



Cass Business School
CITY UNIVERSITY LONDON

BIEE Cass Joint Meeting

11th January 2012

Volatility transmission in crude oil
markets

X. Jin, S. Lin and M. Tamvakis





Research motivation

- 📌 Are oil markets integrated in the second moment?
- 📌 How is volatility is transmitted across markets?
 - Focus on the three main pricing benchmarks: Brent, WTI, Dubai
- 📌 What is the impact of shocks on volatility?
 - Are there any differences among the benchmarks?
 - Is one benchmark more responsive than another?





Review of literature

“Is the world crude oil market one great pool?”

- Broadly yes. Oil markets are “unified” at least in “pairs”.
 - ☆ Adelman (1992) responds to Weiner (1991) to argue that world oil markets are unified, when allowing for transaction costs
 - ☆ Gülen (1997, 1999) uses cointegration tests to confirm the same
 - ☆ Ewing & Lay Harter (2000) confirm the same for ANS and Brent
 - ☆ Bachmeier & Griffin (2006); more recently Bentzen (2007)

“Is volatility transmitted across markets?”

- Yes it generally is
 - ☆ Lin & Tamvakis (2001) look at NY and London futures
 - ☆ Ewing et al (2002) observe volatility transmission between oil and gas and find it is persistent and time-varying
 - ☆ Chang et al (2009) look at Brent, WTI and Dubai and find volatility transmitted among these markets asymmetrically





Review of literature contd.

🎧 “How is volatility behaving when a shock is introduced in a time series?”

- Mostly applied in the context of macroeconomic variables, financial markets, etc.
 - ☆ Sims (1980) introduces the concept for macroeconomic models and several more extend it and refine it
 - ☆ Gallant et al (1993) provide methodology for computing impulse response for non-linear time series and apply it on S&P index returns
 - ☆ Hafner & Herwartz (2006) develop an alternative VIRF methodology and apply it on the FX market, looking at the effects of market news and central bank intervention
 - ☆ Panopoulou & Pantelidis (2009) use VIRF to study information (volatility) transmission between the stock markets of the US and the other G-7 members





Research questions and data

- 🔊 Are the volatilities of the three benchmarks interdependent?
- 🔊 What happens to these volatilities during shock events?

- 🔊 We look at Brent, WTI and Dubai crude oil futures contracts
 - Traded on NYMEX
 - Between 2005:07 and 2011:02, on a daily basis
 - All three series are non-normal, with skewness to the right and excess kurtosis





Interdependence (“integration”)

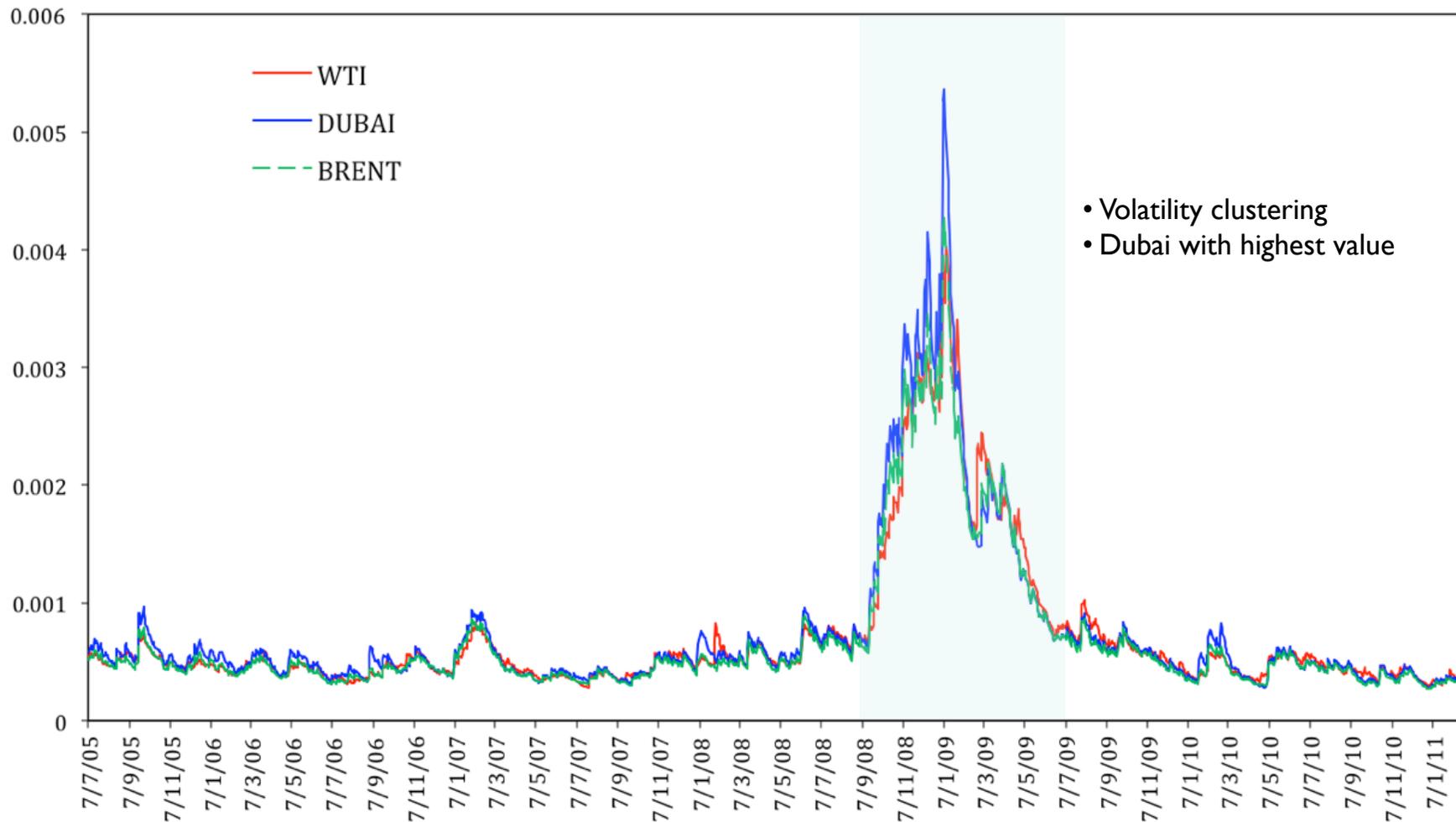
- VAR model to examine returns behaviour first
- Then BEKK model (Engle & Kroner, 1995) to examine correlation between current and lagged conditional VARs-COVARs
- Volatility spillovers are transmitted through the cross product of innovations and squared innovations
- Higher levels of conditional volatility in the past are associated with higher conditional volatility in the present
- Covariances are stationary but with high persistence





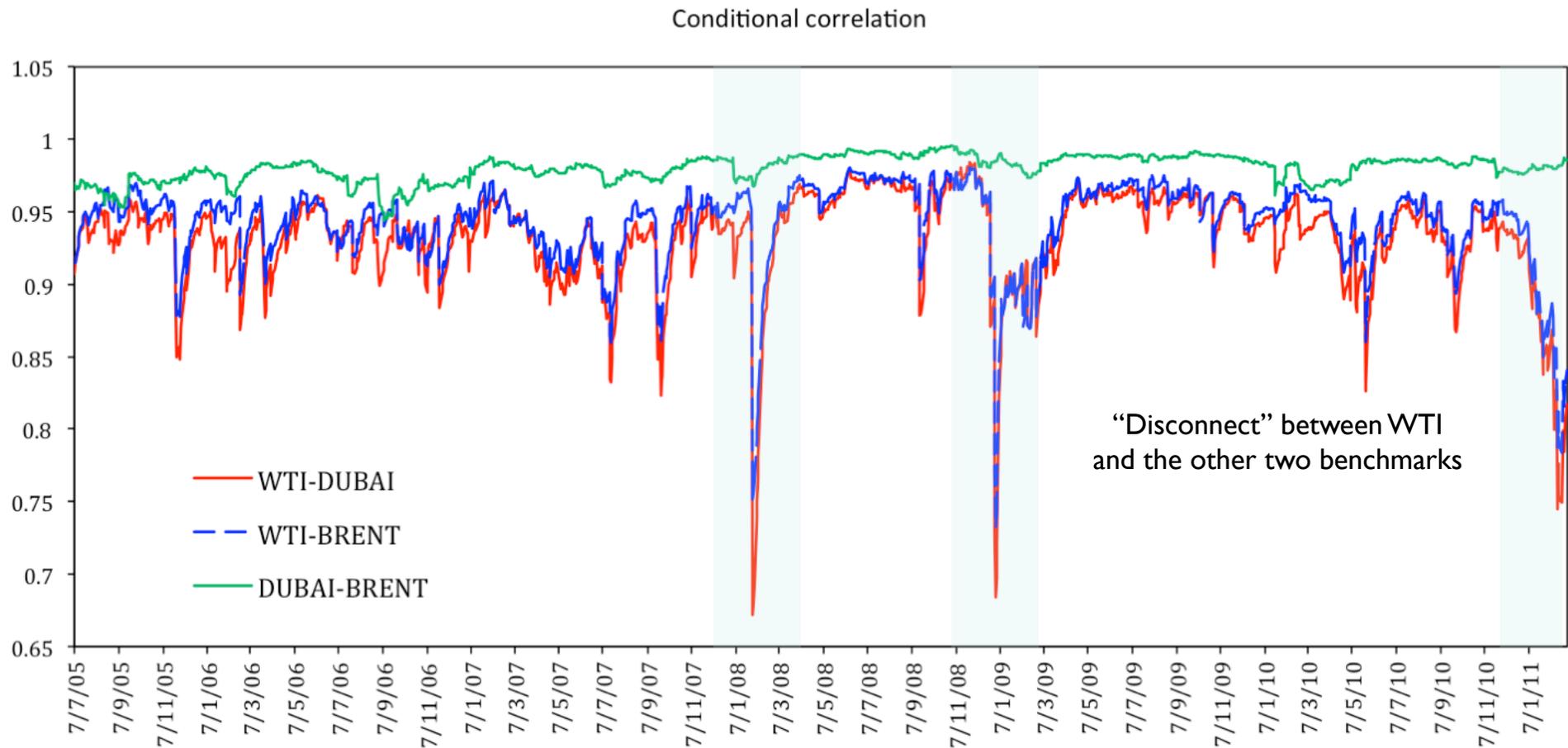
Interdependence (“integration”) contd.

Conditional variance





Interdependence (“integration”) contd.





Methodology - volatility and shocks

Volatility Impulse Response Functions (VIRF) for two 'shock' events

Lehman's collapse

- ☆ Brent exhibits most "responsiveness" (increased volatility), followed by Dubai, with WTI the least responsive
- ☆ Is this because Lehman's news were assimilated earlier in the US?

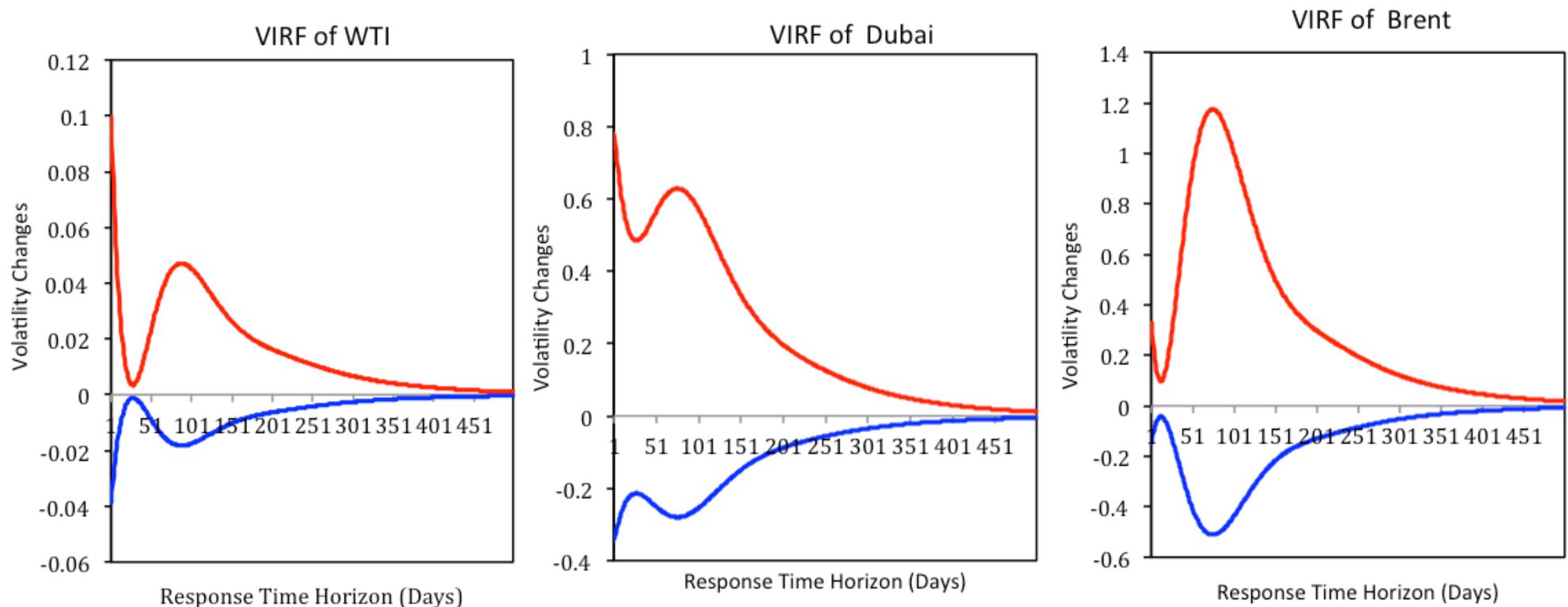
Deepwater Horizon

- ☆ Similar results as above
- ☆ Is WTI still a leading benchmark?





VIRFs post Lehman Bros bankruptcy

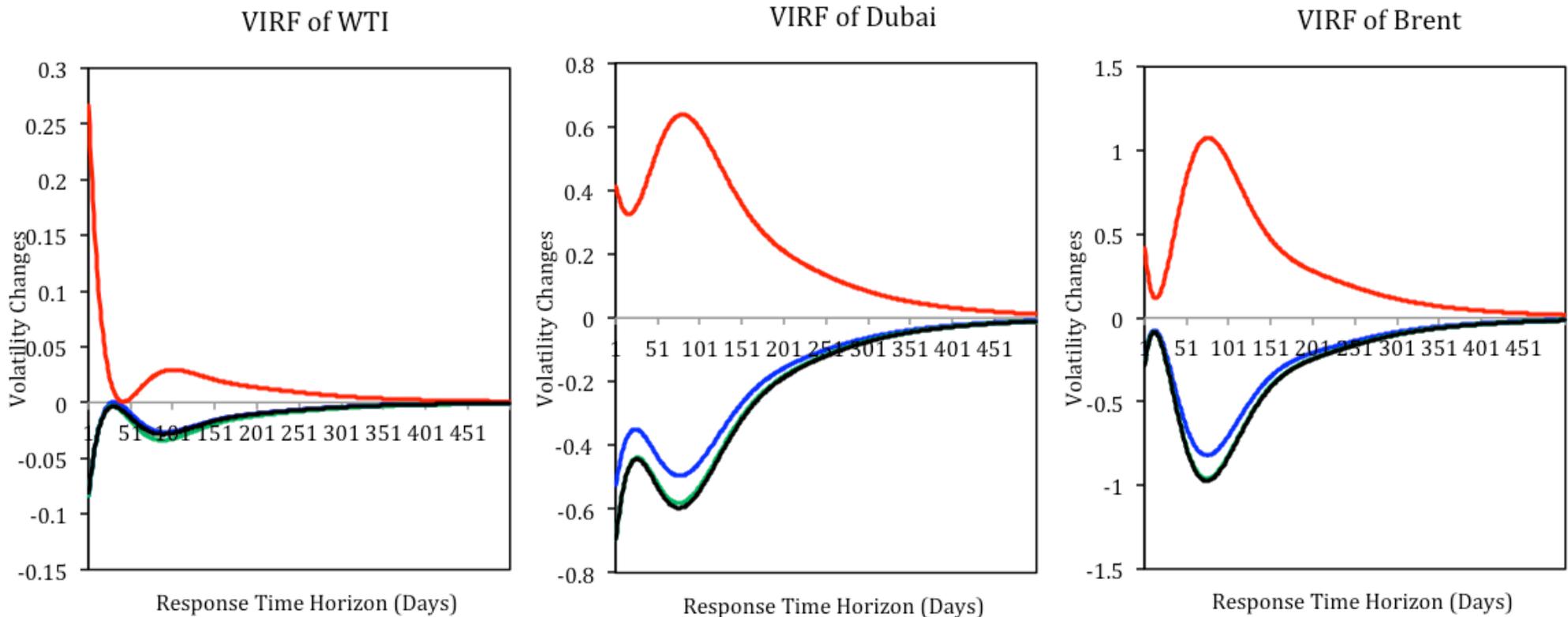


Volatility impulse responses functions for the 2008 Financial Crisis around the bankruptcy of Lehman Brothers. The red lines are averages of VIRF over a period from the filing of Lehman Brothers bankruptcy on September 15, 2008, until 15 days after it; the blue lines are averages of VIRF over a period from 15 days prior to the filing until the day before the filing.





VIRFs post Deepwater Horizon



Volatility impulse responses functions for BP Deepwater Horizon oil spill on April 23, 2010. The red lines are VIRF for shocks on April 23, 2010, the blue lines are VIRF for shocks on April 21, 2010, the green lines are VIRF for shocks on April 22, 2010, and the black lines are VIRF for shocks on April 26, 2010.





Conclusions and future research

- 🎧 Evidence that volatility is transmitted across benchmarks leading to closer market integration (in the variance, not just the mean)
- 🎧 Brent shows most “responsiveness” to shock events, followed by Dubai
- 🎧 WTI lags behind the other two
 - Is this a permanent decoupling?
 - Is it turning into just a dominant US crude, rather than international benchmark?
- 🎧 Future research
 - use data of different frequency: higher (tick) and lower (weekly)
 - describe impact of shocks on conditional covariances and correlations
 - incorporate asymmetric effects in conditional volatility?
 - analyse shock impact on third moment?





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Thank you





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