Limits to arbitrage during the crisis: funding liquidity constraints & covered interest parity

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Research aims

- To document deviations from the Covered Interest Rate Parity (CIP) during the Crisis
- To explain them
Main findings


- “Floating capital normally available for the purpose of taking advantage of arbitrage profits is by no means unlimited in amount” (p. 129)
- “The abnormal discount can only disappear when the high profit of arbitrage between spot and forward has drawn fresh capital into the arbitrage business” (p. 130)
Related literature: FX arbitrage

- FX arbitrage
Related literature: limits to arbitrage

- Limits of arbitrage
  - Surveys: Gromb and Vayanos (2010); Brunnermeier and Oehmke (2012)
  - Heterogeneous beliefs: e.g. Miller (1977), Scheinkman and Xiong (2003)
  - Time horizons: e.g. Dow and Gorton (1994)
  - Moral hazard: e.g. Acharya and Viswanathan (2011)
  - Risk aversion: e.g. Xiong (2001)
  - Slow-Moving Capitals: Duffie (2011)
Related literature: crisis measures

- Unconventional monetary policies
  - CIP and unconventional monetary policies
CIP arbitrage
How to perform CIP arbitrage

- Secured arbitrage
- Unsecured arbitrage
CIP arbitrage: unsecured
CIP arbitrage: secured

- Lender L
- Borrower B
- Hedge fund
- FX Counterparty
- Spot
- Forward
- Cash
- Collateral

ON / 1W REPO
Replicating the CIP arbitrage

Our method to compute CIP takes into account:

1. **Transaction costs** → pure profits
2. **Synchronicity** → no time bias
3. **Actual** prices → no mismeasurement
4. **Secured** money market rates → minimum risk

\[
Z_{4,t} = \frac{F_{t...T}^B}{S_t^A} (1 + r_{j,t...T}^{R,B}) - (1 + r_{k,t...T}^{R,A})
\]
### Data

<table>
<thead>
<tr>
<th>Asset</th>
<th>Synch</th>
<th>Maturity</th>
<th>Bid / Ask</th>
<th>Source</th>
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<td>Snaps / All</td>
<td>spot</td>
<td>Yes</td>
<td>TP / EBS</td>
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<td>FX fwd</td>
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- EURUSD, USDJPY, GBPUSD, USDCHF, EURCHF
- 2006-20012
Documenting CIP deviations
CIP profits: short USD 1M, unsecured

Excess profits from CIP arbitrage (short dollar spot positions)
CIP profits: short USD 1M, unsecured

Excess profits from CIP arbitrage (short doll)

Sept-Dec 2008: Huge deleveraging

Sept. 2007:
Northern Rock collapsed

March 2008:
Bear Stearns failure

Dec. 2007:
“Window dressing”

Aug. 2007:
BNP Paribas suspended redemption of 3 funds

Sept. 2008:
Fannie Mea & Freddie Mac under conservatorship

+ 15. Sept. 2008:
Lehman B. + AIG

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+ 15. Sept. 2008:
Lehman B. + AIG
CIP profits: long USD 1M, unsecured
Non-US FF with aggregate exposure on USD

European banks’ balance sheet positions

In trillions of US dollars

Net positions, by currency

- USD
- EUR
- CHF
- GBP
- JPY
- Other


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Angelo Ranaldo, s/bf-HSG
CIP profits: short USD 1M, unsecured

June 2010: Greek crisis

Winter 2010

European sovereign debt crisis

Lehman
CIP profits: **short EUR 1M, unsecured**

June 2010: Greek crisis

Winter 20101

Lehman

-European sovereign debt crisis-
CIP profits: overview

June 2010: Greek crisis
Winter 2010: European sovereign debt crisis

Lehman
Takeaways

1. Excess profits are **currency-specific**
2. Excess profits are **directional**: only when the USD (EUR) is the funding (investment) currency
3. Same picture for **any** trading strategy
Explanations
Why?

1. Market illiquidity
2. Funding constraints
3. Risk
Market illiquidity
Market illiquidity

Mancini, Ranaldo and Wrampelmeyer (JF, 2012)
Deleveraging
Adrian-Shin measure

- Initial losses → Funding problems for speculators → Reduced positions → Prices move away from fundamentals → Higher margins → Losses on existing positions

Figure 2
Liquidity spirals
Brunnermeier & Pedersen RFS 2009
Prudential hoarding

bank deposits left at the FED NY
Limited capital

- Pledging better collateral, arbitrage requires less capital to cover margins
- Garleanu and Pedersen (2011)
- Measured by the Spread bw REPO GC – REPO MBS

![Liquidity spirals](image)

Figure 2
Liquidity spirals
Risk: 3 elements

- **Lender L**
  - Roll-over Risk
    - Measured by $\Delta$ interest-rate spreads

- **Trader**
  - Contract Risk
    - Measured by option-implied FX volatility

- **Borrower B**
  - Counterparty Default Risk
    - Measured by CDS banks

- **Counterparty**
  - Spot
  - Forward

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Empirical analysis
Estimation

\[ \Delta z_t = \alpha + \rho' \Delta z_{t-1} + \beta' \Delta B_t + \chi' \Delta X_t + \delta' \Delta \Phi_t + \varepsilon_t \]

- Market illiquidity
- Funding constraints
- Risk factors
Estimation

\[ \Delta z_t = \alpha + \rho' \Delta z_{t-1} + \beta' \Delta B_t + \chi' \Delta X_t + \delta' \Delta \Phi_t + \varepsilon_t \]

Policy measures to relax funding constraints

1. Central bank swaps (FED – other CBs)
2. Unconventional facilities

➢ “Exogenous” variables
Results on long EURUSD / shorting USD

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## FED measures

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<td>8.95</td>
<td>0.74</td>
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<td><strong>US %</strong></td>
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<td>65%</td>
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<tr>
<td><strong>FGN %</strong></td>
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<td>35%</td>
<td>52%</td>
<td>6%</td>
<td>56%</td>
<td>100%</td>
<td>55%</td>
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Additional tests & robustness

1. Panel regressions
2. No endogeneity problems
   - Hausman tests
   - Structural VAR
3. Sub-samples
   - The results are not biased by Lehman
4. Other maturities
5. Other intraday snaps
Conclusion
Conclusion

- Limits to arbitrage
- Funding liquidity constraints
- Unconventional monetary policies