Discussion: Arbitrage, Liquidity and Exit: The Repo and the federal funds markets before, during and after the crisis

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The paper

- *Goal:* the authors investigate
  - the links between the federal funds and the repo markets (before, during and after 2007)
  - pricing of unsecured funds (theoretical)
  - liquidity effect on short-term rates
- *Methodology:* multivariate econometric methods (VEC-GARCH) applied to a sample of daily data.
- *Findings:* Over the sample period (2002-2010), 1) the relationship between the federal funds rate (FFR) and the GC repo rate **deteriorates** during/after the crisis, 2) the pricing of federal funds **increased** during the crisis (higher perceived credit risk), 3) the federal funds reaction to shocks in reserve balances **weakened** during the crisis.

Main comments

- Arbitrage definition
- Time-variation of the deviations from the LOOP
- Some technical comments

FFR – Repo Arbitrage?

- The authors suggest that the differential between the FFR and the GC Repo provide some evidence of existing arbitrage opportunities (although the two rates have different credit risk profiles)
- A non-zero rate differential may not necessarily represent a glaring arbitrage opportunity with a profit in USD terms.
- The paper lacks an arbitrage structure which would allow the quantification of realistic profits deriving from FFR-GC Repo differential.
- Perhaps the FFR-Repo rate differential is not the correct proxy to use.
- Alternatives?

FFR – Repo Arbitrage? (cont'd)

- Consider a simple example: **Federal Funds Futures Cash-and-Carry Arbitrage**
  - Maintained assumption: *LIBOR and FFR are perfect substitutes* (i.e. no basis risk)
- Arbitrage strategy (Chance and Brooks, 2009 and the references therein)
  - Lend based on a 2-month LIBOR
  - Sell a 1-month federal funds futures contract
- This strategy creates a synthetic 1-month LIBOR loan with a rate that should be equal to the actual 1-month LIBOR rate.

FFR – Repo Arbitrage? (cont'd)

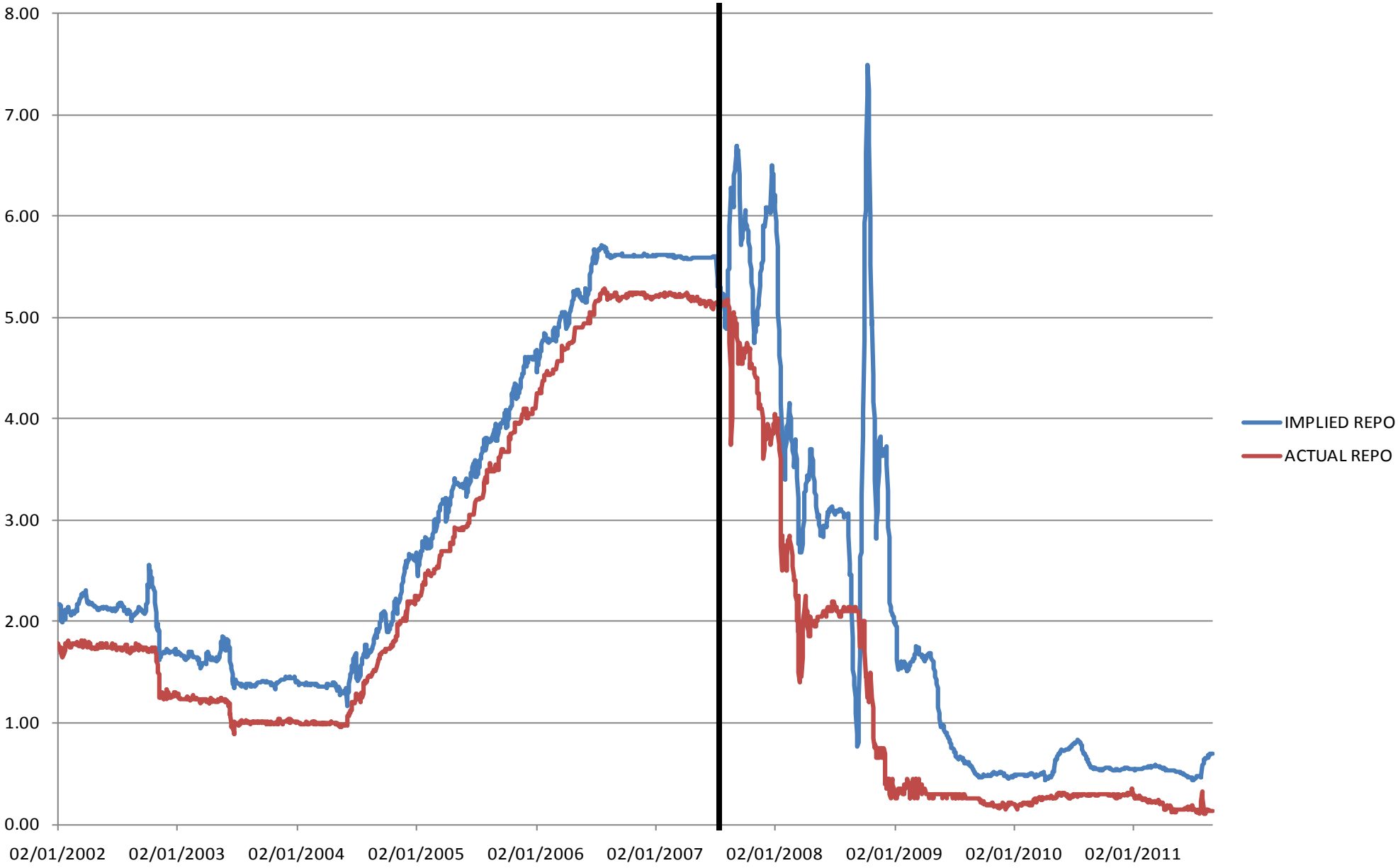
Date	Spot Market	Futures Market
T0	Borrow present value of futures contract at 1-month LIBOR Lend the same present value at 2-month LIBOR	Sell 1-month Federal Funds Futures contract
T1	Repay borrowing Payoff present value of loan	Buy same Federal Funds Futures contract to offset positition

- The **implied 1-month repo rate** (i.e. hurdle rate of the arbitrage strategy) is equal to:

$$IR = \left[\frac{PV(LB_2) + (F_0 - F_T)}{PV(LB_0)} - 1 \right] \left(\frac{360}{30} \right)$$

- The hurdle rate is the rate to a strategy similar to a repurchase agreement carried out with the futures market.

Results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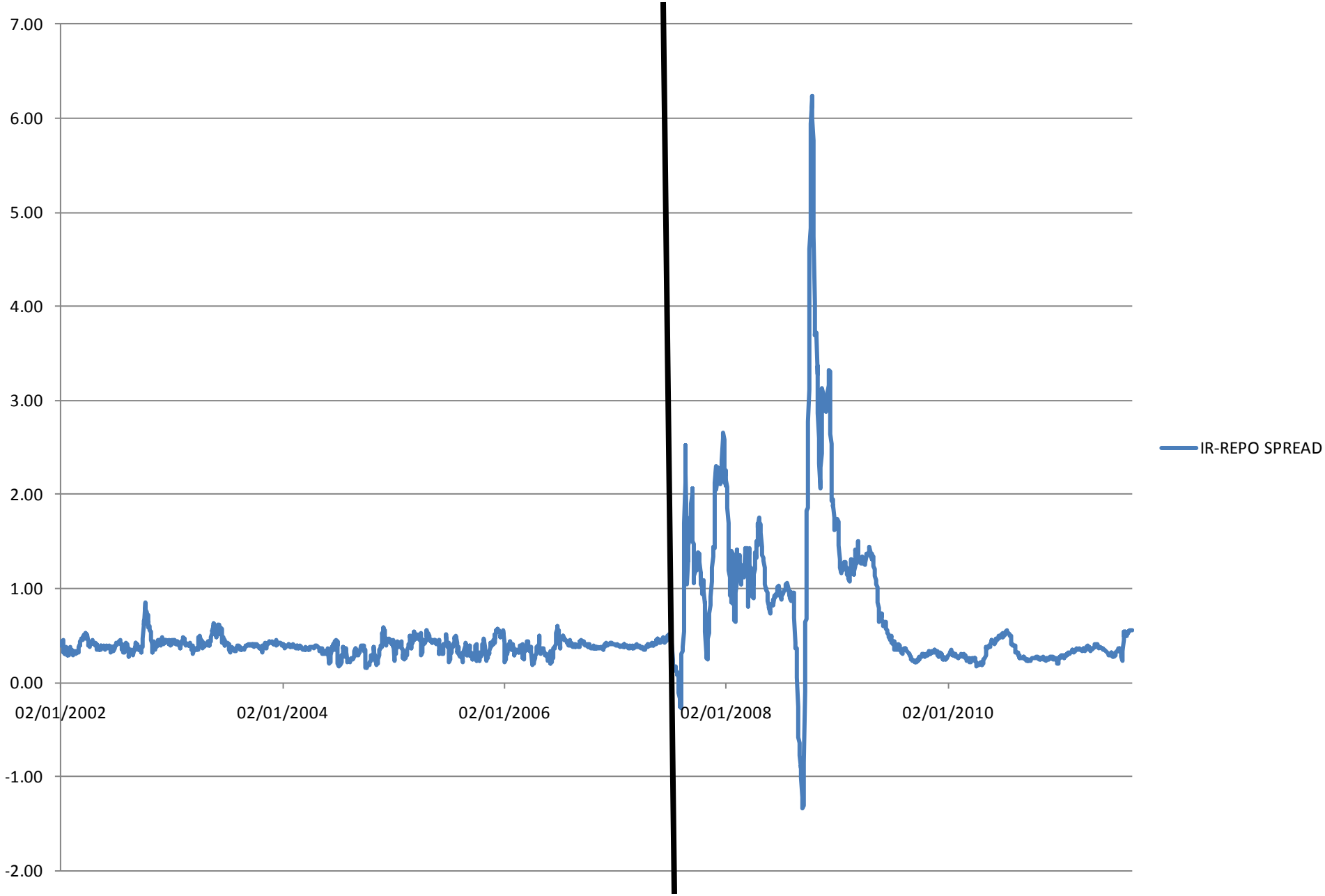
02/01/2011
IMPLIED REPO
ACTUAL REPO

Results (cont'd)



Caveats

- The exercise is based on some simple calculations. Realistic features, which certainly may affect the calculations, have been left out.
- The **absence of basis risk** is important: federal funds futures contracts are cash settled based on the average FFR during the contract month. Hence, during the delivery month there are differences between LIBOR and the implied FFR.
- A more adequate characterization of the strategy would have involved **3-month T-bills and T-bills futures** (or 2-year notes and futures contracts). In this case the implied repo rate would be closer to the term repo for the same underlying
- Others: the mismatch in the design of the LIBOR spot and futures instruments (add-on vs discount). Imperfect hedging.

Any economic value?

- The results of the exercise suggest that there is time-variation in the spread between implied and actual repo rates.
- However, the difference is relatively small:
  - the spread is always smaller than **20bps** per month (excluding 2008)
  - the break-even spread (which would make the two rates equal on average) is equal to a mere **4bps** per month.
- Given that transaction costs (and realistic frictions, such as counterparty limits, brokerage fees etc.) are not included it is likely that the spread **has always been economically negligible** (with the exception of the special circumstances in 2008)

What are the causes of time-variation?

- The spread between implied repo and actual repo displays a large time-variation
- Causes? Various.
- One possible explanation: **funding illiquidity risk**
- Garleanu and Pedersen (2011) and Pedersen (2011) show that negative shocks to fundamentals make **margin constraints bind**, lower risk-free rates and raising Sharpe ratios for risky securities.
- The time-variation of the difference between assets with similar cash flows but different margins (bases) depends on the **shadow cost of capital** (uncollateralized – collateralized loan rates)

Repo spread and funding illiquidity risk

Levels

	coefficient	t-stats	R2
TED spread	0.97	12.53	0.74
LIBOR-GC Repo	1.03	15.00	0.69

Changes

	coefficient	t-stats	R2
TED spread	0.46	6.07	0.15
LIBOR-GC Repo	0.09	2.21	0.03

Other remarks

- The daily rates must be sampled at the same time. Data for both markets are generally available am and pm.
- The cointegration procedure is somewhat ad-hoc. Techniques are available to allow the long-run relationship and the dynamics of the variables to be time-varying (or regime dependent)
- The estimations of the VECH-GARCH model show that only the repo market bear the burden of the adjustment to shocks to the Repo-FFR spread. In both normal and turbulent times. Intuitions?
- The adjustment slowed down during the crisis. In line with a 'run on repo' (Gorton and Metrick 2010; 2011a; 2011b). However, it depends on the risk profile of the collateral (Krishnamurty *et al.*, 2011). A single repo rate may be too simplistic.

Conclusions

- It is an interesting 'first draft' of a paper.
- It is worthwhile exploring
  - the relationships between the cash and repo markets
  - the transmission mechanism linking cash and repo rates
- However, much work has to be done to take into account the key features of these important markets.