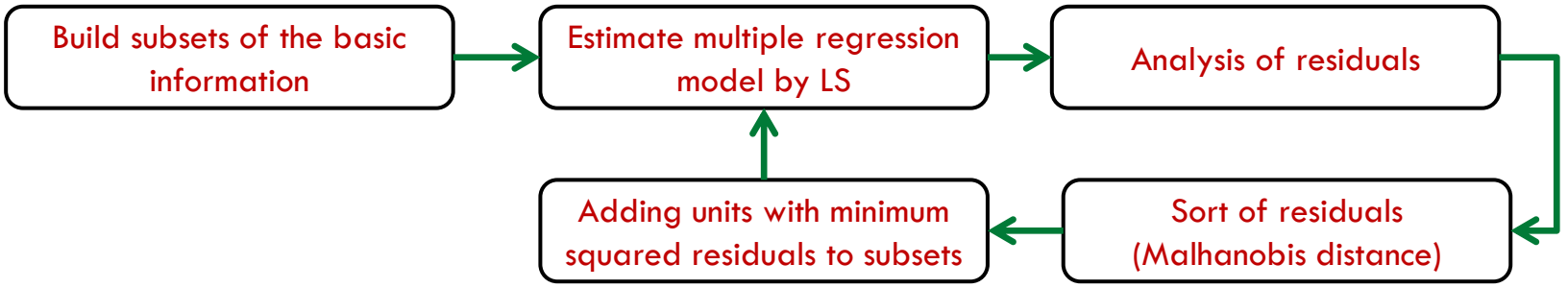
Market factor = f(lagged Market factor, lagged TA indicator)

TA indicator = f(lagged TA indicator , lagged Market factor)

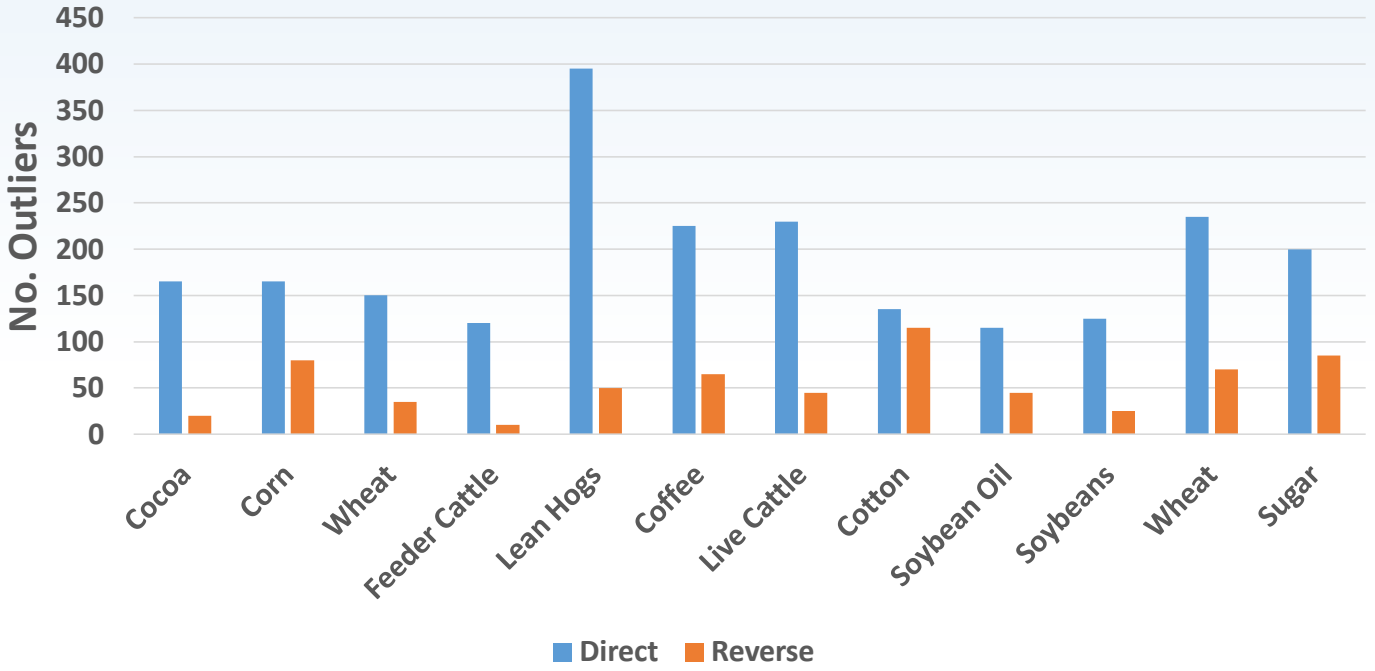
- Two types of models have been estimated: the **direct model** with the market factor as dependent variable and the **reverse model** with the TA indicator as dependent variable.
- The analysis is consistent with the Granger's theory that does not restrict the causality evaluation to only one direction of the relationship.

Data pre-treatment

- All the variables has been standardized to have regression coefficients not affected by the data level and comparable among commodities
- Each time series has been submitted to an outlier check using an innovative robust method proposed by Riani et al. (2007) aiming to identify outliers using a **Forward Search (FS)** based on a multivariate testing.
- The FS technique identifies the outliers according to a procedure based on the estimation market by market of a multiple regression model and detecting them through the deletion residual analysis



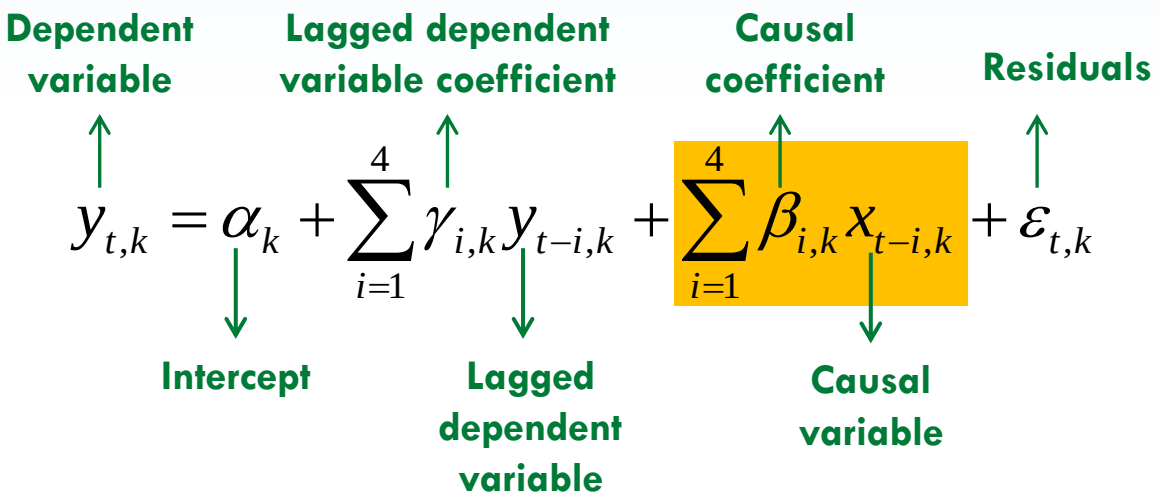
Outliers



- For the "direct" relationships, RV= fa(TA), the FS algorithm detected more outliers than for the "reverse" relationship (TA=fb(RV).
- In the worst case the outliers detected represent less than 10% of the complete set of observations available (4,824).
- The combined effect of these outliers has led to eliminate 1,270 rows of observations from the initial dataset for the "direct" relationship (corresponding to about 26% of the total); 550 (11% of the total) in the case of "reverse" relationship .

Granger-causality methodology

- Each market was analysed considering two time series as the linear causality technique requires. For time t and commodity k the conventional Granger's approach (= not-contemporaneous model):



SUR system

- Following the Irwin and Sanders' proposal, in order to increase the power of the causality test, we estimated the ***k*** markets as a system of Seemingly Unrelated Regression (SUR).

$$
\begin{aligned}
y_{t,1} &= \alpha_1 + \sum_{i=1}^{4} \gamma_{i,1} y_{t-i,1} + \sum_{i=1}^{4} \beta_{i,1} x_{t-i,1} + \varepsilon_t \\
y_{t,2} &= \alpha_2 + \sum_{i=1}^{4} \gamma_{i,2} y_{t-i,2} + \sum_{i=1}^{4} \beta_{i,2} x_{t-i,2} + \varepsilon_t \\
y_{t,3} &= \alpha_3 + \sum_{i=1}^{4} \gamma_{i,3} y_{t-i,3} + \sum_{i=1}^{4} \beta_{i,3} x_{t-i,3} + \varepsilon_t \\
&\vdots \qquad\qquad \vdots \qquad\qquad \vdots \qquad\qquad \vdots \\
y_{t,12} &= \alpha_{12} + \sum_{i=1}^{4} \gamma_{i,12} y_{t-i,12} + \sum_{i=1}^{4} \beta_{i,12} x_{t-i,12} + \varepsilon_t
\end{aligned}
$$

- We assume that in the markets there is an erratic force that affects all the commodity prices in the same way (correlation between market equation residuals).
- The level of the fitness of the SUR investigated with the Lagrange multiplier statistics (Beusch and Pagan, 1980) is highly positive and demonstrates that the SUR approach is always the most adequate: all the markets react in the same way to the same exogenous changes.

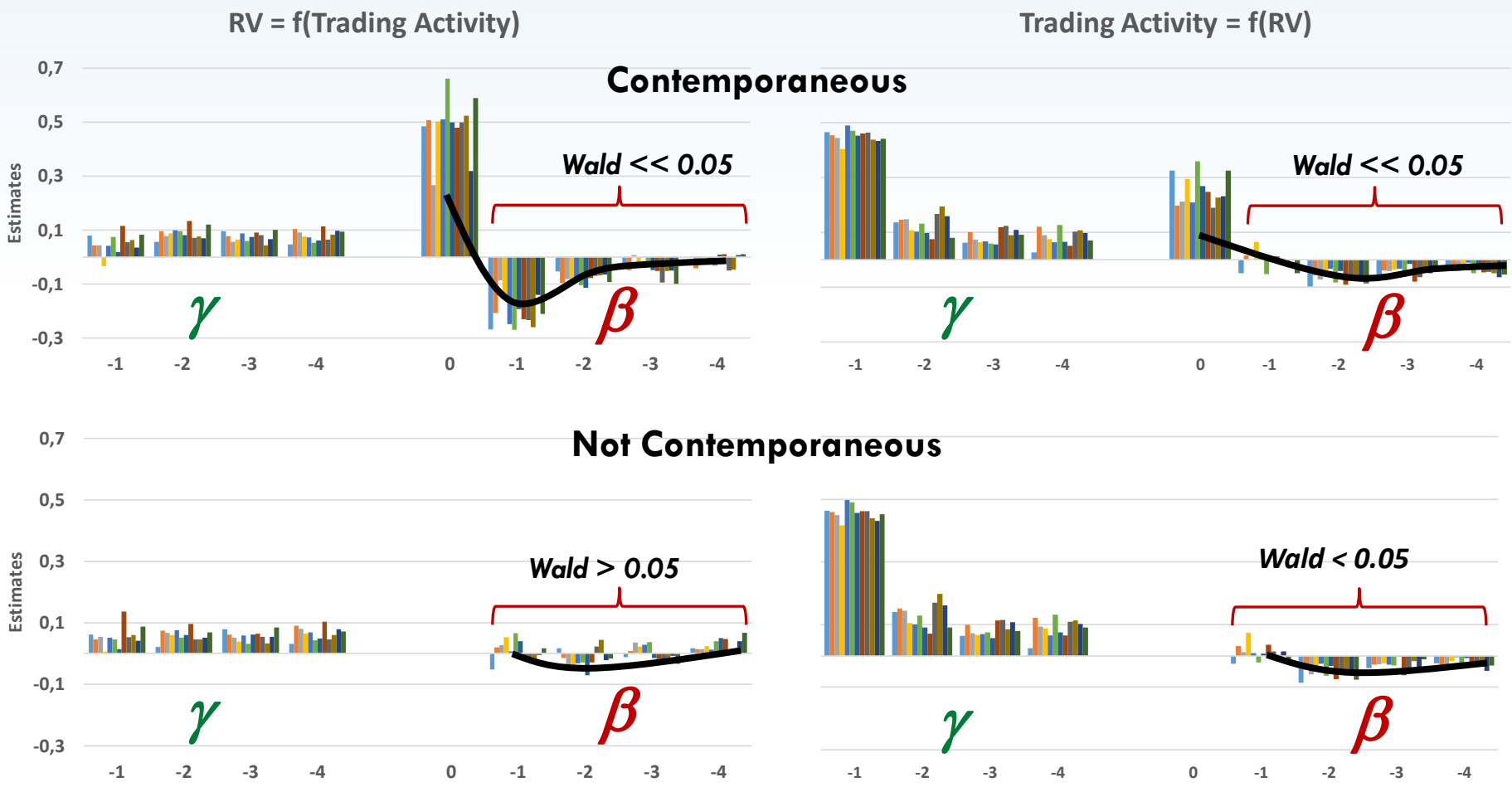
Causality Evaluation Strategy

- The SUR model has been tested with a not conventional version of the model introducing the current value for the causal variable (**Contemporaneous model)**

$$y_{t,1} = \alpha_1 + \gamma_{t-1,1} y_{t-1,1} + \cdots + \gamma_{t-4,1} y_{t-4,1} + \beta_{t,1} x_{t,k} + \beta_{t-1,1} x_{t-1,k} + \cdots + \beta_{t-4,1} x_{t-4,k} + \varepsilon_t$$

- This model provides an ex-post analysis of the degree of causality between the series;
- The contemporaneous independent variable is highly significant and contributes to improving the statistical significance of the coefficients of the lagged causal variables. Those are purified from the influence of the independent series at time *t* and this increases the performance of the model (see the Wald test);
- All the markets seem to react to exogenous information with a **clear homogeneity.**

Comparison


RV = f(Trading Activity)
Trading Activity = f(RV)
Contemporaneous
Not Contemporaneous
Estimates
0,7
0,5
0,3
0,1
-0,1
-0,3
Wald << 0.05
Wald << 0.05
Wald > 0.05
Wald < 0.05
γ
β
-1
-2
-3
-4
0

Contemporaneous tests

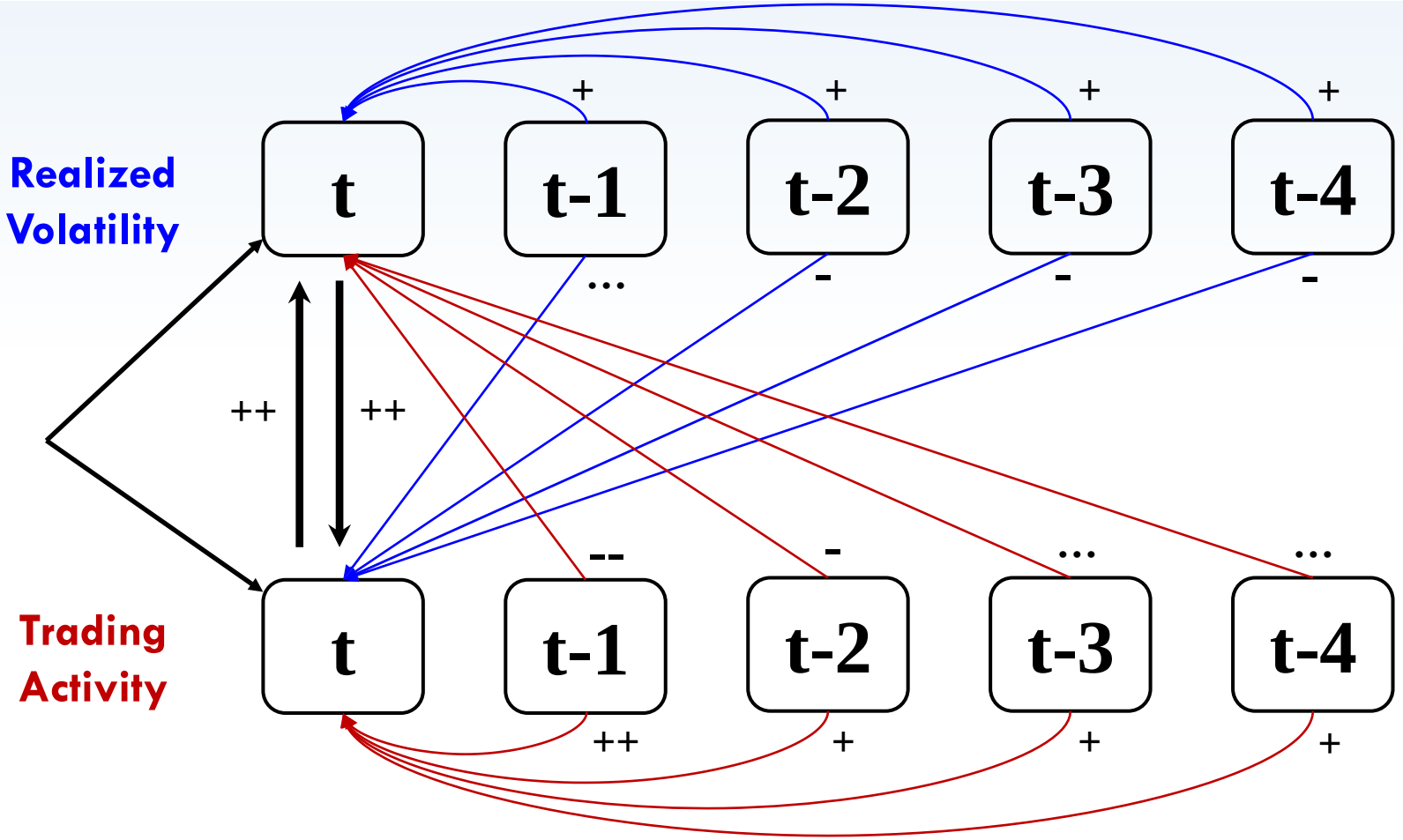
- In both relationships the main effect is provided by the contemporaneous variables (current Realized Volatility and current Trading Activity). In order to better understand the instantaneous impact between them, we turned to "contemporaneous tests" .
- It is difficult to establish whether a causal relationship between the two variables exists or whether they are both affected by a third unobservable variable. An attempt to isolate the effect of a variable at time t with respect to the other has been made using instrumental variables, where the instruments are vectors of lagged, or contemporaneous - but exogenous - series (z) selected from the entire information set available at time t.
- The variables used as instruments have proved effective.
- The clearest relationship is between volatility and trading activity but, from a statistical point of view, both the relationships are significant.

Concluding remarks - 1

- We can just suggest an in-depth analysis of the influence of the information frequency for evaluating causality in commodity futures markets: evidence collected or released at weekly intervals does not reveal all relevant phenomena.
- The contemporaneous tests confirm the qualitative indications of the Granger causality test and add information on the existence and the sign of the relationships linking trading activity and volatility at time t.

- If in period t a large amount of unexpected information reaches the market, the effect is to produce either a change in expectations, leading to adjustments in the number of transactions (trading activity), or greater heterogeneity of opinions and beliefs among traders, leading to greater volatility. At time t, there is a causal relationship between trading activity and volatility in addition to their being bound by a common cause, based on the information that has been spread onto the market.

Concluding remarks - 2



Concluding remarks - 3

- The graph shows that the past values of volatility contribute to its increase: the coefficients are low but significant, uniform among the markets and almost the same for all the lags considered.
- Past values of trading activity also exert a positive influence on the level of this variable at time t.
- Cross effects between lagged RV and TA are present and are statistically significant, as shown by the Wald tests. The sign of the relationship is negative in both cases and shows, first, that an earlier increase in trading activity helps to reduce the volatility of the market and, secondly, that an increase in past volatility dampens investor activity, reducing market transactions and exchanges ("shot adjusted").
- The direct effect exerted by a change in trading activity (volatility) on the volatility (trading activity) runs out on day t since, during the first few days, the negative sign of the coefficients compensates and cancels the (positive) effect registered earlier.