Discussion of:

"Volatility During the Financial Crisis Through the Lens of High Frequency Data: A Realized GARCH Approach"

by

Denisa Banulescu-Radu, Peter Hansen, Zhuo Huang and Marius Matei

Caio Almeida (EPGE/FGV)

Joint with Kym Ardison (EPGE-FGV / Kellogg)

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The Goal

- To study financial volatility during the recent Global Crisis.
- The authors propose a two-stage methodology to identify important events during the crisis.
- First, a realized GARCH model (Hansen et al., 2012) is used to extract daily shocks on conditional volatility.
  - Propose a robust RV-GARCH model to eliminate outliers.
  - The largest (and smallest) shocks are used to identify days of interest.
- Second, use high frequency data to identify the exact timing of important events within each preselected day.
Discussion Key Points:

1) Realized Measures and Quadratic Variation:
   - Alternative ways to identify important events during the crisis.

2) RV-GARCH and Conditional Volatility Forecasting.

3) RV-GARCH or HAR-RV?

4) Two additional points.
1) Realized Measures, Quadratic Variation and Crisis Events

- Consider the SDE for the log of an asset price $p(t)$:
  \[ dp(t) = \mu(t)dt + \sigma(t)dW_t + \kappa(t)dq_t \]  

- Then, as $\Delta \downarrow 0$:
  \[ RV_{t+1} = \sum_{i=1}^{\frac{1}{\Delta}} r_{i+1}^2 + \sum_{t<s\leq t+1} \kappa^2(s) \xrightarrow{p} \int_t^{t+1} \sigma^2(s)ds \]  

- If there are no jumps in prices, any consistent realized measure converges to the integrated conditional volatility.

- When jumps exist, RV may be substituted by BV, or RK among others, to approximate integrated volatility.
1) Realized Measures, Quadratic Variation and Crisis Events

- In this context, which measure would be the best to identify important events during a crisis?

- Why should we choose *model-based* conditional volatility shocks?

- I could think of at least three alternatives:
  - 1) Shocks to approximated integrated volatility via RV (RK or BV).
  - 2) Jumps in prices.
  - 3) Jumps in volatility.
1) Realized Measures, Quadratic Variation and Crisis Events: Econometrics

- Given a measure, how can we statistically identify the relevant dates?
  - This paper’s measure: Shocks in Conditional Volatility.
  - Identification: No theory available.

- Possible alternatives:
  - Formal tests for large volatility jumps (Jacod & Todorov, Ann.Apl.Prob., 2010; Todorov & Tauchen, JBES 2011)
1) Realized Measures, Quadratic Variation and Crisis Events: Empirical Results

- I present results for shocks in RK, and jumps in prices (obtained from RV and BV).

- Some of these measures will generate different results from RV-GARCH, which are worth being investigated.
  - We also identify some similarities across measures.

- To identify jumps in volatility we would need option prices. Left out of this presentation.
Shocks in RK (Blue), and in RV-GARCH Cond. Vol. (Red)
Negative Jumps in Prices
From Jan 2006 to Dec. 2009, comparing RK shocks to RV-GARCH cond. volatility shocks:

- From the six largest shocks in RV-GARCH, three are coincident with RK shocks.

- There are six large positive RV-GARCH shocks and seven RK shocks, with two coming in clusters (Sep 2008, Feb. 2009).

- RK presents much more pronounced negative shocks.

From Jan 2006 to Dec. 2009, comparing jumps in prices to RV-GARCH cond. volatility shocks:

- There are around fifteen large jumps in prices.

- The largest shock in RV-GARCH vol. (Feb, 27, 2007) coincides with a large jump in the price.
2) RV-GARCH and Volatility Forecasting

- The volatility shock is fundamental in the analysis:
  \[ v_t = E[log h_{t+1}|F_t] - E[log h_{t+1}|F_{t-1}] \] (3)

- Nice interpretation: Change in volatility expectation due to arrival of news at time \( t \).

- Hansen, Huang and Shek (JAE, 2012) showed: RV-GARCH can produce multi-period predictions for conditional vol.

- But, how good are these volatility predictions?

- The adequacy of using RV-GARCH volatility shocks should depend on its **ability to forecast conditional volatility**.
2) RV-GARCH and Volatility Forecasting

- True conditional volatility is unobservable...
  - Ideal to test the RV-GARCH forecasting ability: Benchmark series for the spot volatility.

- Possible solution: Todorov’s (WP, 2017) recently proposed nonparametric measure of spot volatility.
  - Extracted from a panel of short-maturity option prices (weekly options).
  - Could test if RV-GARCH conditional volatility predicts this series of spot volatility.
2) Forecasting Conditional Volatility
3) RV-GARCH or HAR-RV?

- Wouldn’t a HAR-RV model (Corsi, JFEC, 2009) identify a subset of important dates similar to the one identified by RV-GARCH?

- The HAR is simpler to estimate (linear regression) while RV-GARCH uses QML.

- And, HAR forecasts well future (realized) variance (Corsi, JFEC 2009, Andersen et al., ReStat 2007)
3) RV GARCH and HAR Volatility Shocks
4) Two additional points

▶ When the authors use high frequency data to identify intraday events:

▶ In most pictures (4 in 6): Negative jumps in prices are followed by an increase in the RV measure (the leverage effect).

▶ This suggests that maybe jumps in prices could be used to identify both important dates during the crisis as well as intra-day events.

▶ Weller (WP, 2016) uses a cross-section of bid-ask spreads to identify a measure of high frequency tail risk.

▶ He is able to quantify jump risks associated with FOMC announcements, and to anticipate some extreme market risks before the 2010 Flash Crash.

▶ Goes beyond what is done in the current paper, which try to identify and explain important events, in-sample.
Conclusions

- Nice paper making use of high frequency data to suggest an interesting way to identify important events during a financial crisis.

- A more complete discussion and motivation for the use of the RV-GARCH (instead of alternative measures) will enrich the contribution.

- Thank you for your attention!