The Connectedness between Crude Oil Futures and Equity Markets during the pre-and post-Financialisation Eras

Sania Wadud, University of Aberdeen, UK and Curtin University, Australia
Robert B. Durand, Curtin University, Australia
Marc Gronwald, Xi'an Jiaotong-Liverpool University, China

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Outline of Presentation

- Background
- Theoretical and Empirical View
- Research Focus
- Empirical Strategy/Framework
- Empirical Findings
- Robustness Check
- Conclusion

Background

Observed changes

- Increased investors' interest in commodities
- Expansion of trading volume and open interest
- Elevated price and volatility level

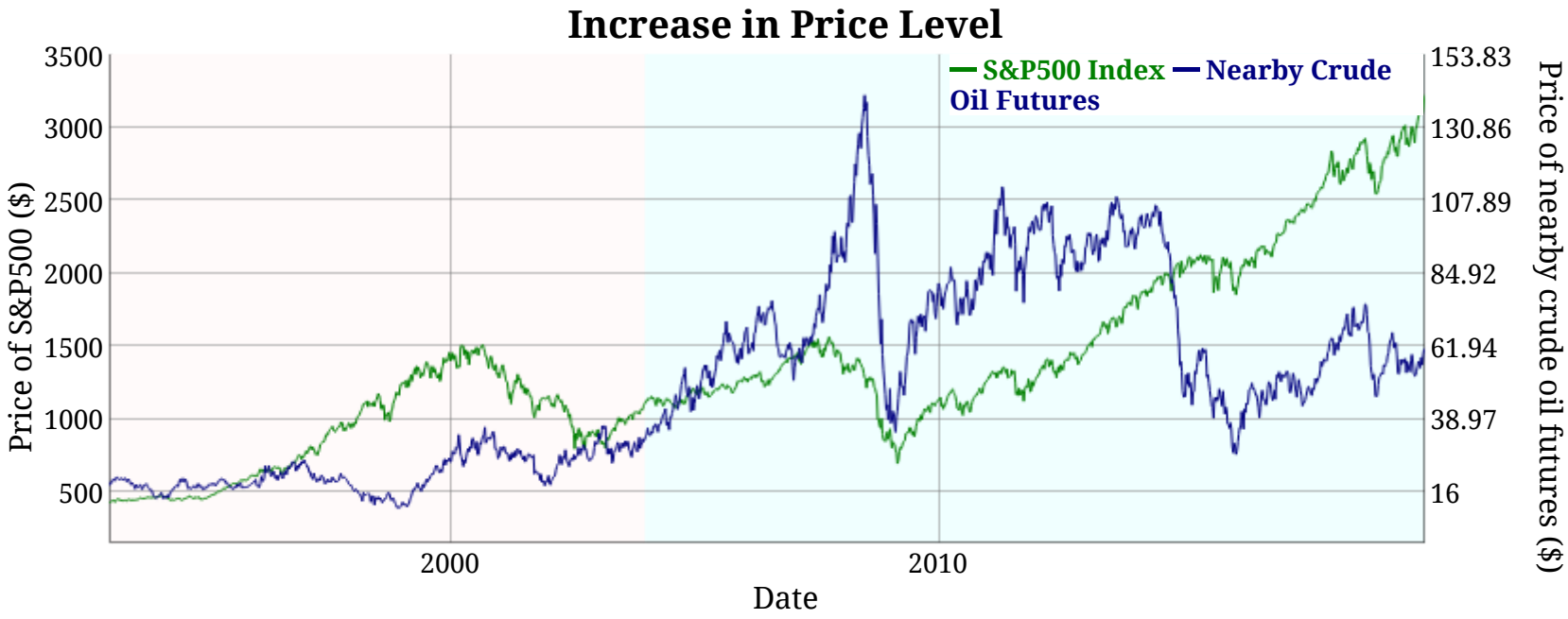

Figure 1: Price level. Sources: Thomson Reuters.

Observed changes

- Positive correlation between net hedge fund positions and futures prices
- Evolution of market participants

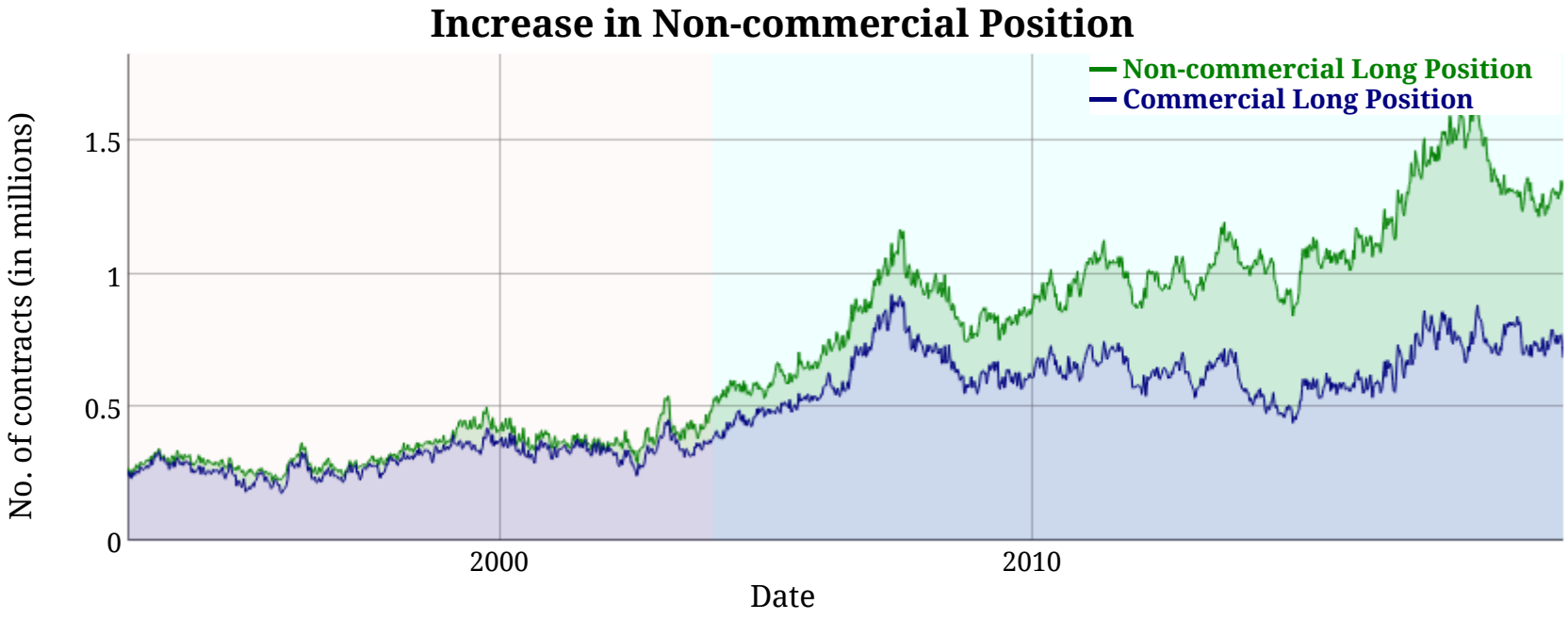

Figure 2: Non-commercial vs commercial long position for crude oil. Sources: U.S. Commodity Futures Trading Commission (CFTC)

Potential Impacts

- Efficient derivative pricing (Büyüksahin et al. 2008)
- Reduce market price risk (Pirrong 2011)
- Break the relationship between prices and inventories (Masters 2008)
- Spillover price volatility (Tang et al. 2012)
- Increase in correlation among commodities and between equities and commodities (Basak and Pavlova 2016)
- Decrease in diversification benefits (Silvennoinen and Thorp 2013, Sadorsky 2014)

Views on Speculation and Volatility

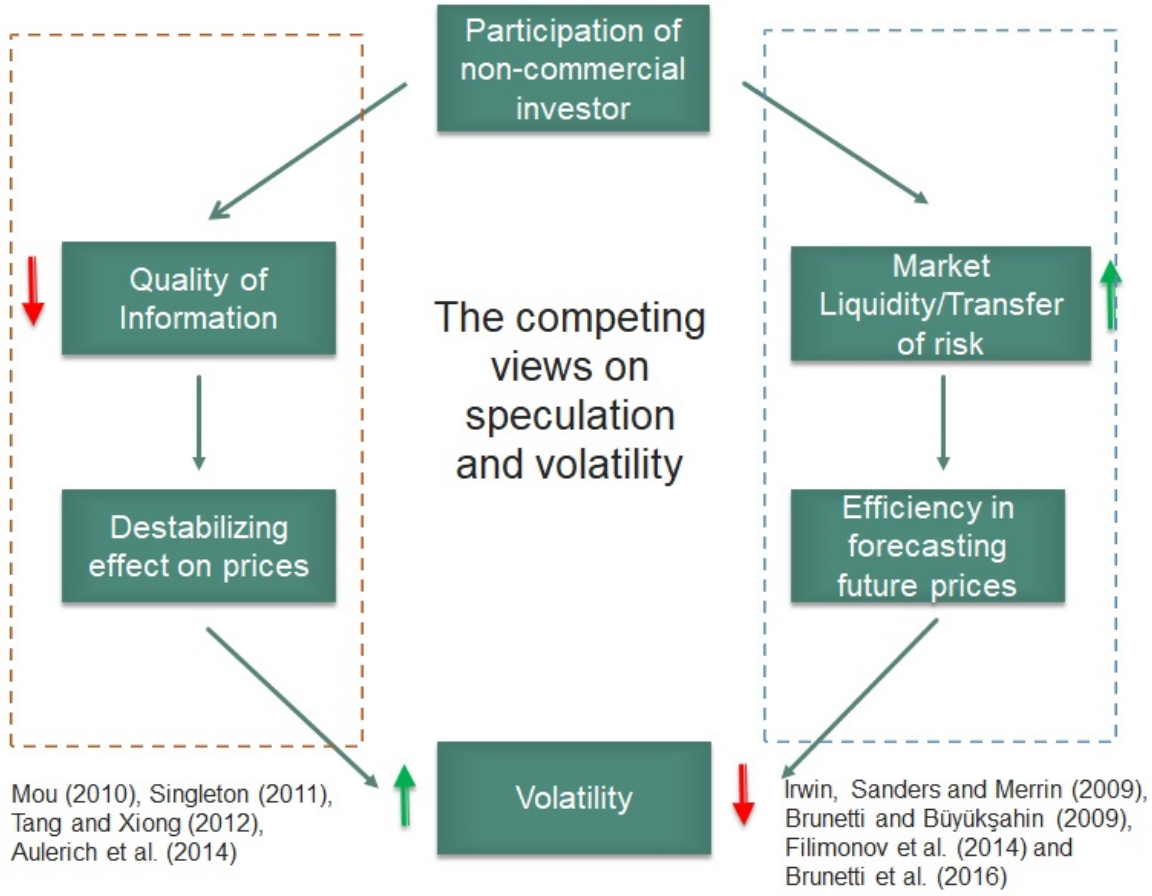

Figure 3: The competing views concerning the relationship between volatility and speculation

The Paper in a Nutshell

Since financialisation,

Cross-market Linkage

- whether the volatility link between crude oil futures and equities varies?

Volatility

- have volatility of crude oil futures and equities started to move in sync?
- how volatility impacts on the connectedness between crude oil futures and equities?

Volatility patterns

- whether seasonal effect is altered?
- whether the impact of Samuelson's (1965) maturity and correlation effect are changed?

Empirical Strategy

Approach

- Sample period analysis
- Financialisation-specific measure

Econometric Framework

- Estimated model (VARX-DCC-GARCH)
- Regression analysis
- Granger-Causality test
- Other tests

Data Description

Sample Period

- Pre-financialisation (Jan 1993- Dec 2003)
- Post-financialisation (Jan 2004-Dec 2019)

Variables

- Volatility of returns (weekly-Tue) to (i) crude oil futures contracts (EIA) and (ii) S&P500 index (Yahoo Finance).
- The extent of speculative activity (CFTC CoT) (i) Speculation index and (ii) Open interest.
- Following Hedegaard (2009),

$$\text{Speculation Index} = \frac{\text{Non-commercial Long Position} - \text{Non-commercial Short Position}}{\text{Total Open Interest}}$$

Empirical Findings

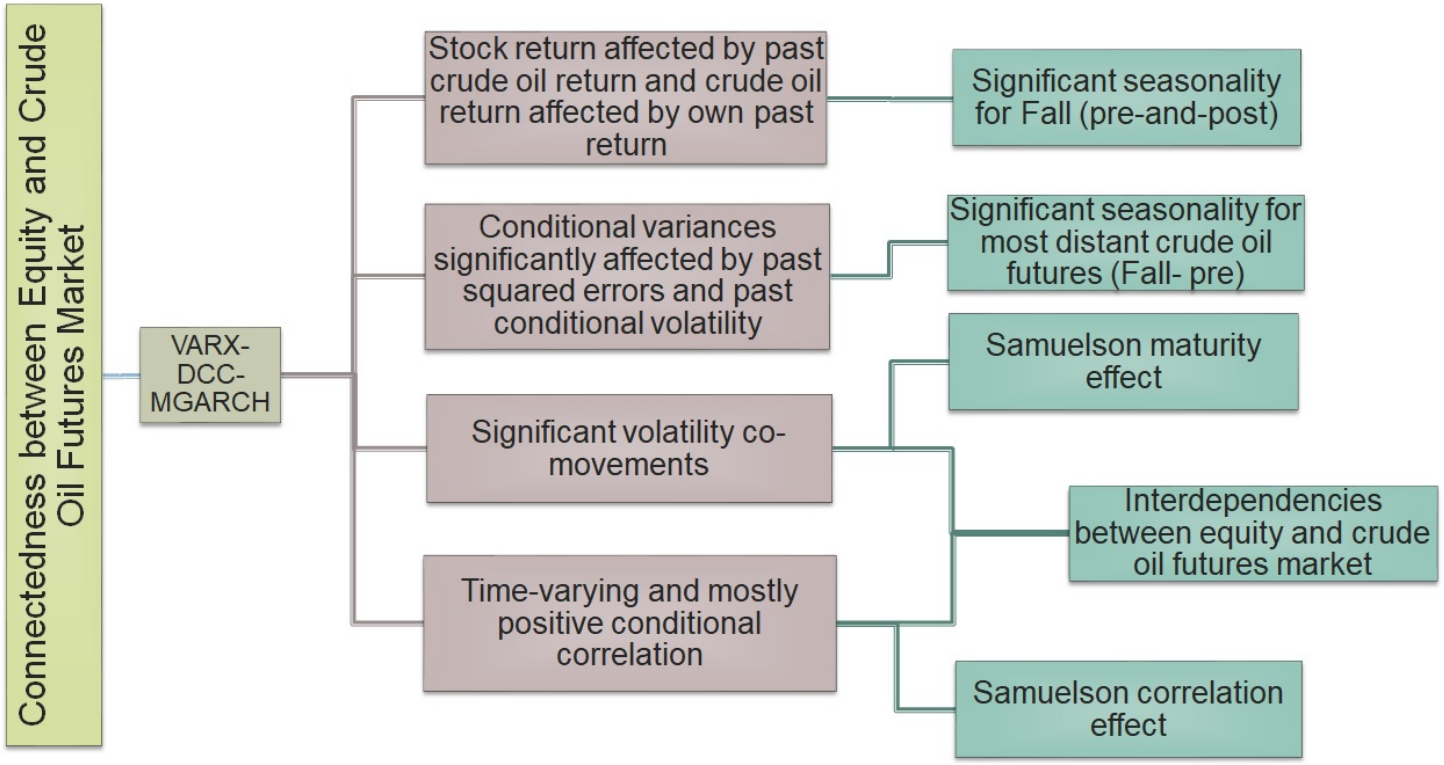

Figure 4: VARX-DCC-GARCH Analysis

Empirical Findings

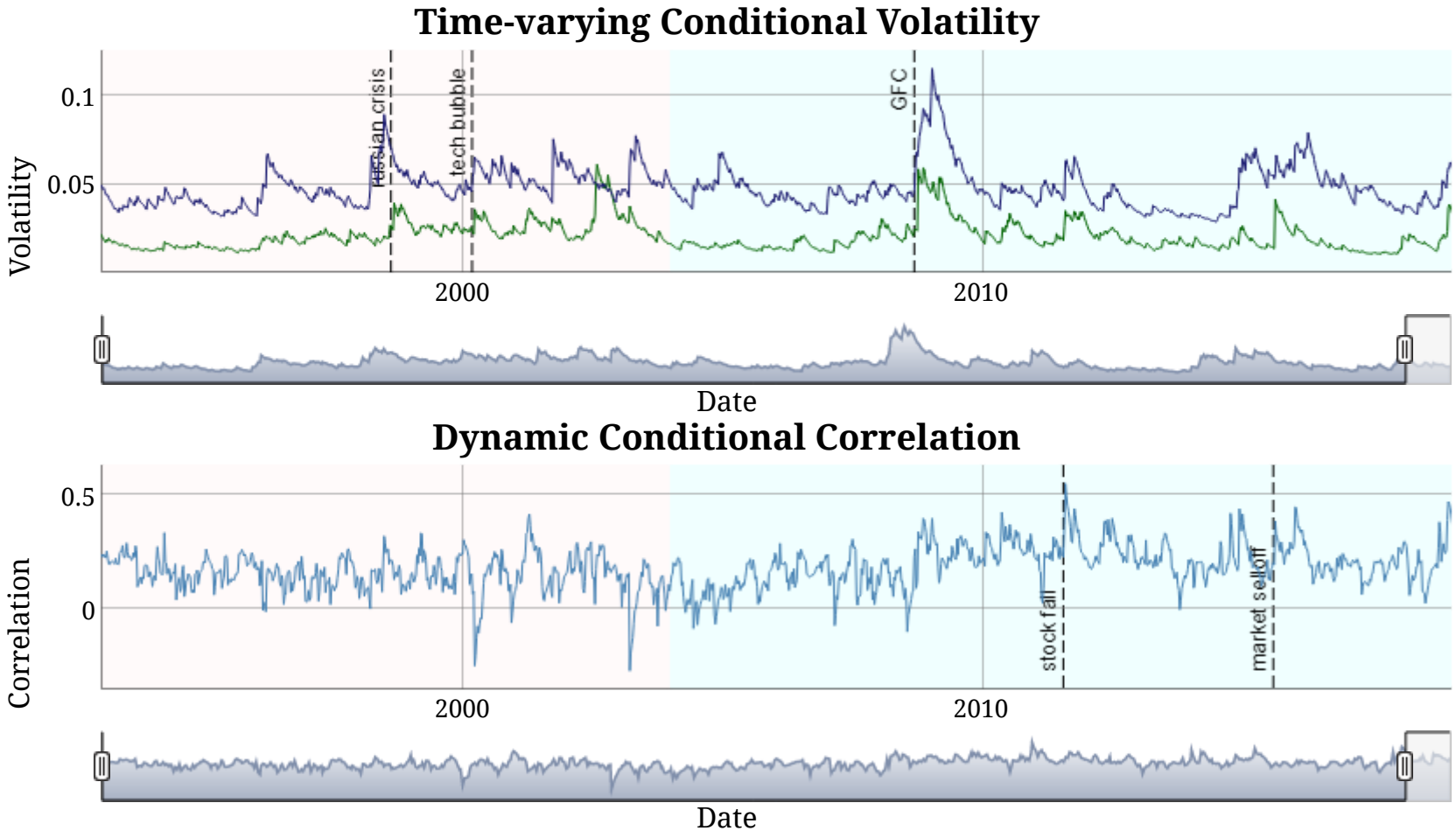

Figure 5: Time-varying conditional volatility and dynamic conditional correlation

Interconnectedness and Long-run Risks

Regression Analysis

Regression Results

Impact	Pre-financialisation	Post-financialisation
`$h_{SP500} - h_{Oil}$`	No impact	(+) effect `$\uparrow$`
`$h_{Oil} - h_{SP500}$`	No impact	(+) effect `$\uparrow$`
`$h_{SP500} - \rho_{SP500-Oil}$`	Partly	(+) effect `$\uparrow$`
`$h_{Oil} - \rho_{SP500-Oil}$`	Partly	Mostly `$\downarrow$`

Note: h and ρ represents first difference of the conditional volatility and conditional correlation respectively.

Seasonality

- Return
- Volatility

Samuelson Maturity and Correlation Effect

Visual Inspection

- Density curve

Parametric Test

- Regression-based test

Non-parametric Test

- Kolmogorov-Smirnov
- Jonckheere–Terpstra test

Samuelson Effect on Volatility

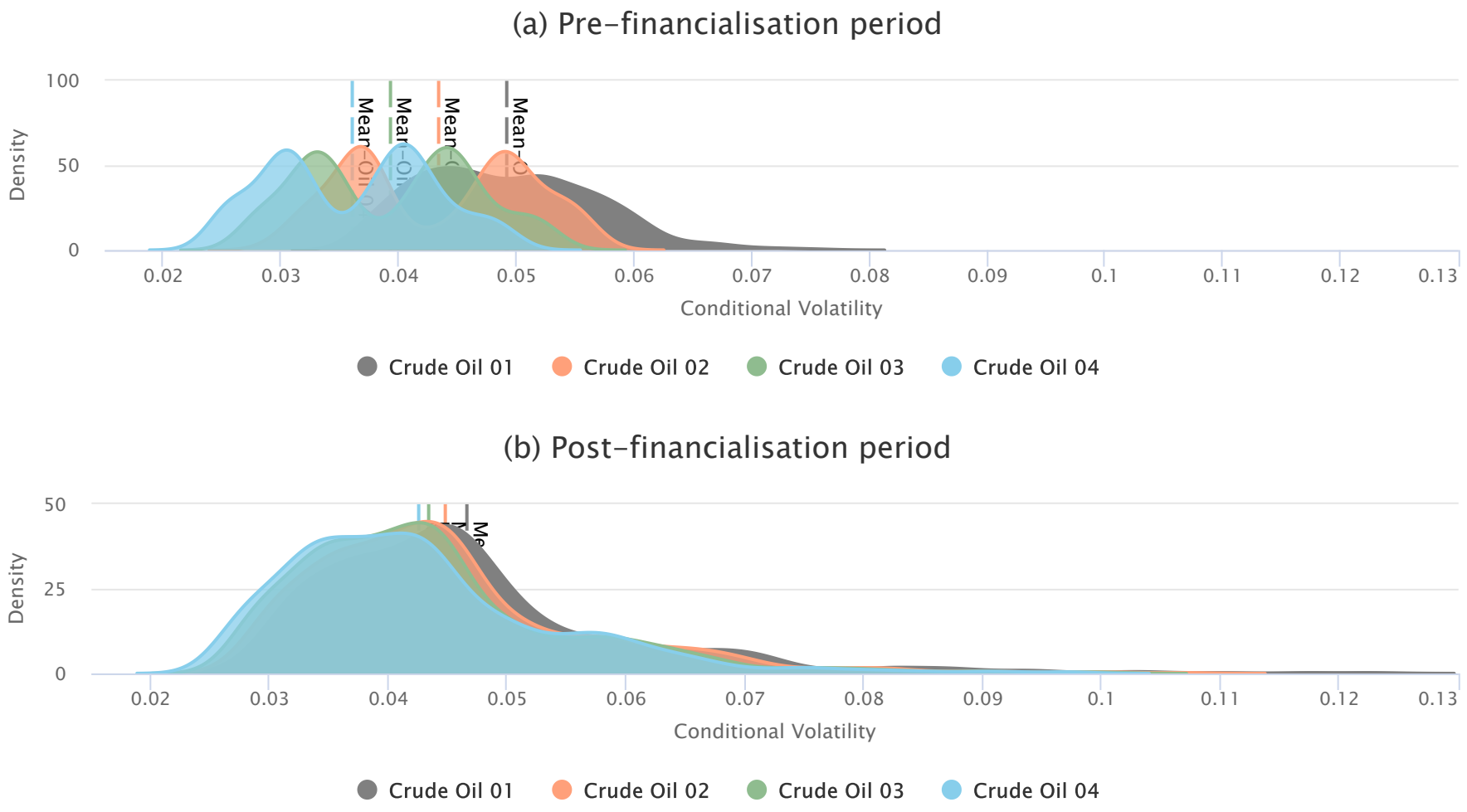

Figure 6: Samuelson's volatility effect for (a) pre- and (b) post-financialisation period

Samuelson Effect on Correlation

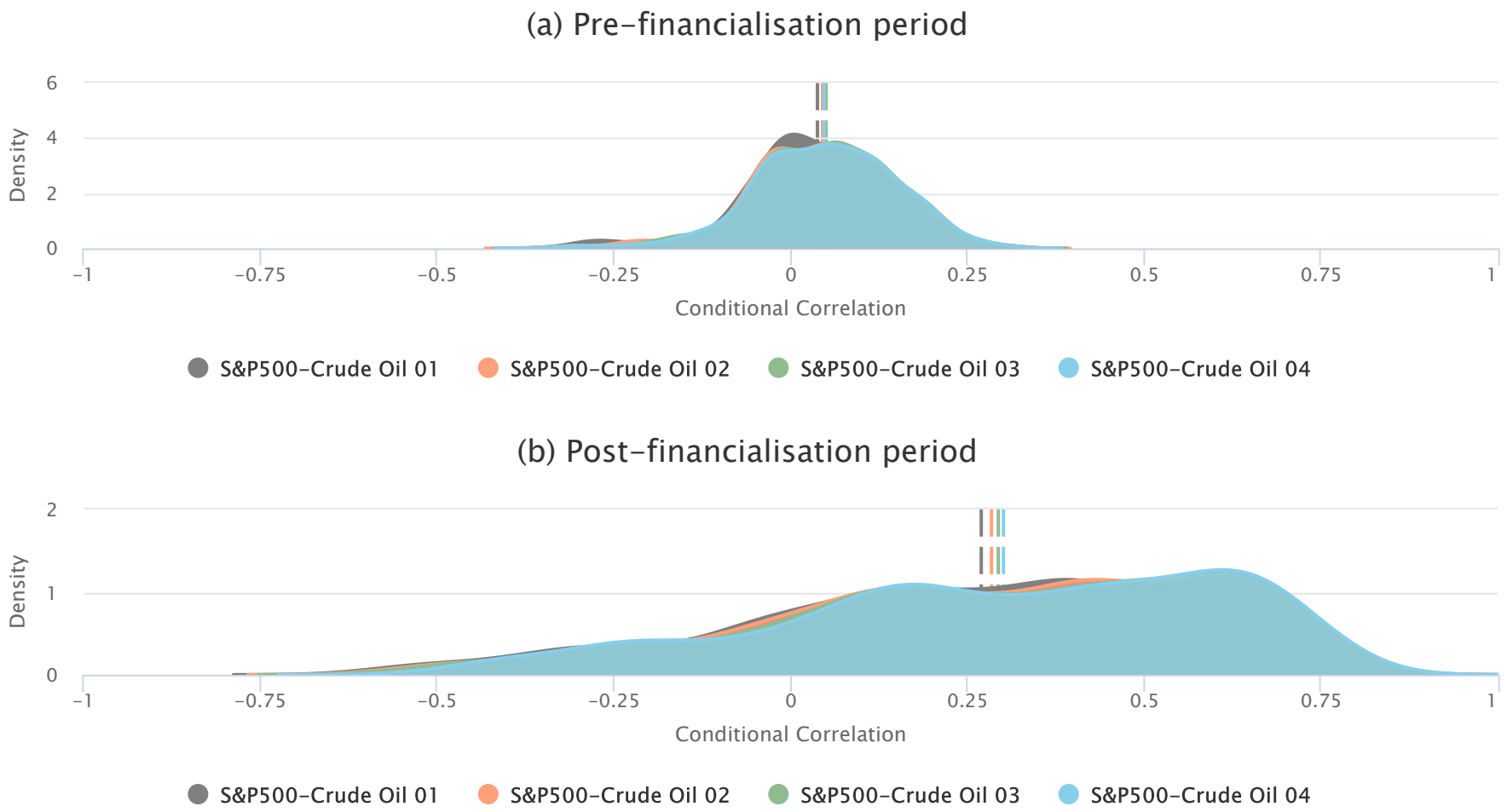

Figure 7: Samuelson's correlation effect for (a) pre- and (b) post-financialisation period

Impact of Financialisation (Financialisation-Specific Measure)

Regression Analysis

Regression Results

Impact	Pre-financialisation	Post-financialisation
Speculative activity on `$h$`	(-) Nearby crude oil	No impact
Open interest on `$h$`	(-) S&P500	(-) Crude oil
Speculative activity on `$\rho_{SP500-Oil}$`	No impact	No impact
Open interest on `$\rho_{SP500-Oil}$`	No impact	No impact

Note: h and ρ represents first difference of the conditional volatility and conditional correlation respectively.

Granger Causality

- Speculative activity $\rightarrow$ volatility
- Open interest $\leftrightarrow$ volatility

Robustness Check

- Alternative model
- Alternative financialisation measure
- Detrended open interest

Conclusions

Since financialisation,

- Inter-market dependence in volatility
- Weaken seasonality
- Diminishing Samuelson volatility effect
- Prominent (inverse) Samuelson correlation effect in oil futures (equity-oil)
- Change in speculative activity may drive volatility to change
- Other factors

Thanks!

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Apendix

Measures of Speculative Activity

- Following Robles and Von Braun (2009),

$$\text{Speculation Index} = \frac{\text{Non-commercial Long Position}}{\text{Total Open Interest}}$$

- Following De Roon, Nijman, and Veld (2000), Sanders, Boris, and Manfredo (2004) and Sanders, Irwin, and Merrin (2010),

$$\text{Speculative Pressure} = \frac{NCL - NCS}{NCL + NCS}$$

where NCL and NCS represents non-commercial long position and non-commercial short position respectively.

VARX DCC GARCH Model

Mean Equation: $r_t = \mu_t + \Phi r_{t-1} + \Psi d_t + \varepsilon_t; \varepsilon_t | F_{t-1} \sim N(0, H_t)$

where $r_t = (r_t^{S\&P500}, r_t^{CL01}, r_t^{CL02}, r_t^{CL03}, r_t^{CL04})'$ is a $k \times 1$ dimensional vector representing returns at time t. μ_t is a $k \times 1$ vector of constant terms. $d_t = (d_t^{winter}, d_t^{summer}, d_t^{fall})'$ is a 3×1 vector. ε_t is a $k \times 1$ vector of the residual returns in r_t.

Time-varying covariance matrix, H_t

$$\varepsilon_t = H_t^{\frac{1}{2}} v_t, v_t \sim N(0, 1)$$

Where, v_t is a $k \times 1$ vector of IID errors.

Following Engle (2002), H_t takes on the form,

$$H_t = D_t R_t D_t$$

where $D_t = diag(\sqrt{h_t^{S\&P500}}, \sqrt{h_t^{CL01}}, \sqrt{h_t^{CL02}}, \sqrt{h_t^{CL03}}, \sqrt{h_t^{CL04}})$, R_t is a symmetric $k \times k$ matrix of time-varying conditional correlation coefficients that includes $[R_t]_{ij} = \rho_{ij,t}$

The conditional variances are derived through a first order univariate GARCH $(1,1)$ process,

$$h_t = \omega + A\varepsilon_{t-1}^2 + Bh_{t-1} + \gamma d_t$$

The unconditional variance estimate $Q_t = E_{t-1}[v_t v_t{}']$

then R_t can be rewritten as,

$$R_t = [diag(Q_t)]^{-\frac{1}{2}} Q_t [diag(Q_t)]^{-\frac{1}{2}}$$

where Q_t is a $k \times K$ symmetric positive-definitive matrix. Thereafter, the correlation coefficient $\rho_{ij,t}$ should be parametrised. To achieve that the model assumes that Q_t follows an autoregressive process.

$$Q_t = \overline{Q}(1 - \theta_1 - \theta_2) + \theta_1 \epsilon_{t-1} \epsilon_{t-1}^{'} + \theta_2 Q_{t-1}$$

where, θ_1 and θ_2 are non-negative i.e. $\theta_1 \geq 0$ and $\theta_2 \geq 0$ and $\theta_1 + \theta_2 < 1$, which ensures that Q_t is positive and mean-reverting.

Link between Conditional Correlation and Condtional Volatility

$$\rho_{ij,t} = \xi_0 + \xi_1 h_{i,t} + \sum_{t=1}^{4} \xi_2 h_{j,t} + \vartheta_{ij,t}$$

Link among Conditional Volatility of Assets

$$h_{j,t} = \Xi_0 + \Xi_1 h_{S\&P500} + \vartheta_{i,t}$$

$$h_{S\&P500} = \Upsilon_0 + \sum_{t=1}^{4} \Upsilon_1 h_{j,t} + \vartheta_{j,t}$$

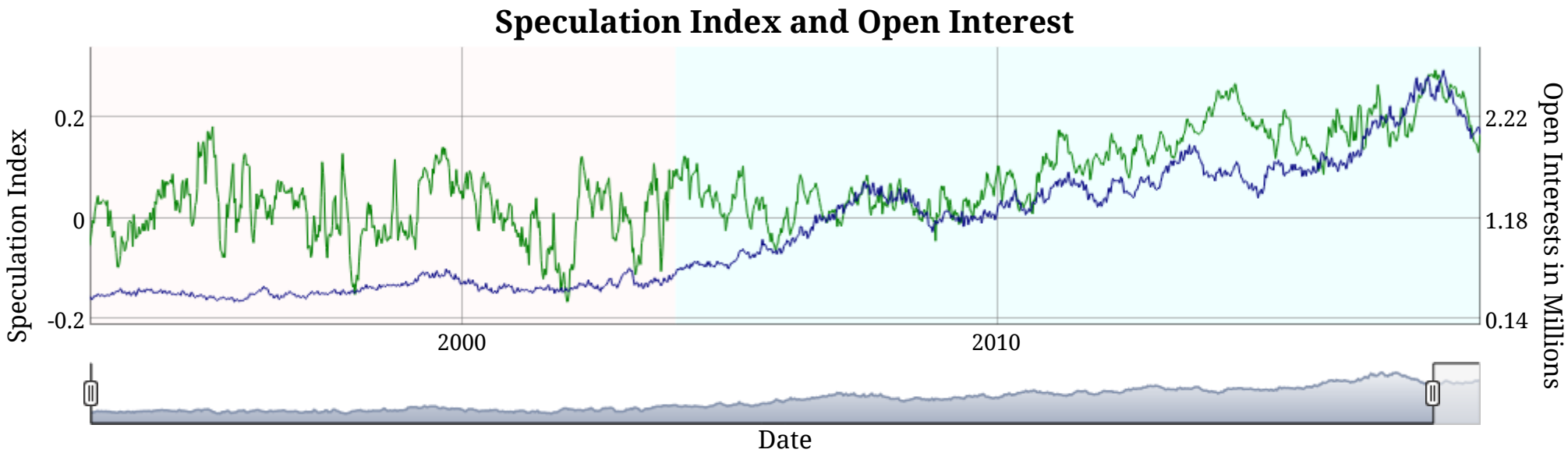

Figure 8: Speculation Index and Open Interest