

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



Keynes, J. M. (1923): A tract on monetary reform.

- “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
 - Prachowny (1970), Frenkel and Levich (1975, 1977)
 - CIP: Taylor (1989), Rhee and Chang (1992), Akram, Rime, and Sarno (2008) and Fong, Valente, and Fung (2010)
 - On the crisis: Baba, Packer, and Nagano (2008), Baba and Packer (2009b, 2009a), Coffey, Hrungr, and Sarkar (2009), Genberg, Hui, Wong, and Chung (2009) and Jones (2009).

Related literature: limits to arbitrage

- Limits of arbitrage
 - Surveys: Gromb and Vayanos (2010); Brunnermeier and Oehmke (2012)
 - Funding constraints: e.g. Brunnermeier and Pedersen (2009), Garleanu and Pedersen (2011), Gromb and Vayanos (2002), Kondor (2009)
 - Agency problems: e.g. Shleifer and Vishny (1992, 1997), Allen and Gorton (1993)
 - 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

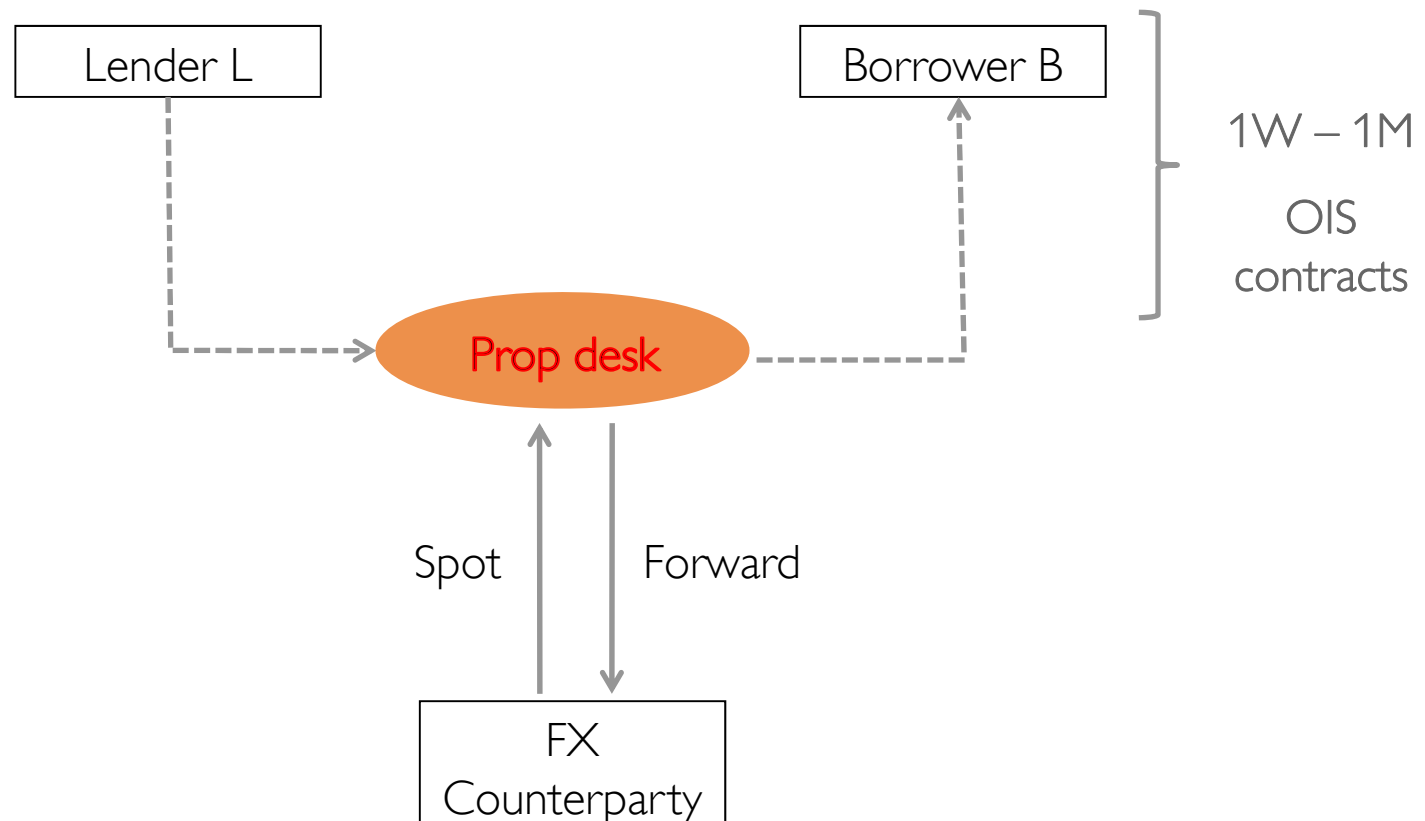
CIP arbitrage



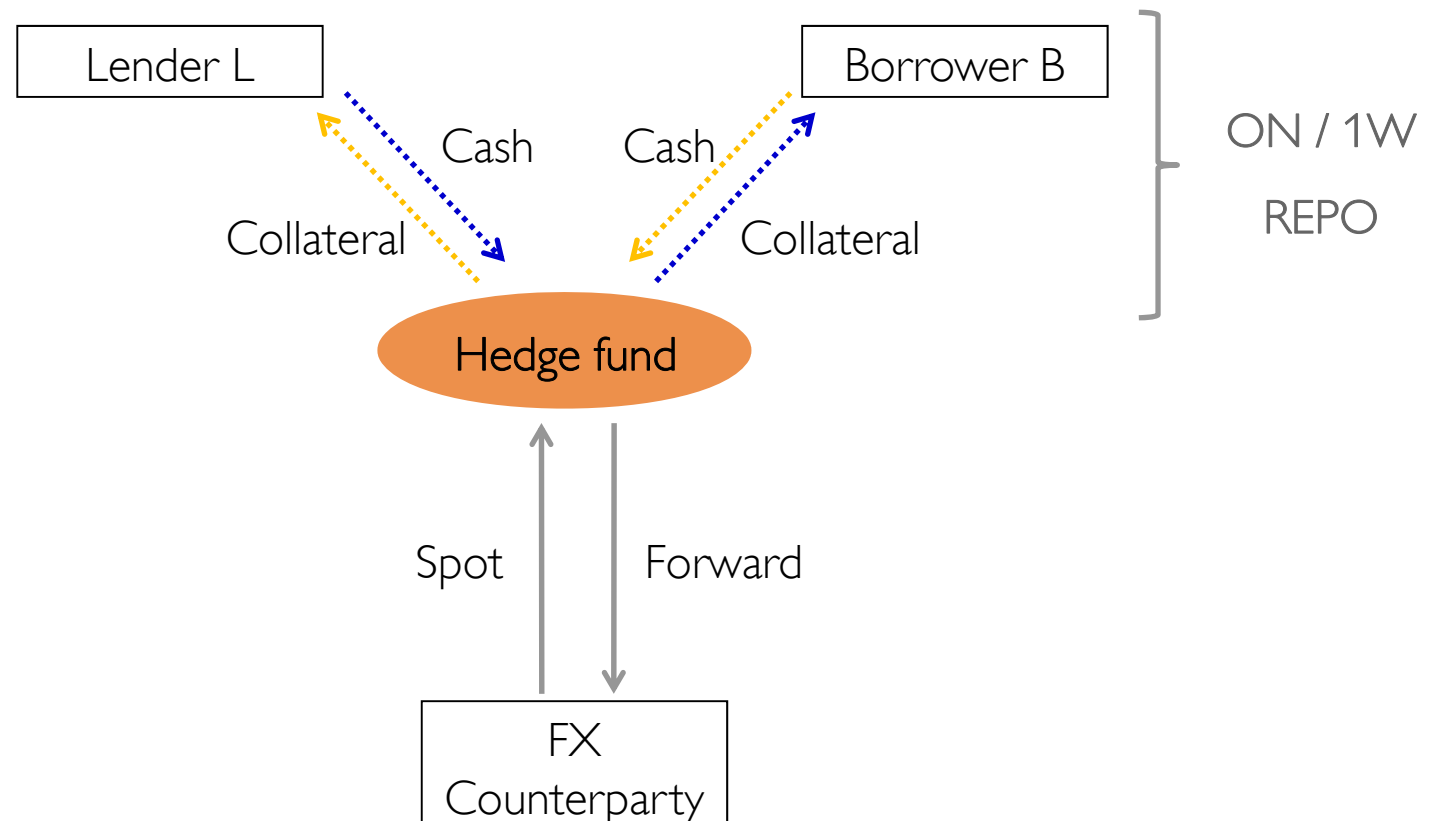
How to perform CIP arbitrage

- Secured arbitrage
- Unsecured arbitrage

CIP arbitrage: unsecured



CIP arbitrage: secured



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

$$z_{4,t} = \frac{F_{t...T}^B}{S_t^A} \left(1 + r_{j,t...T}^{R,B} \right) - \left(1 + r_{k,t...T}^{R,A} \right)$$

Data

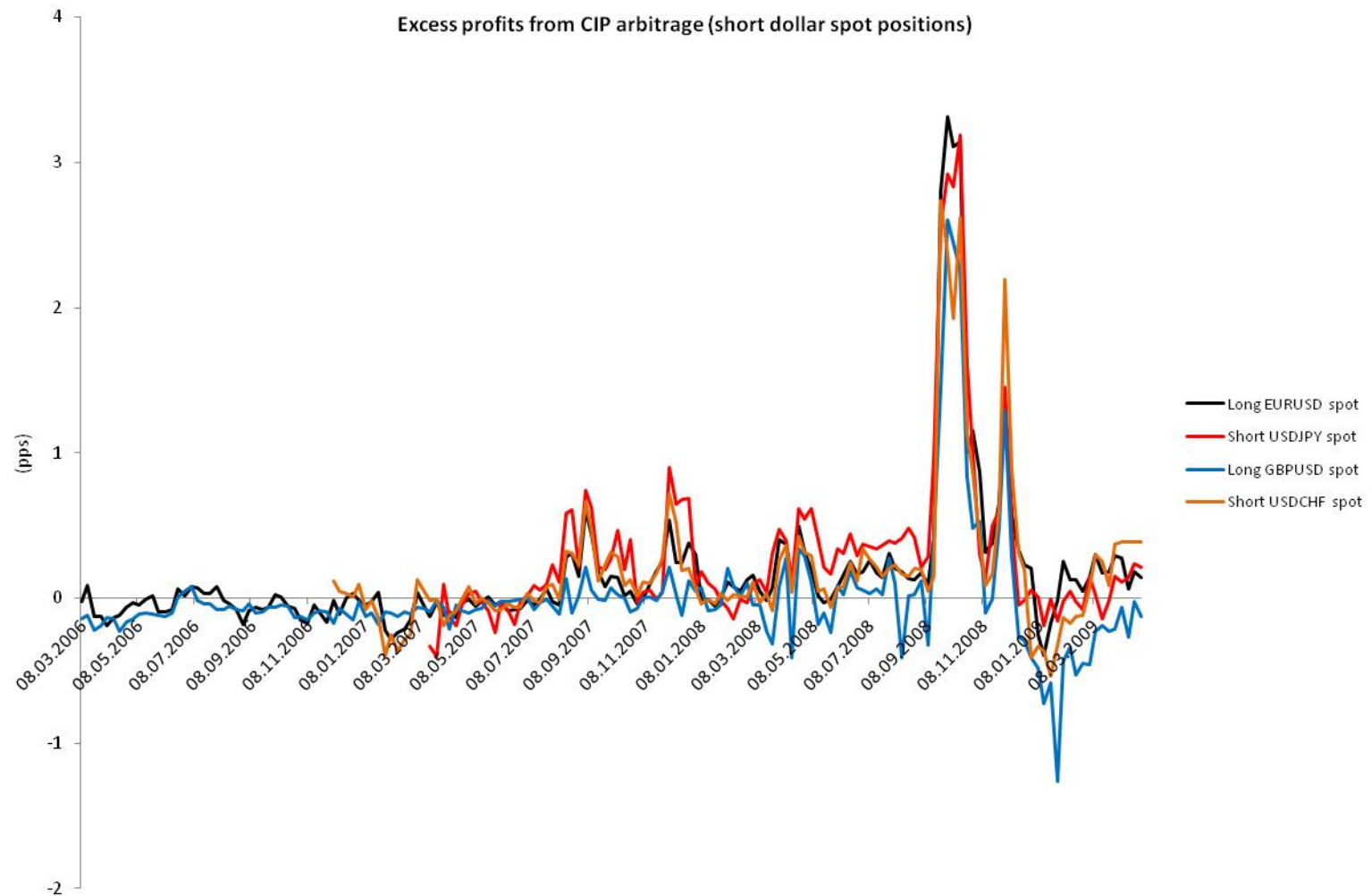
Asset	Synch	Maturity	Bid / Ask	Source
FX spt	Snaps / All	spot	Yes	TP / EBS
FX fwd	Yes, snaps	ON-2Y	Yes	TP
OIS	Yes, snaps	1W-2Y	Yes	TP
REPO USD	Snaps	ON-3M	Price	ICAP
REPO EUR	All trades	ON-1Y	Yes	EUREX
REPO CHF	All trades	ON-3M	Yes	EUREX

- EURUSD, USDJPY, GBPUSD, USDCHF, EURCHF
- 2006-20012

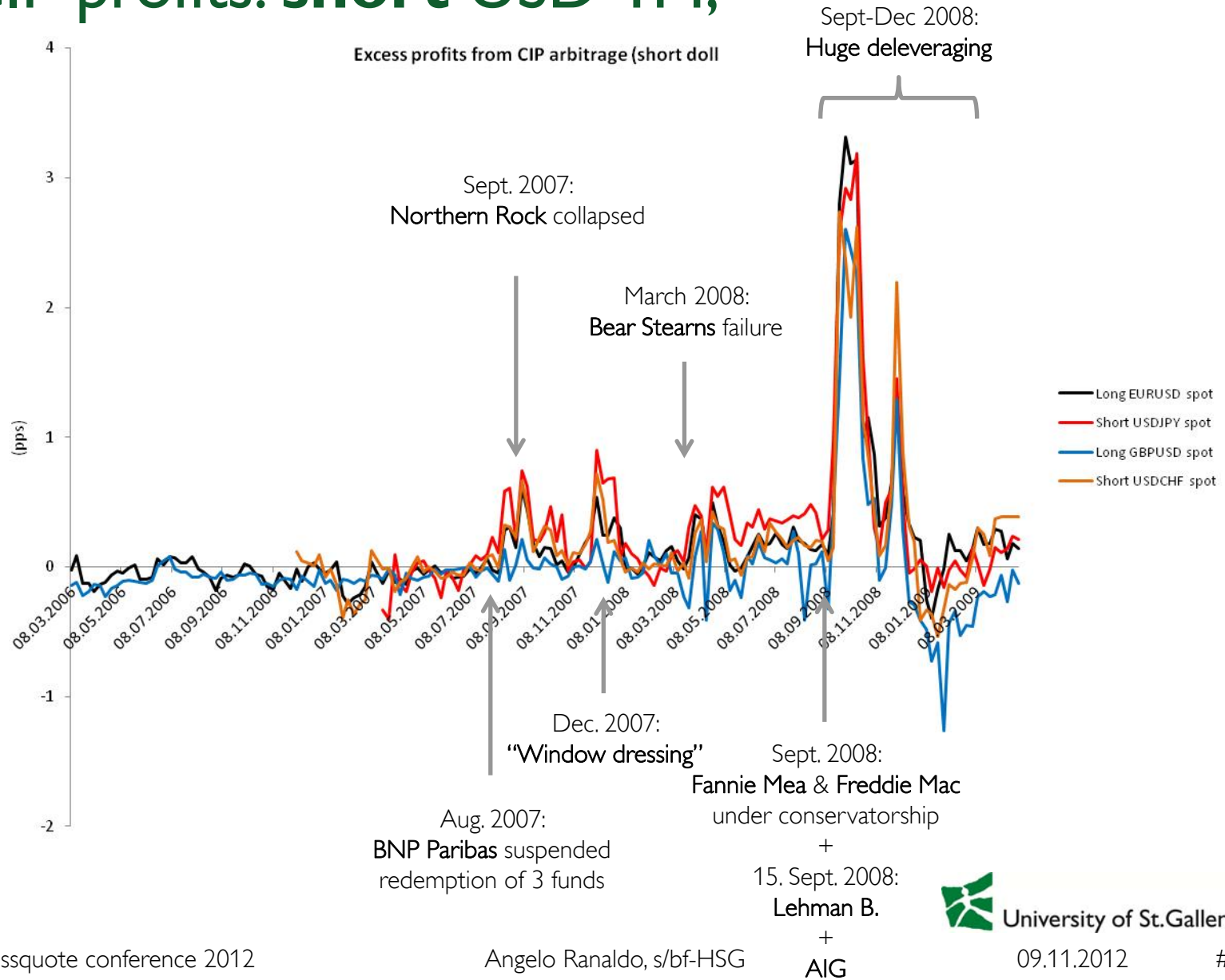
Documenting CIP deviations



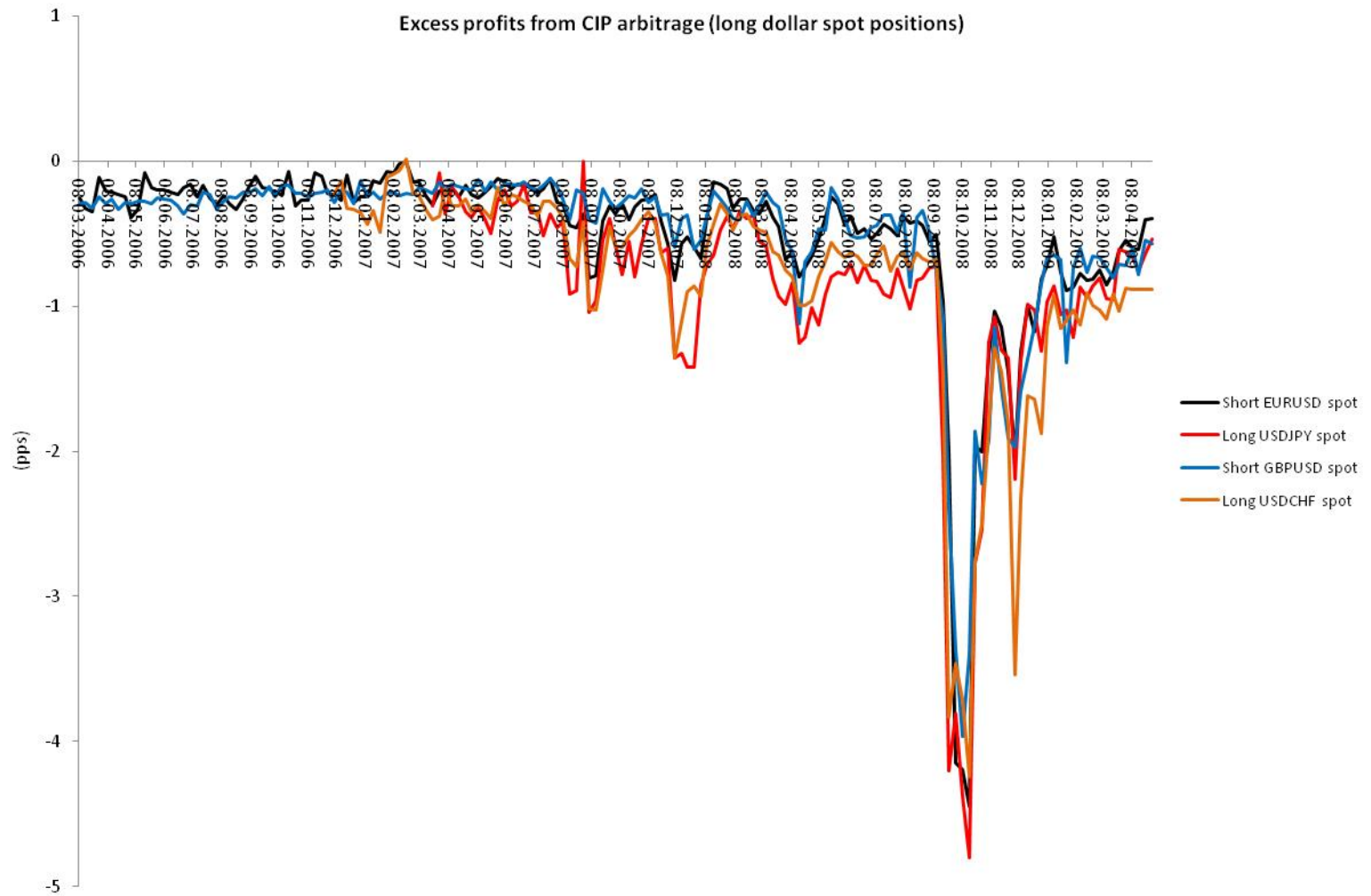
CIP profits: short USD 1M, unsecured



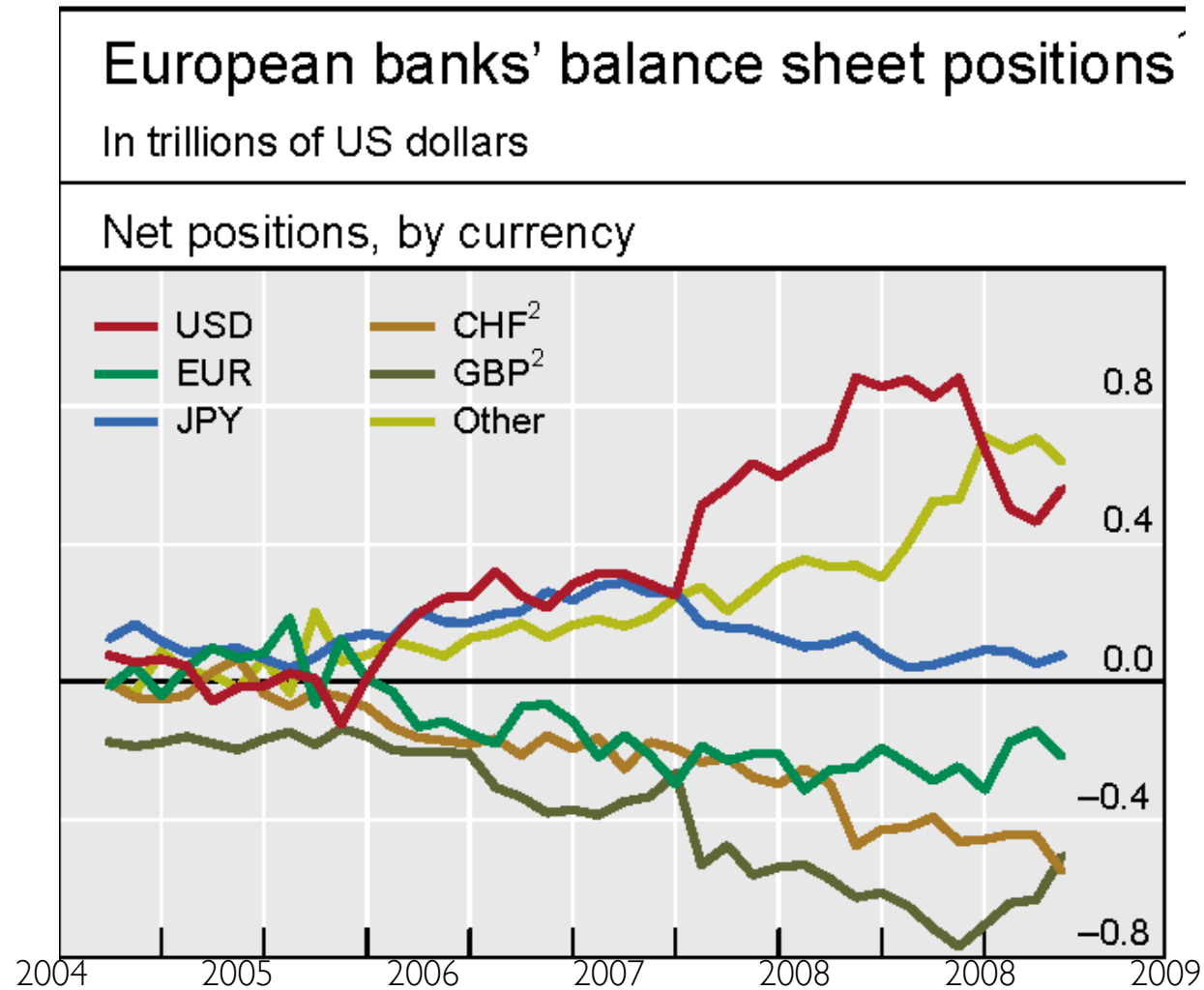
CIP profits: short USD 1M, unsecured



CIP profits: long USD 1M, unsecured



Non-US FF with aggregate exposure on USD

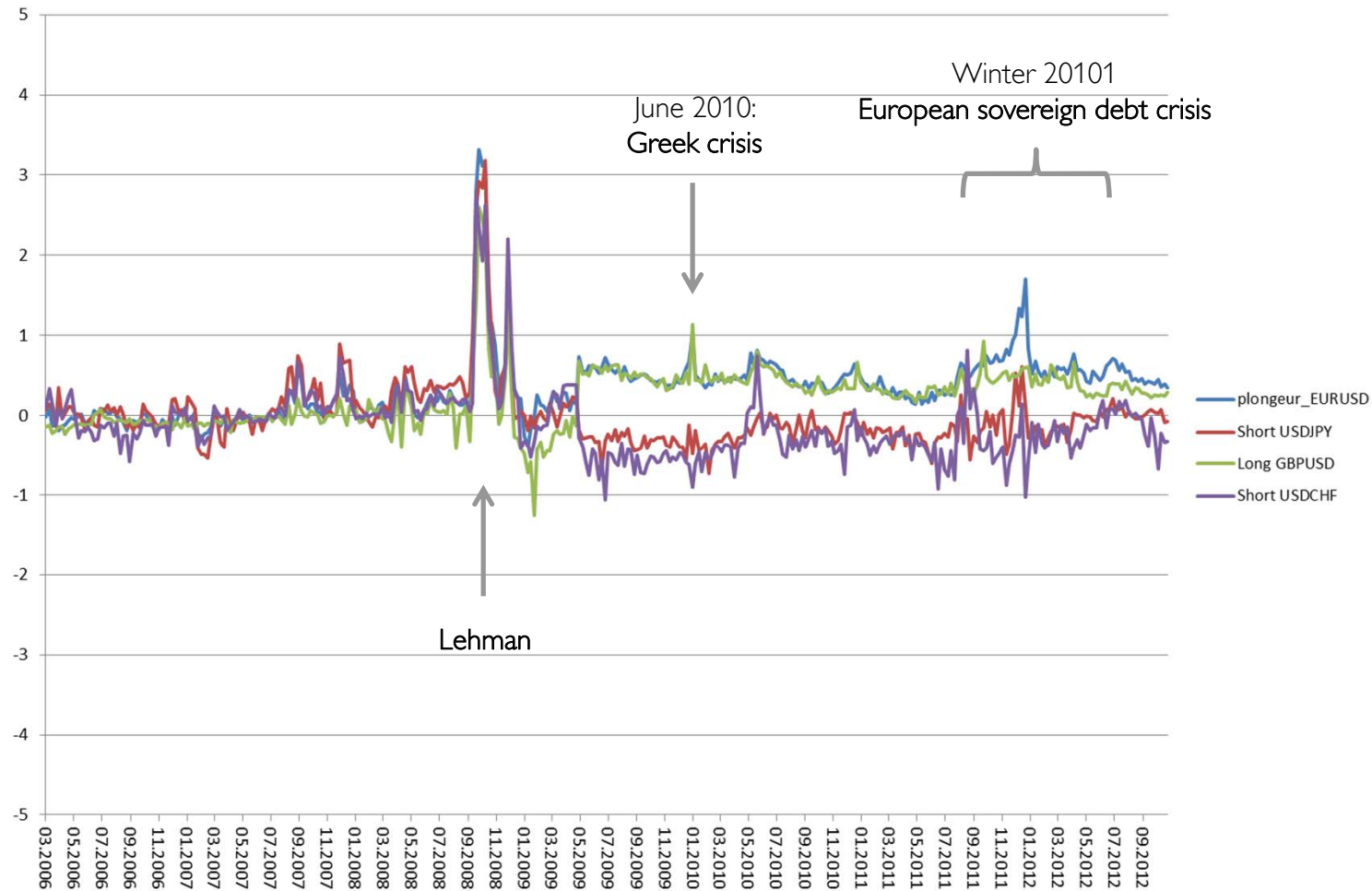


McGuire, P. and G. von Peter: „The US dollar shortage in global banking“, BIS Quarterly Review, March 2009

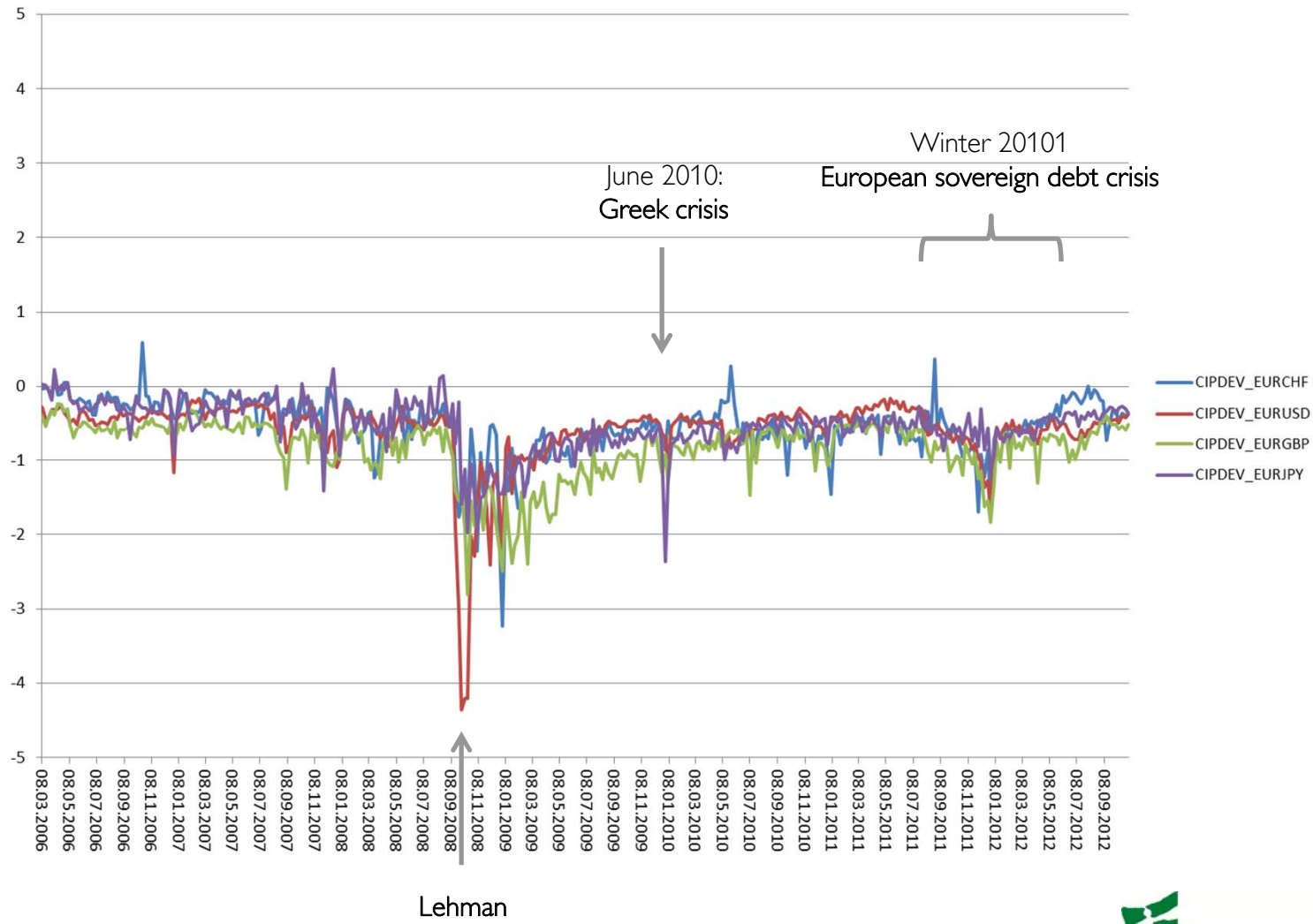


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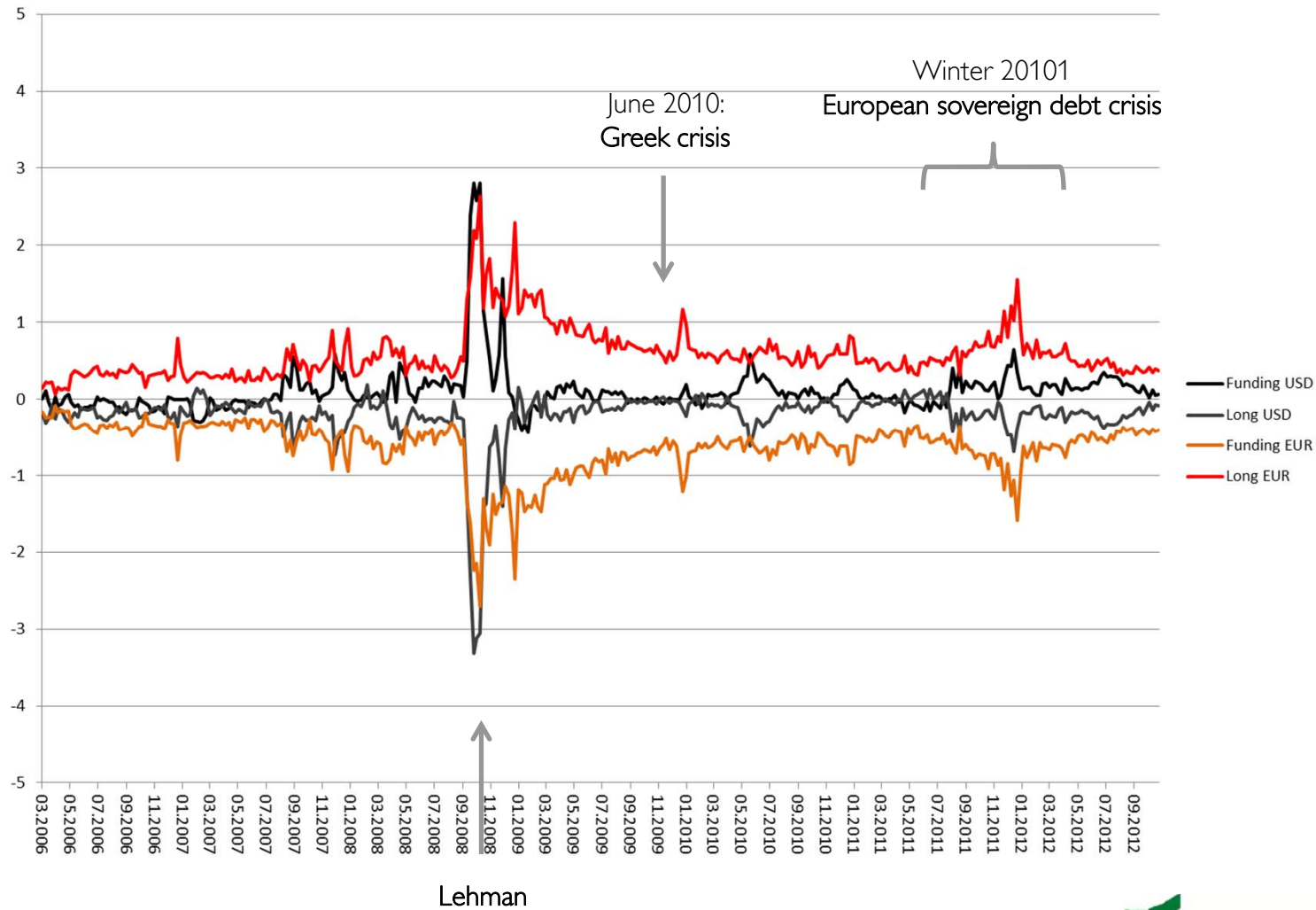
CIP profits: short USD 1M, unsecured



CIP profits: short EUR 1M, unsecured



CIP profits: overview



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

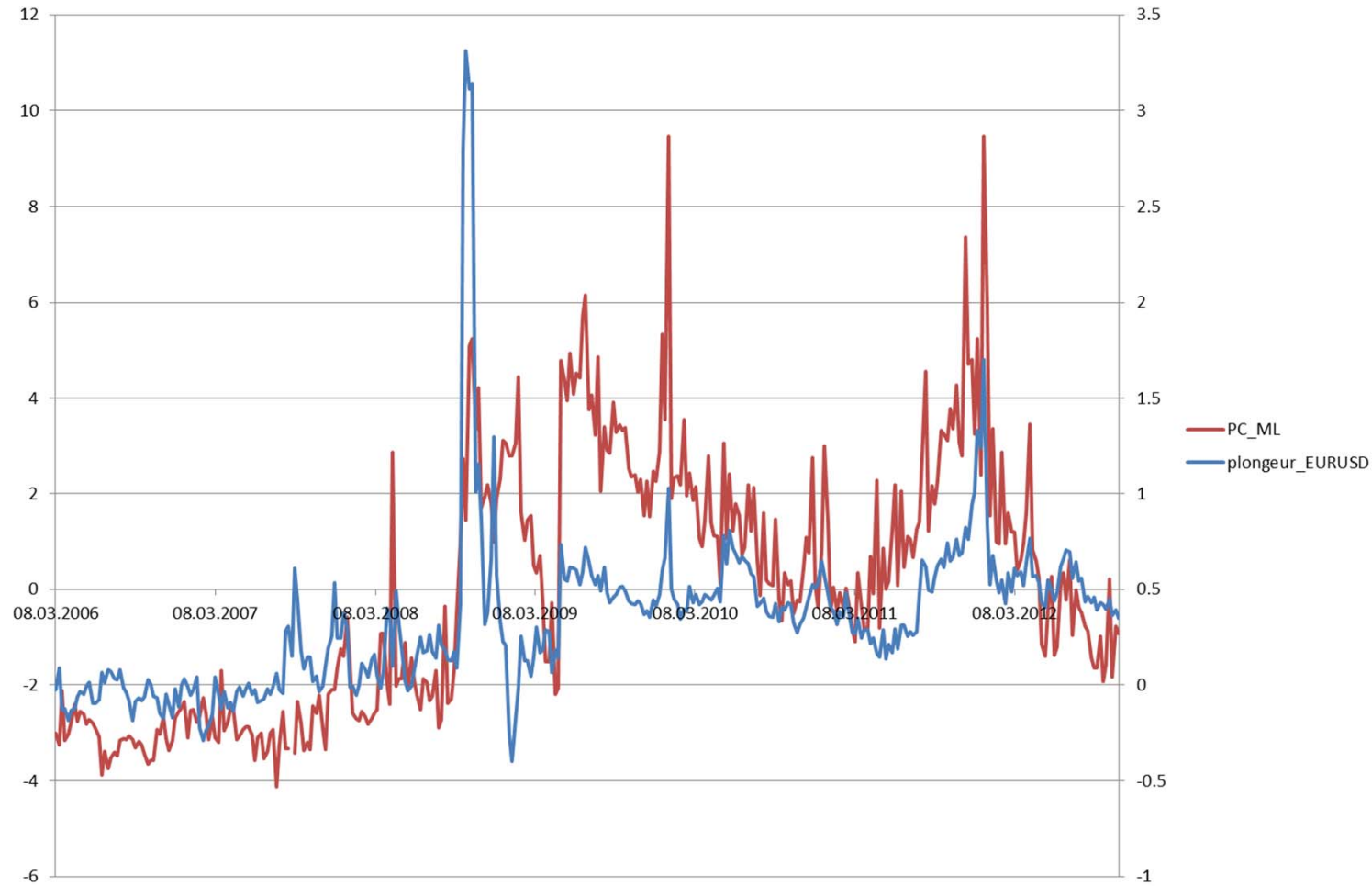


Why?

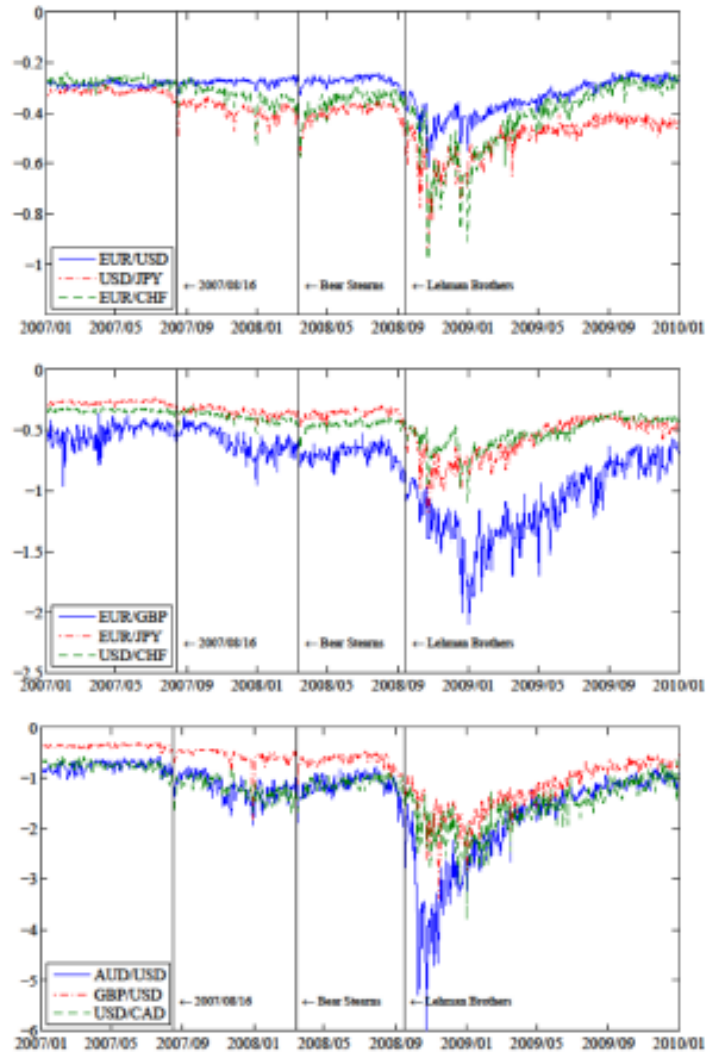
1. Market illiquidity
2. Funding constraints
3. Risk



Market illiquidity



Market illiquidity



Mancini, Rinaldo and
Wrampelmeyer (JF, 2012)

Swissquote conference 2012

Angelo Rinaldo, s/bf-HSG



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09.11.2012

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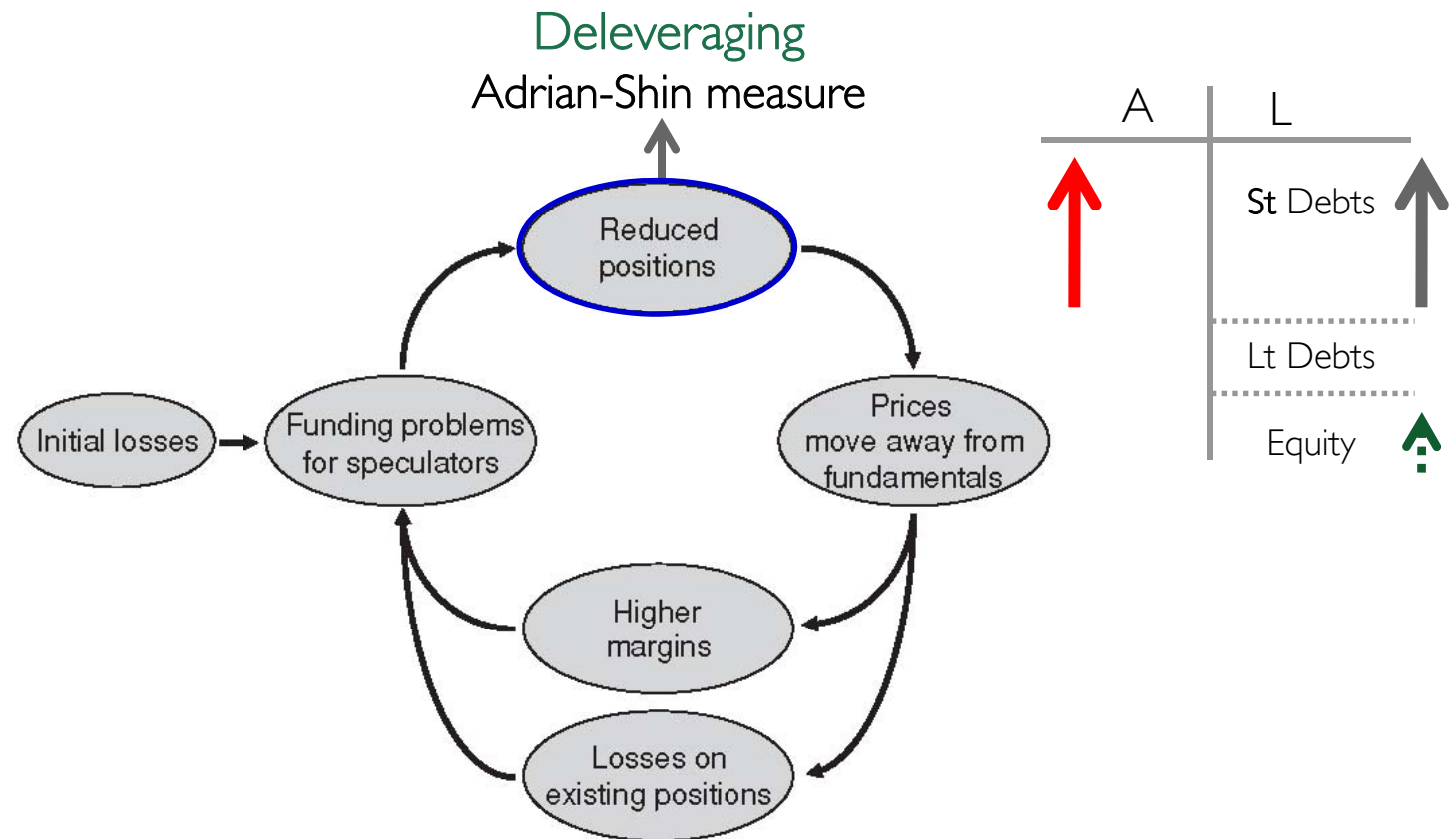
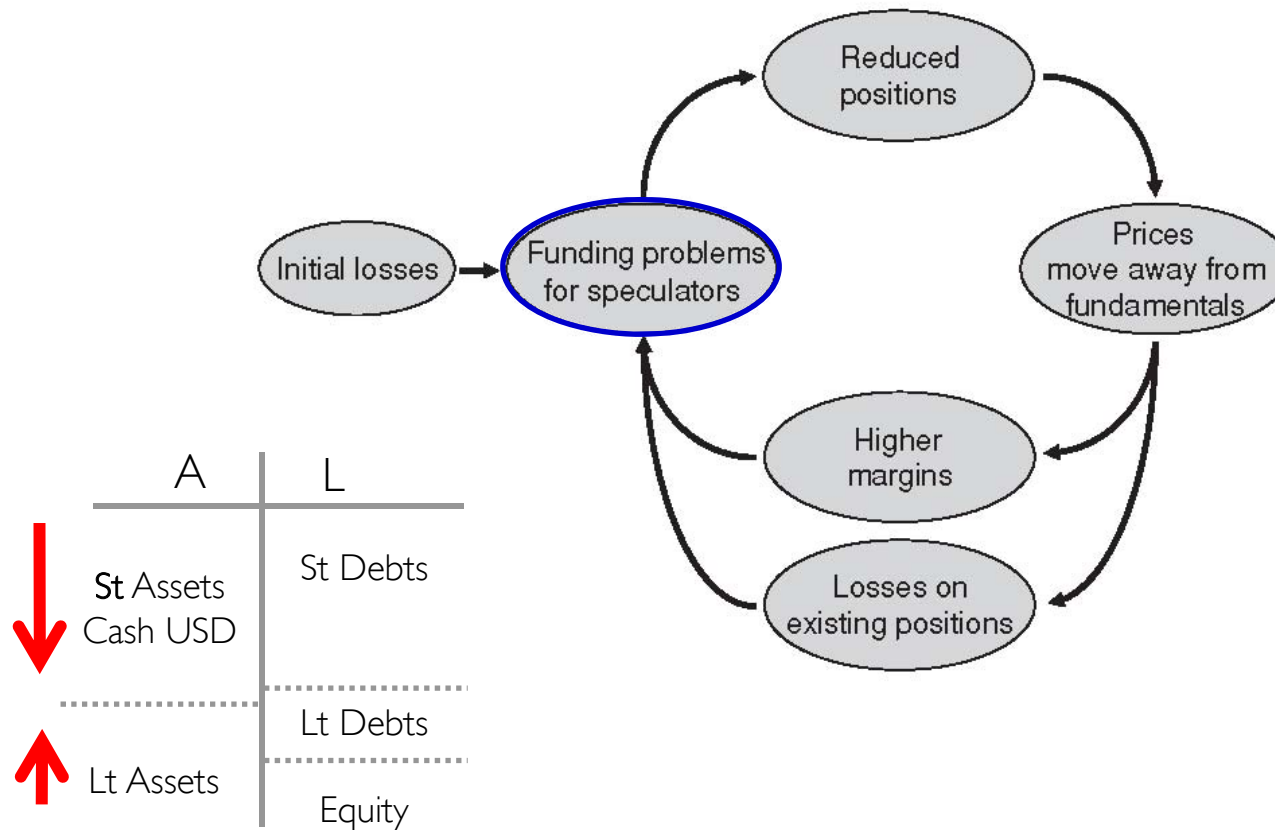


Figure 2
Liquidity spirals

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

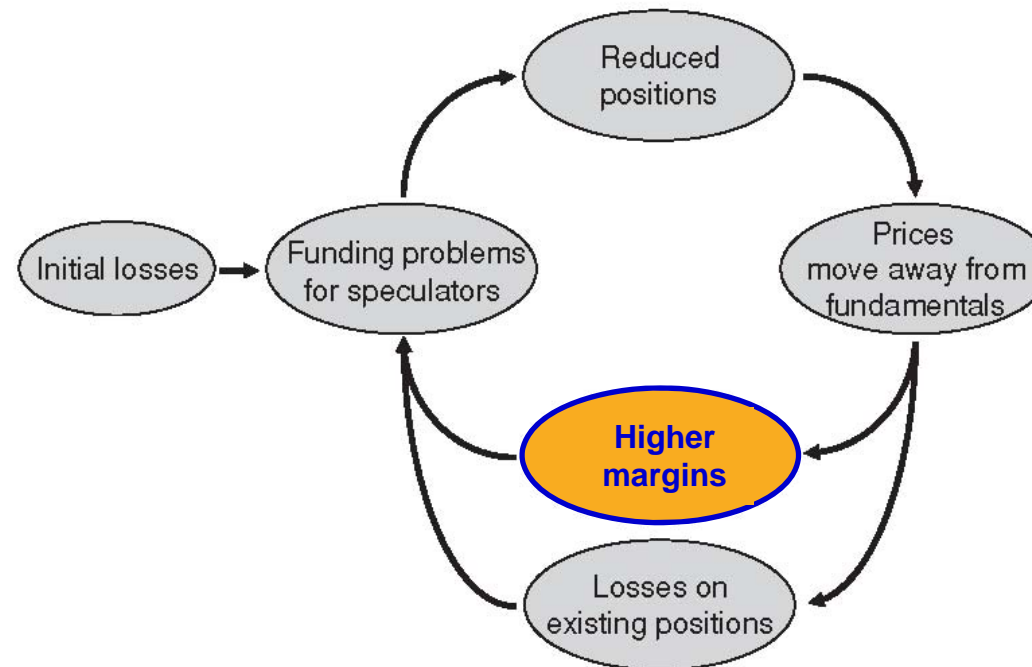
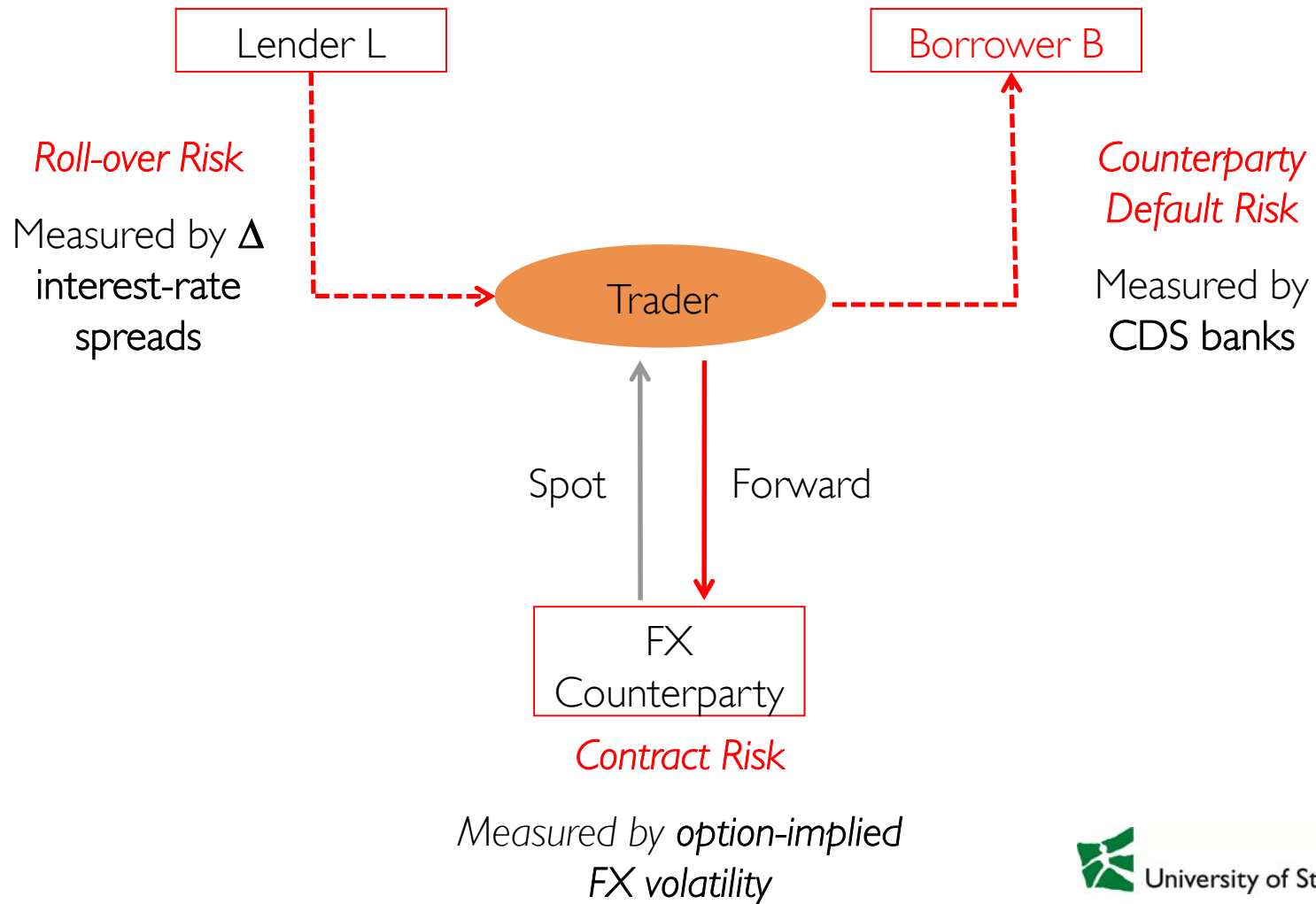


Figure 2
Liquidity spirals

Risk: 3 elements



Empirical analysis



Estimation

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

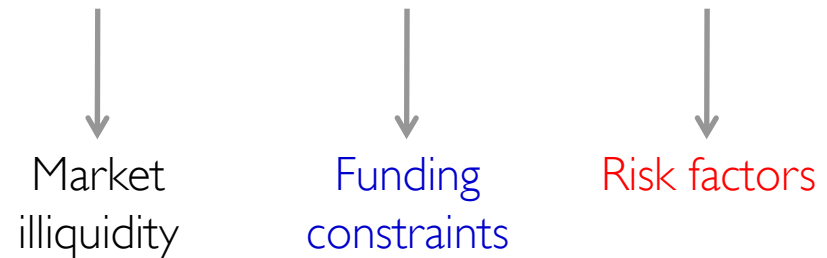
↓
Market
illiquidity

↓
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

	1	2	3	4	5	6	7
Market Illiquidity	-0.066	-0.055	-0.054	-0.055	-0.051	-0.058	-0.056
	-4.184	-3.296	-3.353	-3.314	-3.080	-3.754	-3.111
Funding Constraints	0.084	0.109	0.090	0.078	0.064	0.115	0.101
	6.646	8.106	6.154	5.052	3.800	9.276	6.582
Central banks swap			-0.048				
			-4.212				
Reserve credits				-2.906			
				-3.172			
Liquidity hoarding					0.666		
					6.281		
Deleveraging						2.669	
						2.076	
Limited capital							0.231
							2.233
Risk	0.047						
	7.122						
Contract risk		0.131	0.139	0.145	0.081	0.133	0.130
		5.121	5.654	5.546	3.058	5.466	4.739
Rollover risk		0.034	0.104	0.130	0.152	0.028	0.061
		0.313	0.966	1.128	1.379	0.269	0.516
Counterparty risk		0.271	0.333	0.306	0.120	0.297	0.317
		1.233	1.593	1.320	0.594	1.416	1.338
Adj. R2	0.423	0.347	0.402	0.295	0.416	0.403	0.348

FED measures

	AMLF	Discount Window	MBS purchase	PDCF	CP	CB swap lines	TAF
Total USD Trillion	0.22	15.76	1.85	8.95	0.74	10.06	3.82
US %	100%	65%	48%	94%	44%	0%	45%
FGN %	0%	35%	52%	6%	56%	100%	55%

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