Covered interest rate parity deviations during the crisis

Tommaso Mancini Griffoli, Angelo Ranaldo
SNB research unit

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SWISS NATIONAL BANK

Agenda

- CIP basics and motivation
- CIP details
- CIP initial empirics
- Some takeaways
- More empirics
- A theory of CIP breakdown

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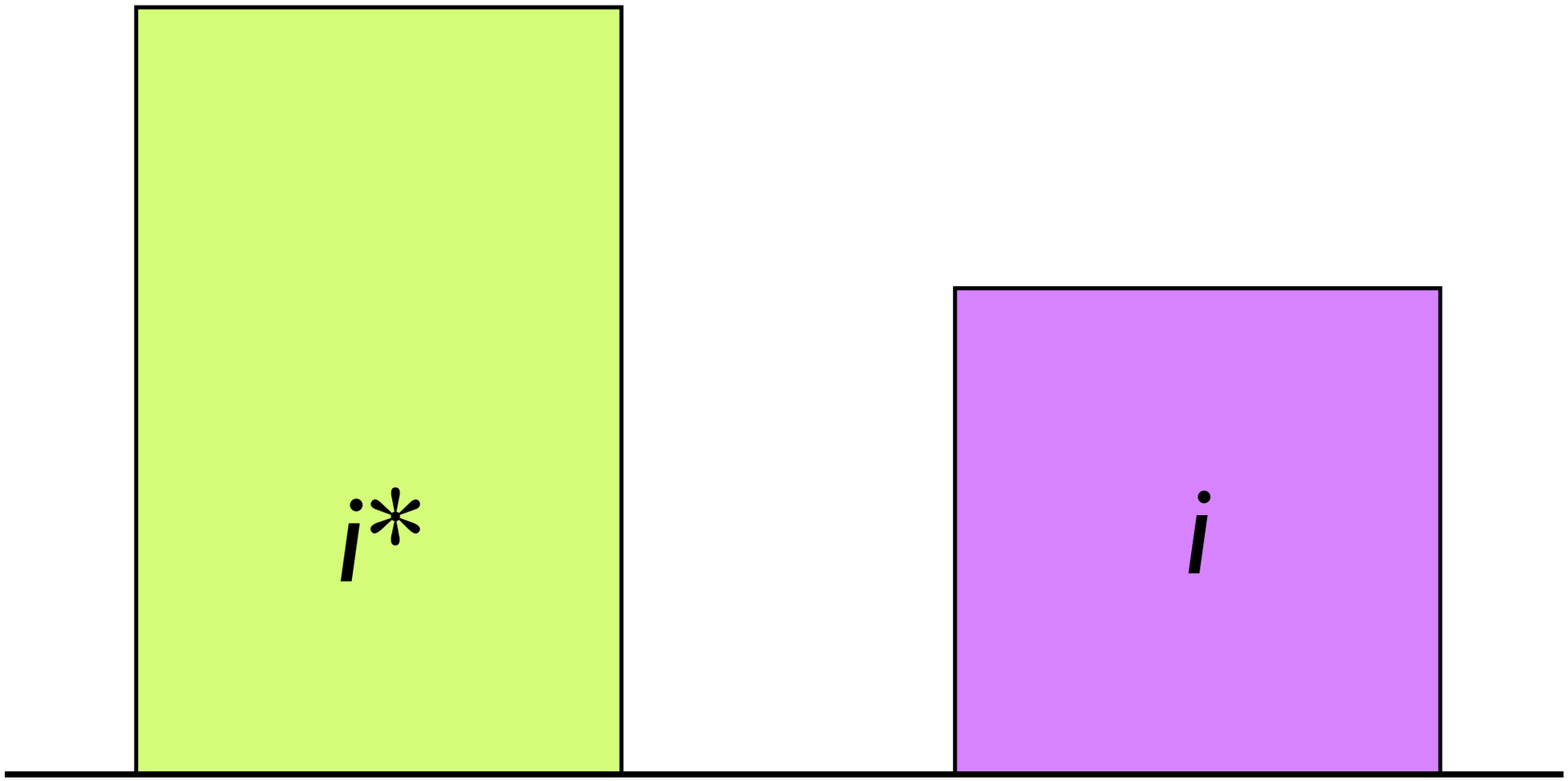
Covered Interest Parity (CIP)



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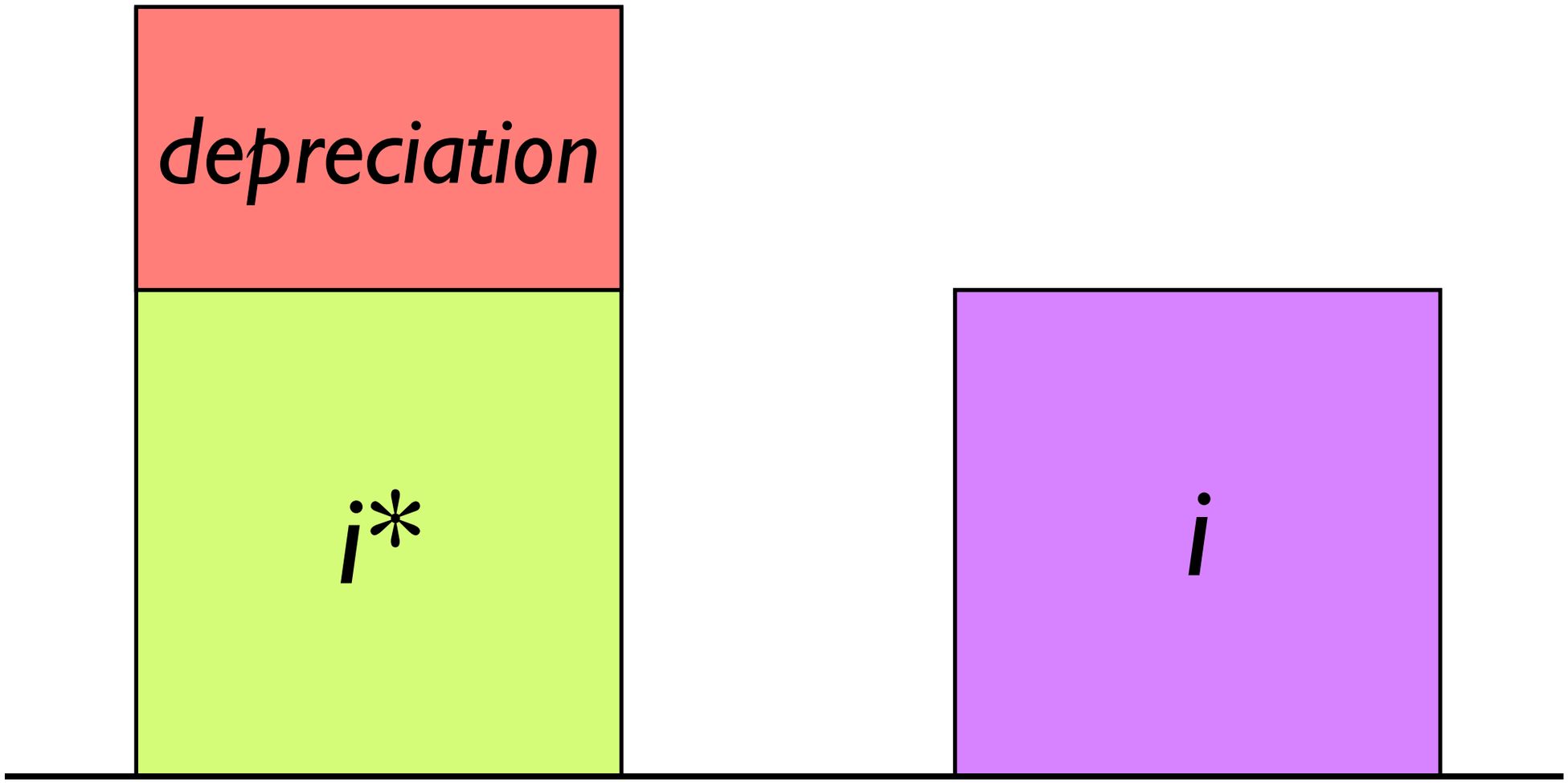

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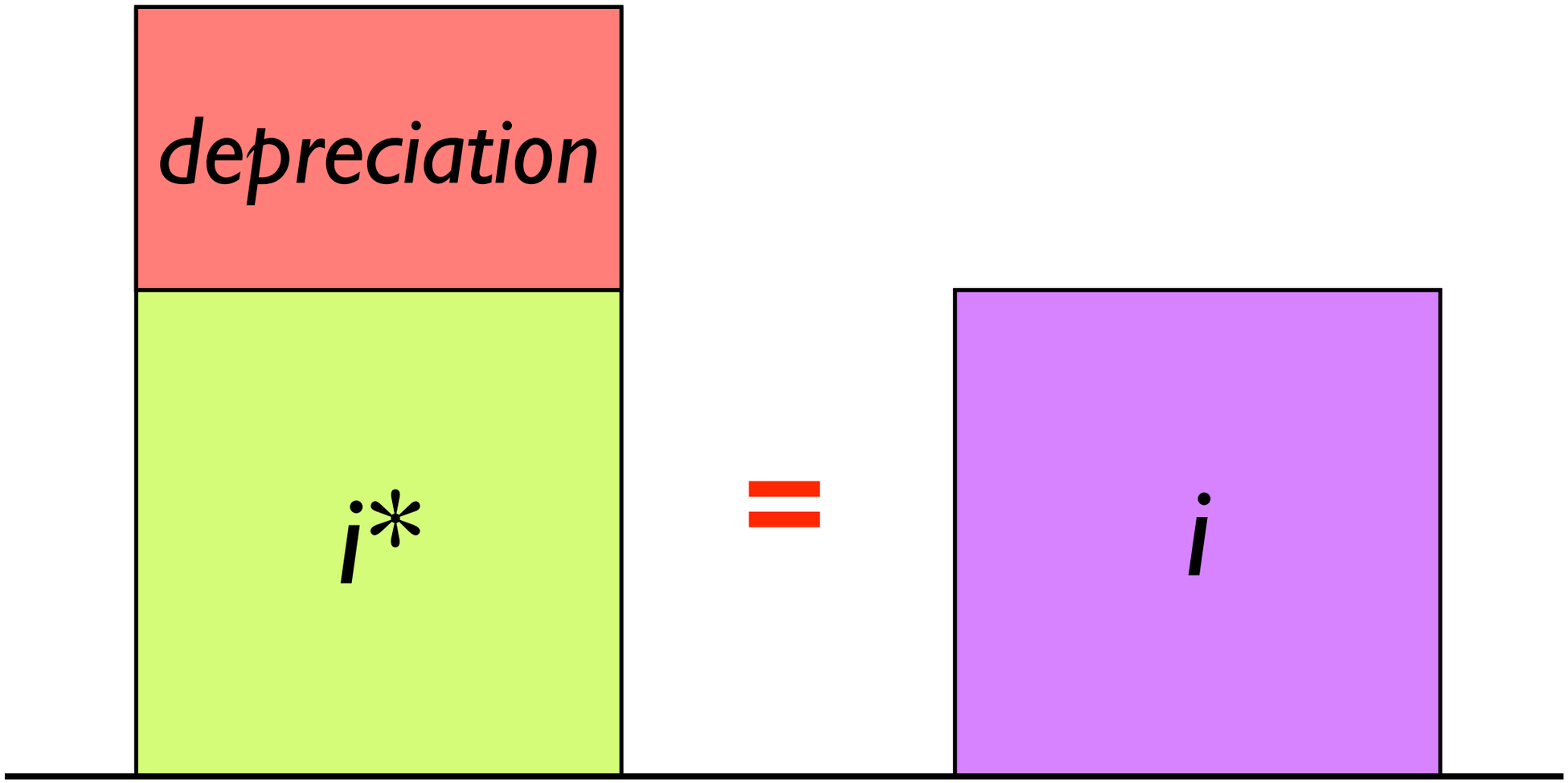

CIP condition

Note: S is domestic per foreign currency units.

CIP condition

$$\frac{I}{S}$$

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CIP condition

$$\frac{1}{S}(1+i^*)$$

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$$\frac{F}{S}(1+i^*)$$

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CIP condition

$$\frac{F}{S}(1+i^*) = (1+i)$$

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interest differential

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depreciation (forward premium)

interest differential

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CIP balancing

$$\frac{F}{S}(1+i^*) > (1+i)$$

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CIP balancing

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- Riskless gains!
- Sell (short) domestic currency spot
- Buy (long) domestic currency forward

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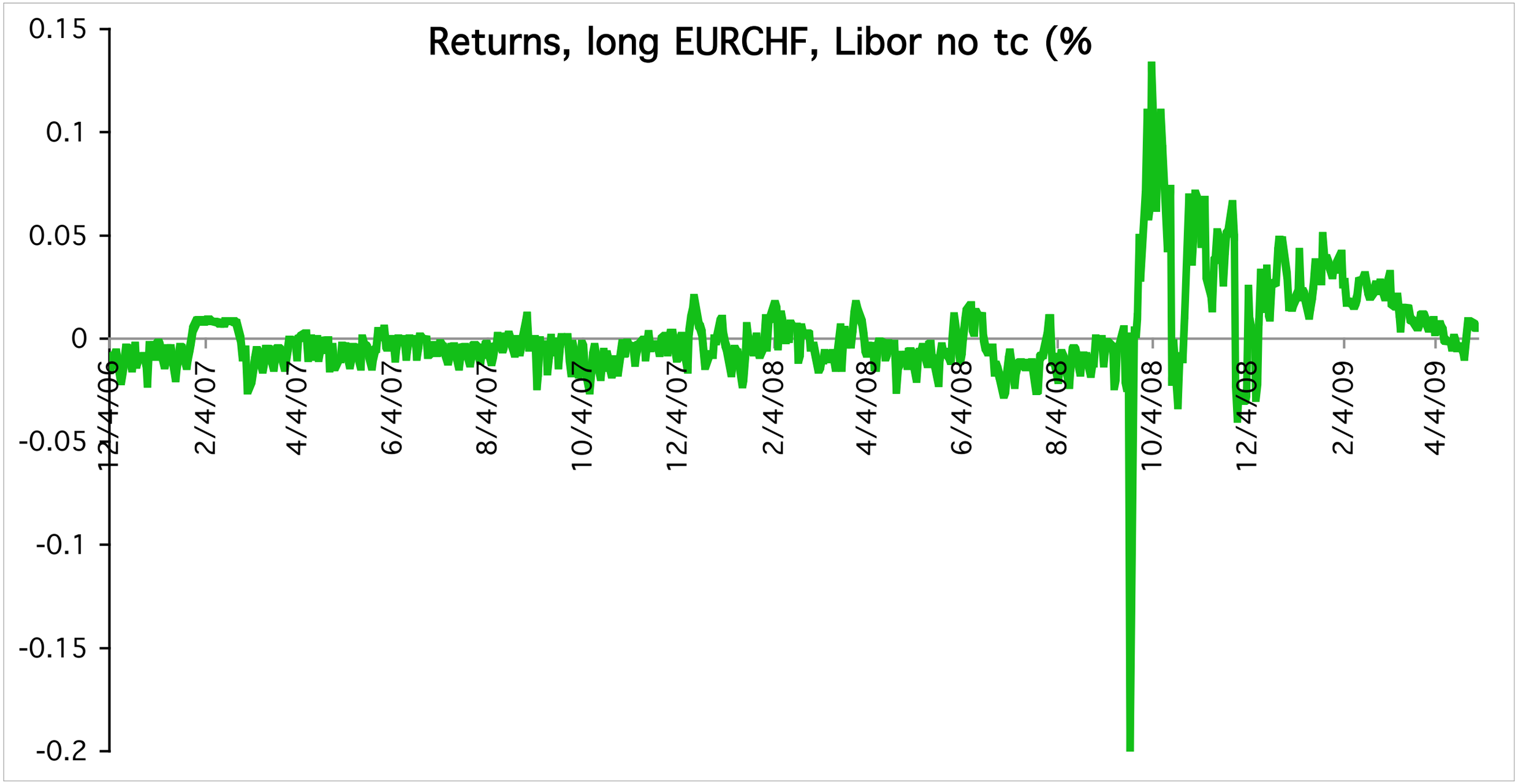
In theory…

- CIP should always hold!
- Otherwise, infinite Sharpe ratios!

In practice…

- Some deviations in CIP
  - Over short periods (Taylor ’89)
  - Over longer periods... since Lehman
    - Baba, Packer & Nagano (BIS ’08), Baba & Packer (BIS ’09), Coffey, Hrung, Nguyen & Sarkar (NYFed ’09), others...

CIP deviations



The story is more complicated!

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Problems with using Libor

- Ask
- Indicative
- Not representative
- Strategic
- Poor timing
- May not have been used by speculators!

A more realistic rate… another funding market

- Bid-Ask spreads
- Traded/ firm prices
- Continuous quotes
- Avoid counterparty risk
- Avoid low liquidity

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Overnight rates

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Overnight rates

- [x] Bid-Ask spreads
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Arbitrage mechanics

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SPOT

Short *j*

Long *i*

Arbitrage mechanics

SPOT	FUNDING
Short *j*	pay O/N j
Long *i*	get O/N i

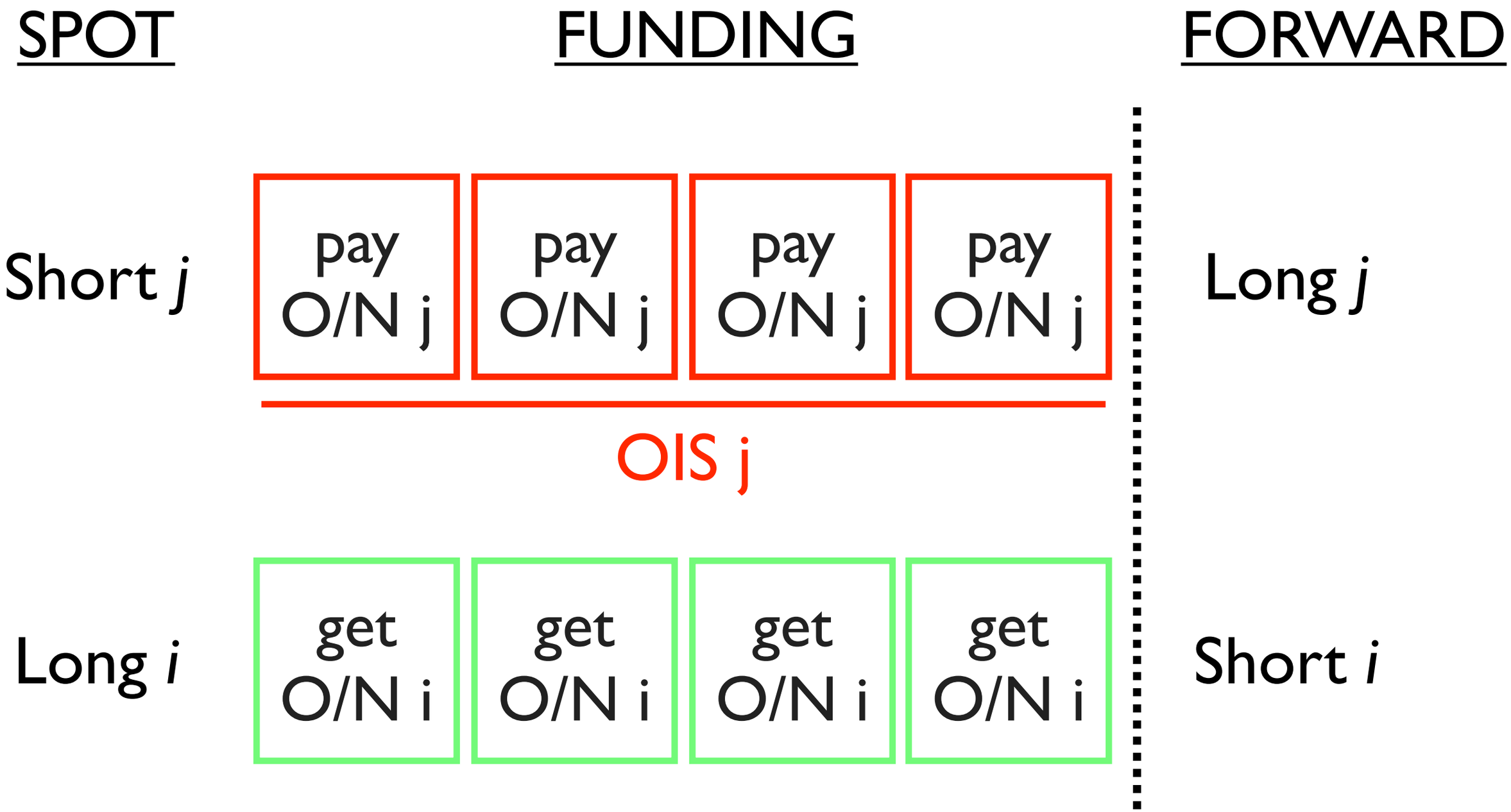
Arbitrage mechanics

SPOT	FUNDING			
Short *j*	pay O/N j	pay O/N j	pay O/N j	pay O/N j
Long *i*	get O/N i	get O/N i	get O/N i	get O/N i

Arbitrage mechanics

SPOT	FUNDING				FORWARD
Short *j*	pay O/N j	pay O/N j	pay O/N j	pay O/N j	Long *j*
Long *i*	get O/N i	get O/N i	get O/N i	get O/N i	Short *i*

Arbitrage mechanics



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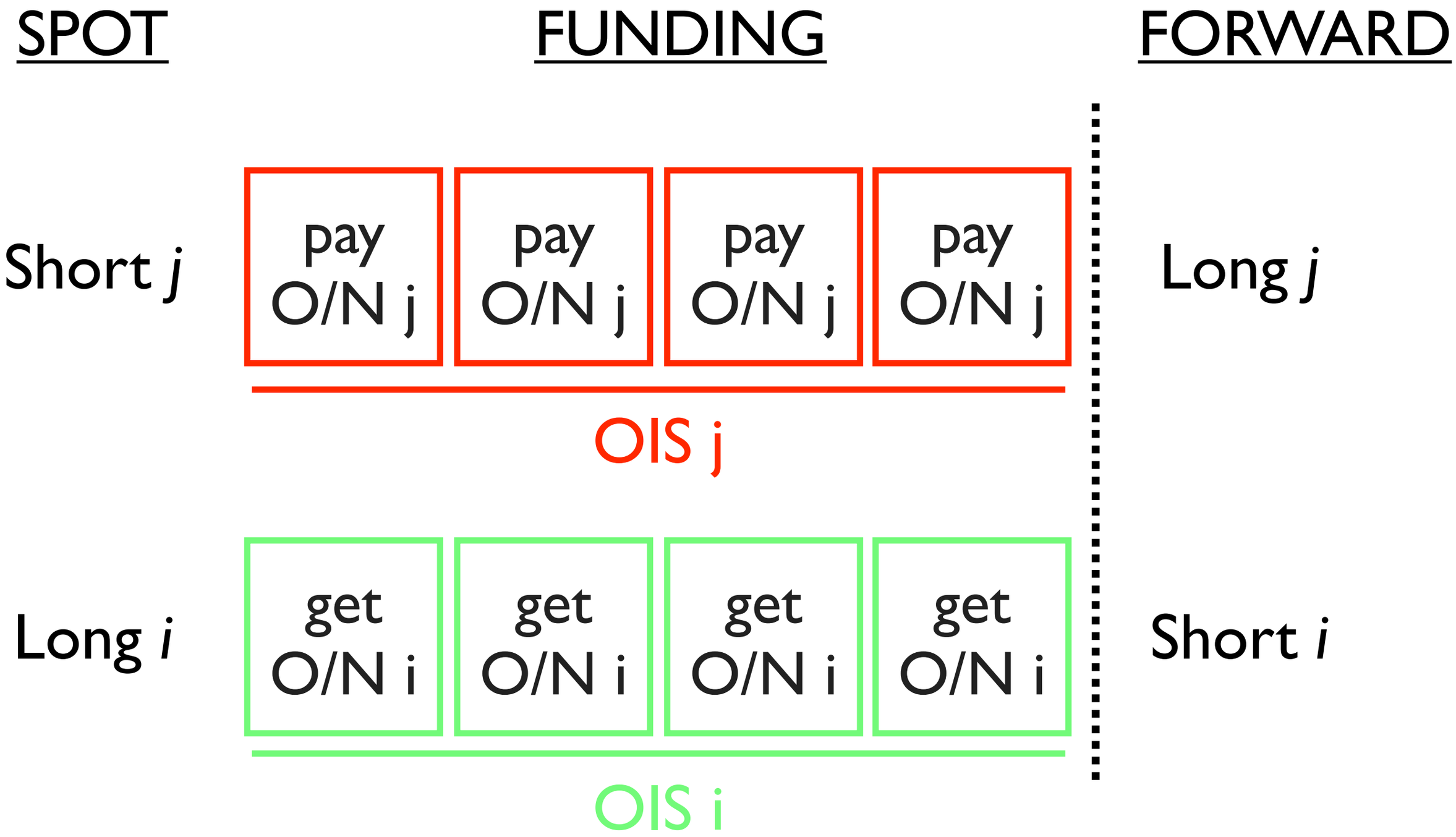

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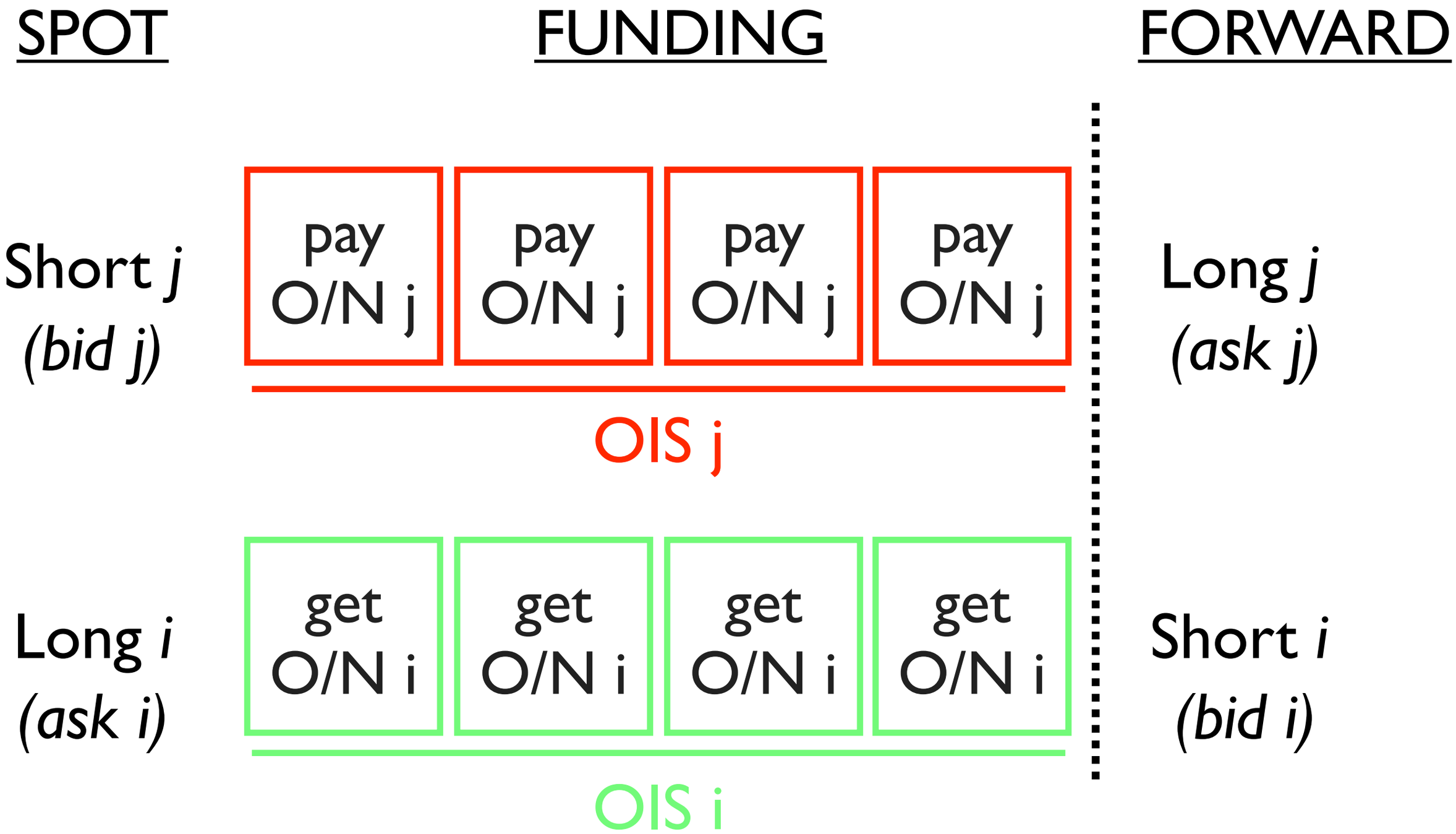

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CIP condition

$$\frac{F^B}{S^A}(1+OIS^{*B}) = (1+OIS^A)$$

Note: S is domestic per foreign currency units, conventionally referred to as foreign-domestic exchange rate. Buying foreign currency spot is equivalent to emitting a bid for the foreign-domesic rate, thus buying at the market's ask price, as in S^A in the denominator.

CIP profits

$$\frac{F^B}{S^A}(1+OIS^{*B}) - (1+OIS^A)$$

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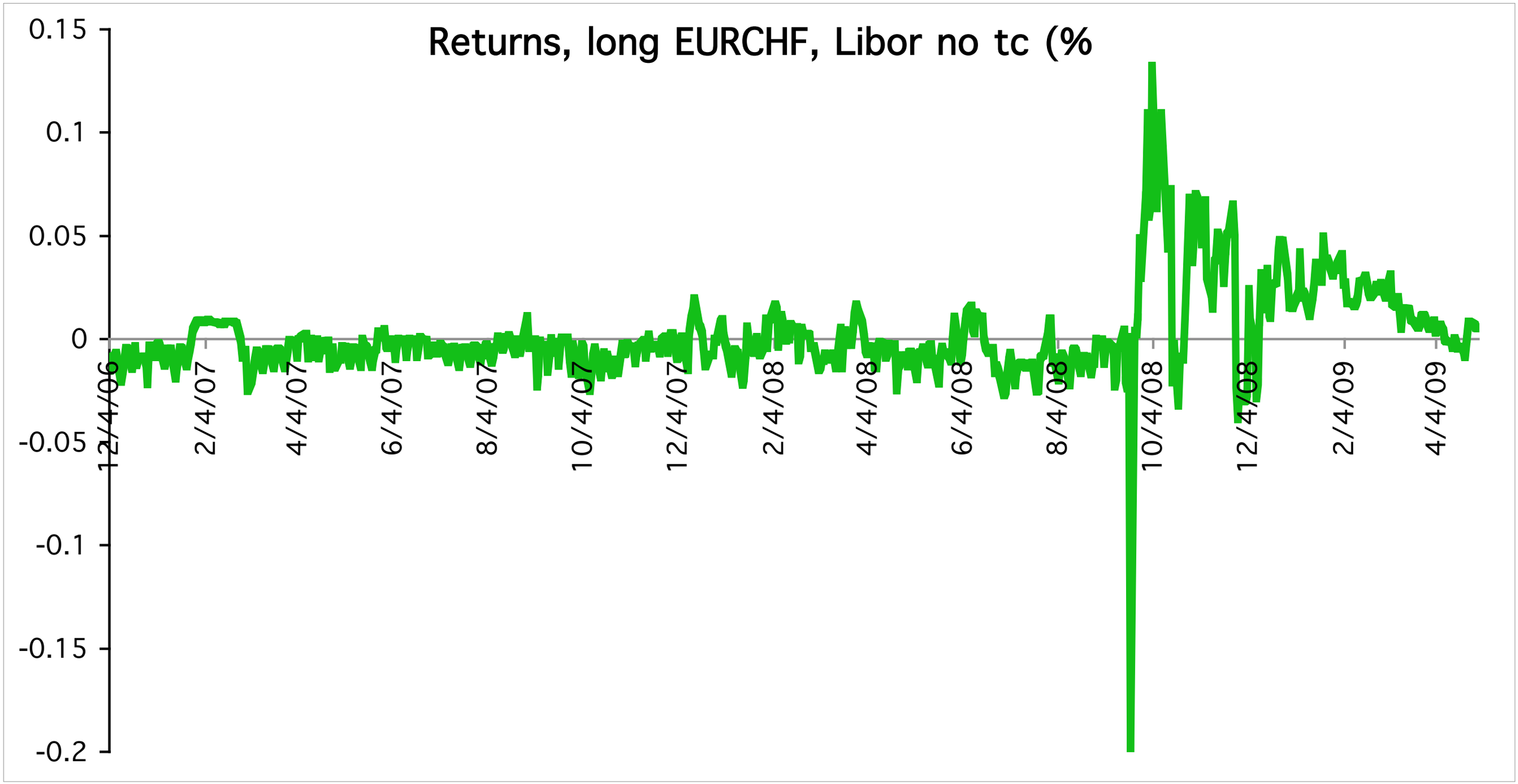
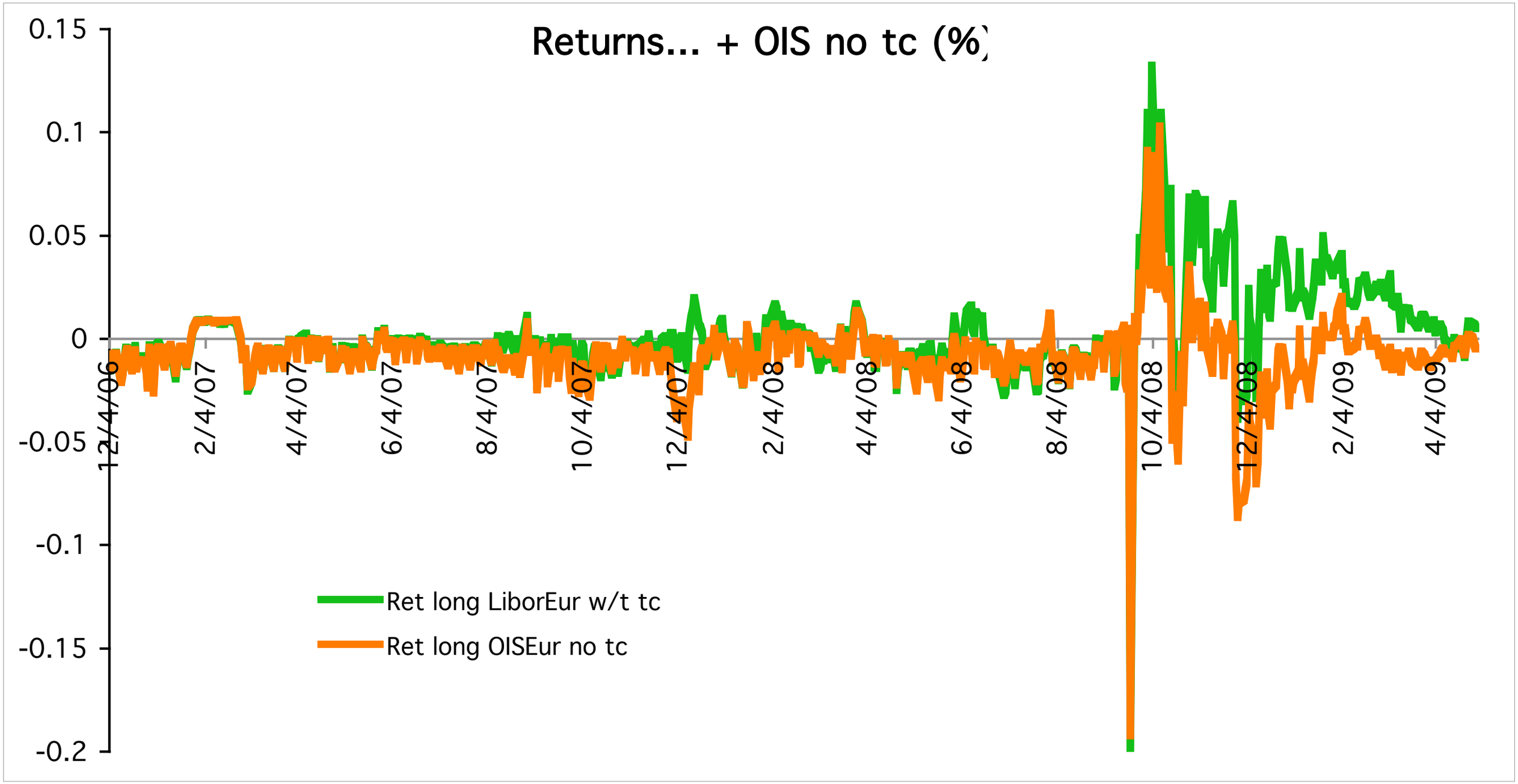
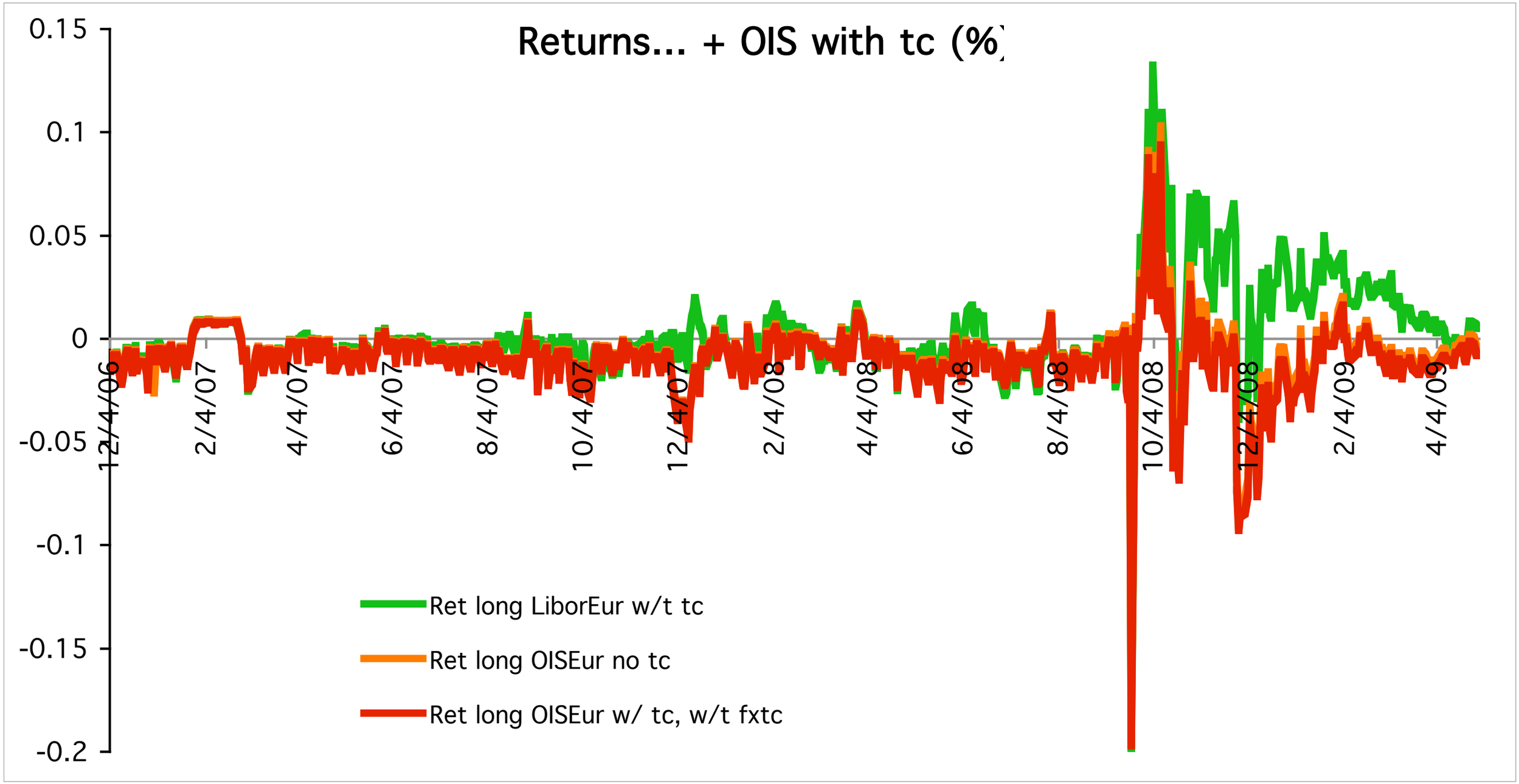
Libor (no transaction costs)



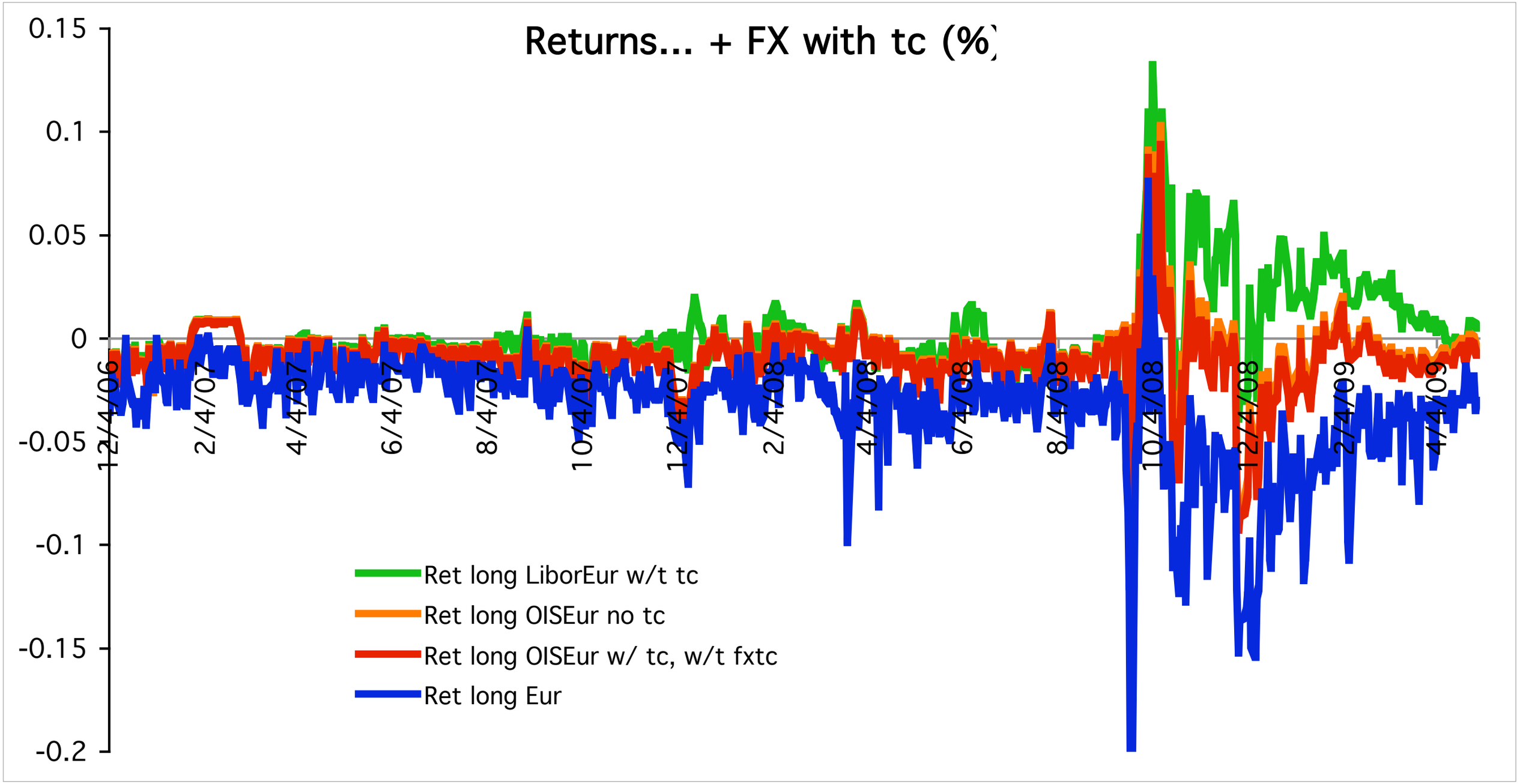
OIS (no trans costs)



OIS (with trans costs)



FX (with trans costs)



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Libor → OIS

- Profits change... get rid of default risk
  - if Libor-OIS spreads higher in target currency
    - profits decrease
  - if Libor-OIS spreads higher in funding currency
    - profits increase

Libor → OIS

CIP profits = α + β (Libor-OIS related variable) + ...
(Libor, no tc)

Libor → OIS

CIP profits = α + β (Libor-OIS related variable) + ...
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- β will turn out significant
- Tell stories about national vs. foreign default risk
- But uninformative!

Other remarks

- OIS transaction costs hardly affect profits
- FX transaction costs make a significant difference
- Similar results for other currency pairs

Main message

- Using more detailed and realistic measures:
  - Fewer, lower & less persistent CIP deviations
  - But deviations remain!
  - Despite our “stricter” test

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We must look further...
perhaps at currencies themselves

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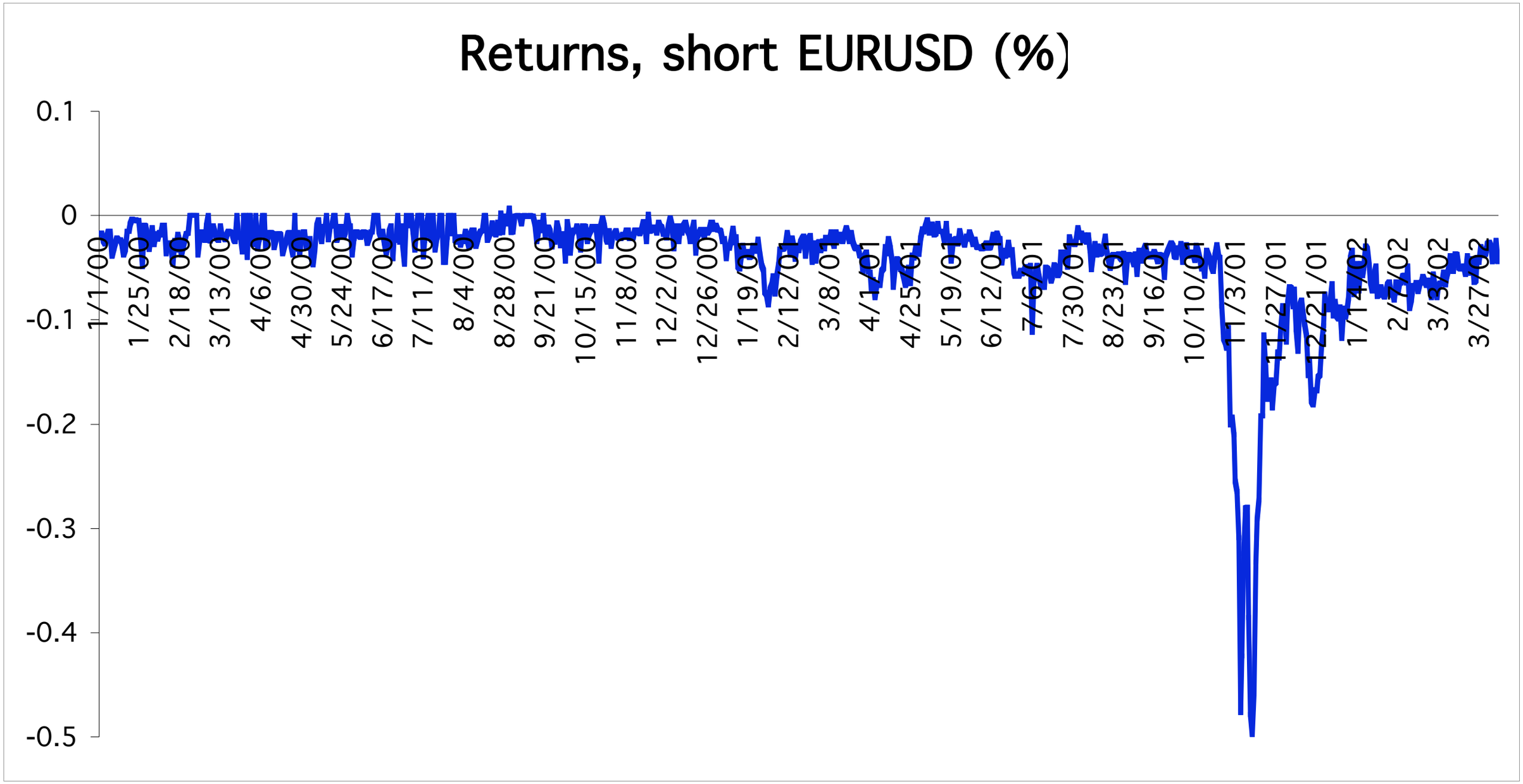
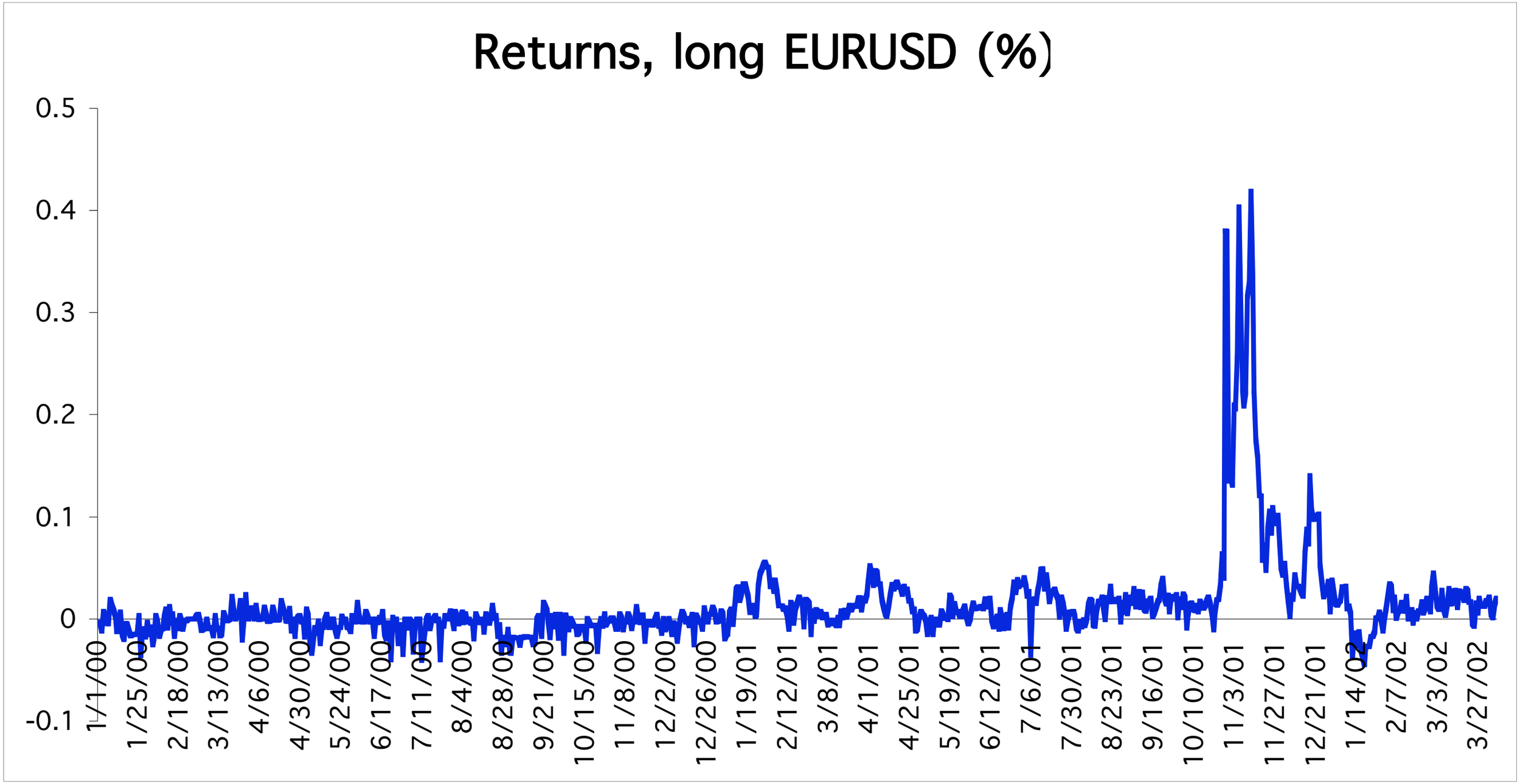
Long USD positions



Short USD positions



Further clues

- Very similar charts for other currency pairs
  - long dollar ➡ (–) profits
  - short dollar ➡ (+) profits
- CIP deviations seem to be
  - currency specific (dollar)
  - directional (short dollar)

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Short USD profitable

$$\frac{F^B}{S^A}\,(1+OIS^{EUR}) > (1+OIS^{USD})$$

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Short USD profitable

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- F^B too high
- USD too cheap on FWD market

Towards a theory

- FWD not priced according to CIP
- Usually, price pressure on FWD comes from arbitrageurs,
- Who short an appreciating currency (for given OIS differential)
- But if - for some reason - arbitrage is insufficient, FWD becomes "stale" (as seen from CIP)
- Thus, spot movements determine if CIP profits are positive or negative

An illustration

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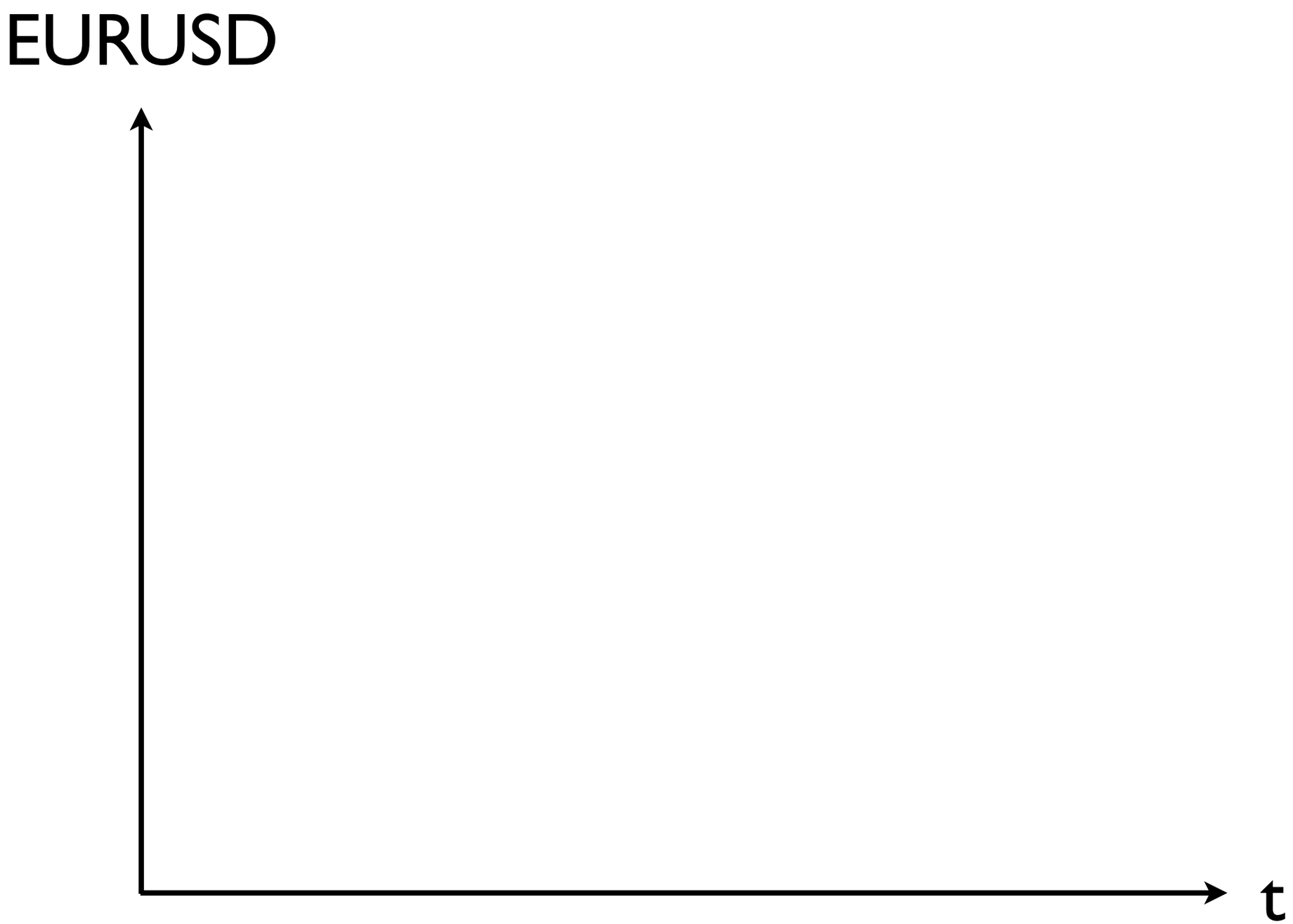

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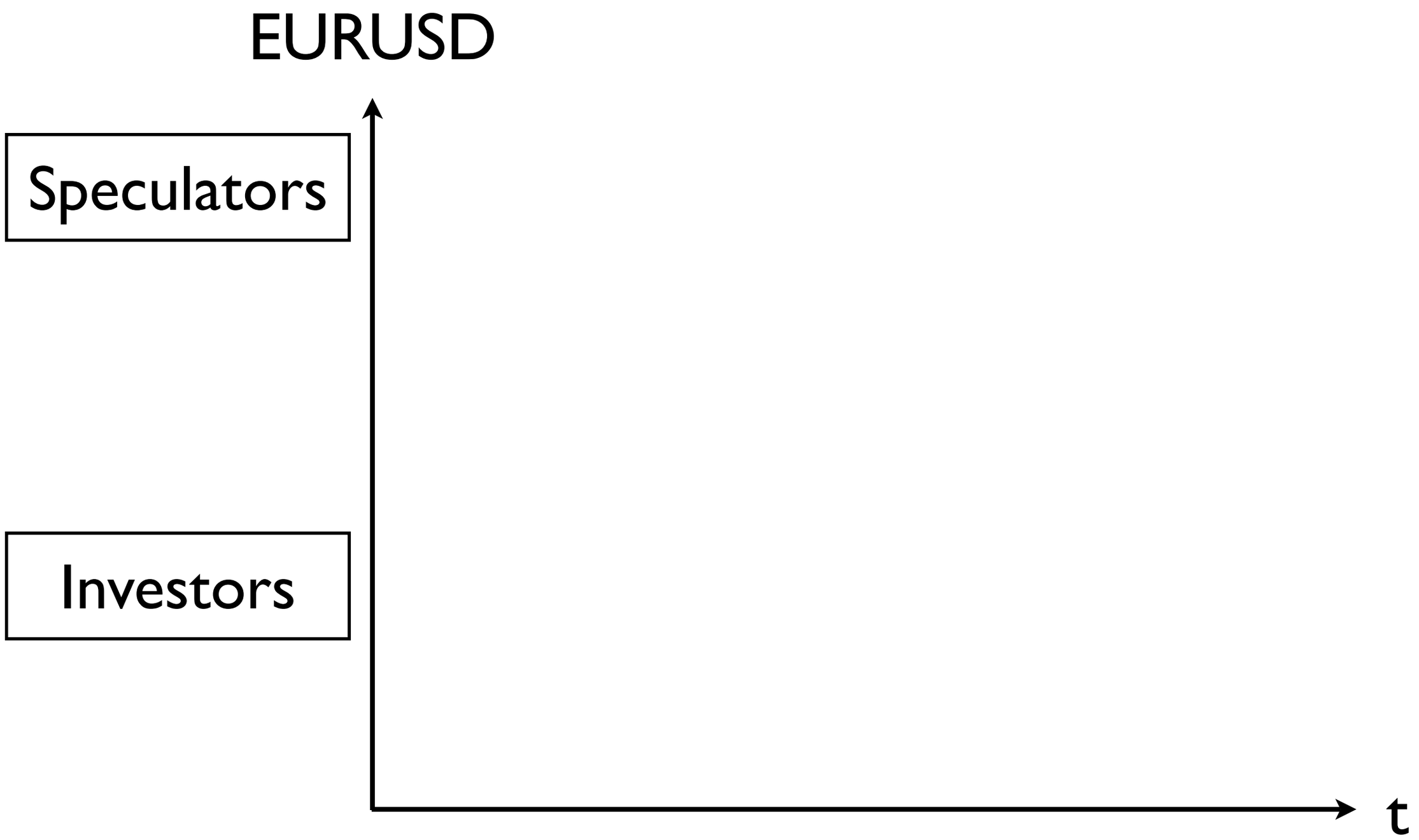

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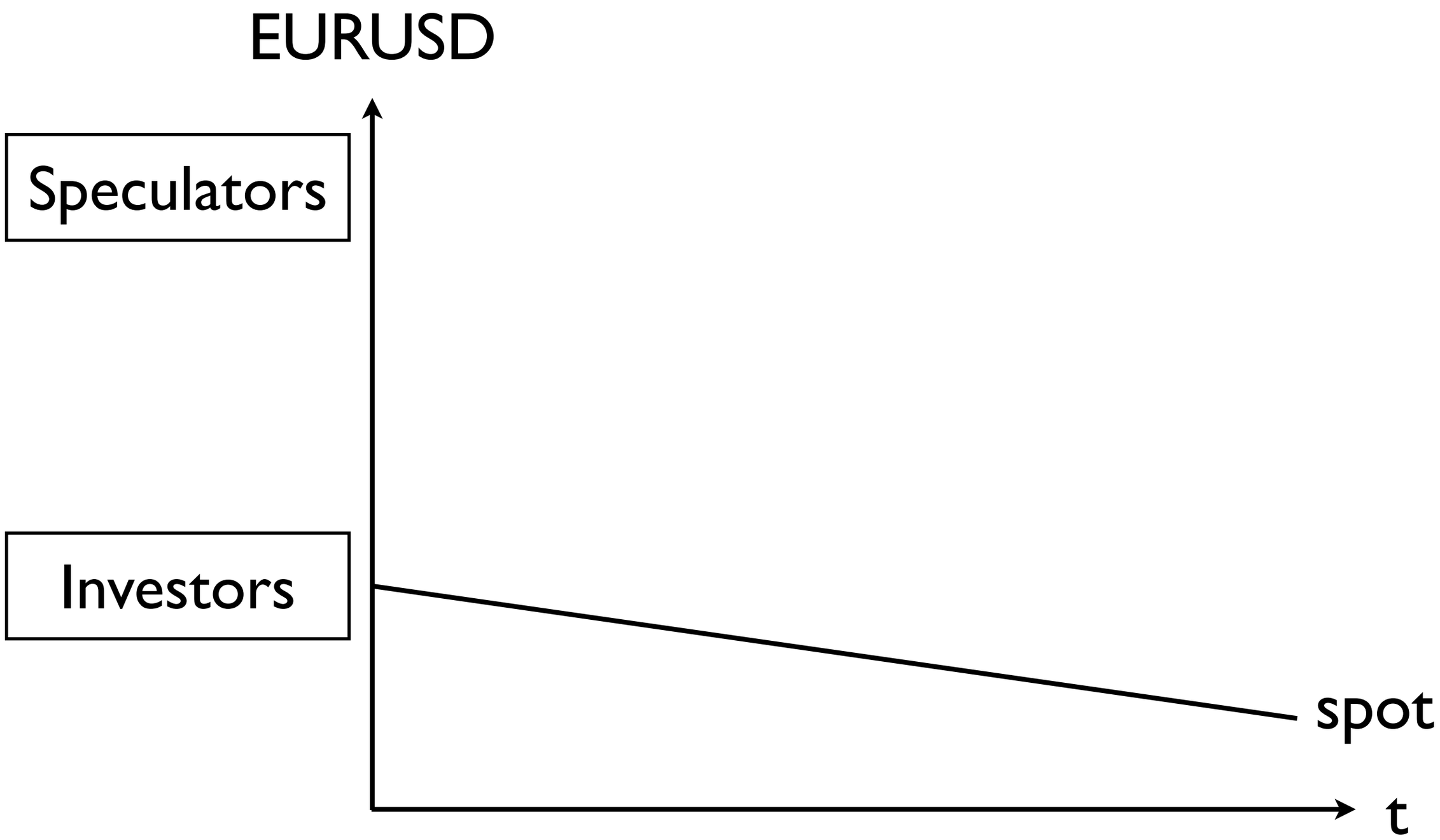

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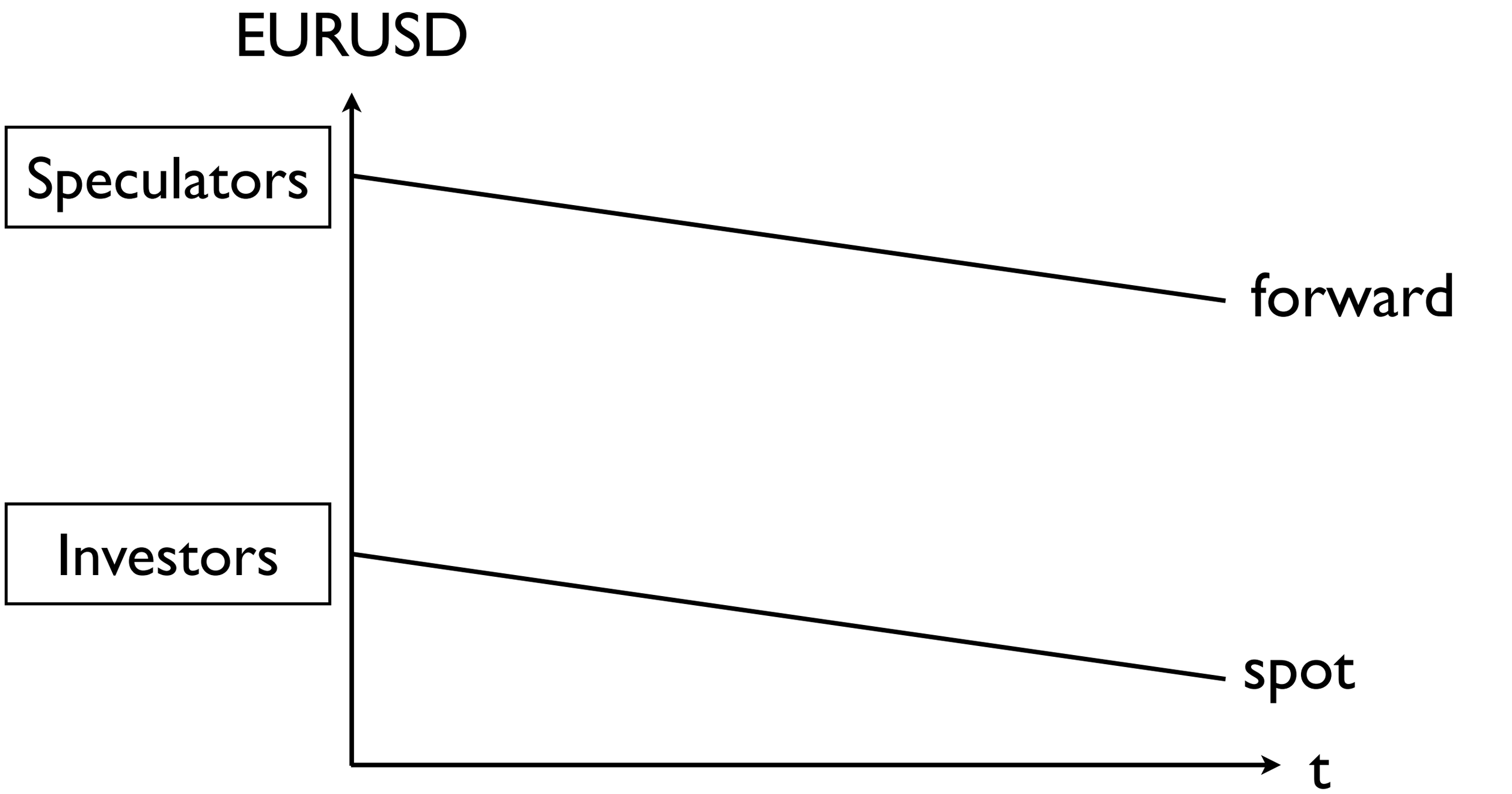

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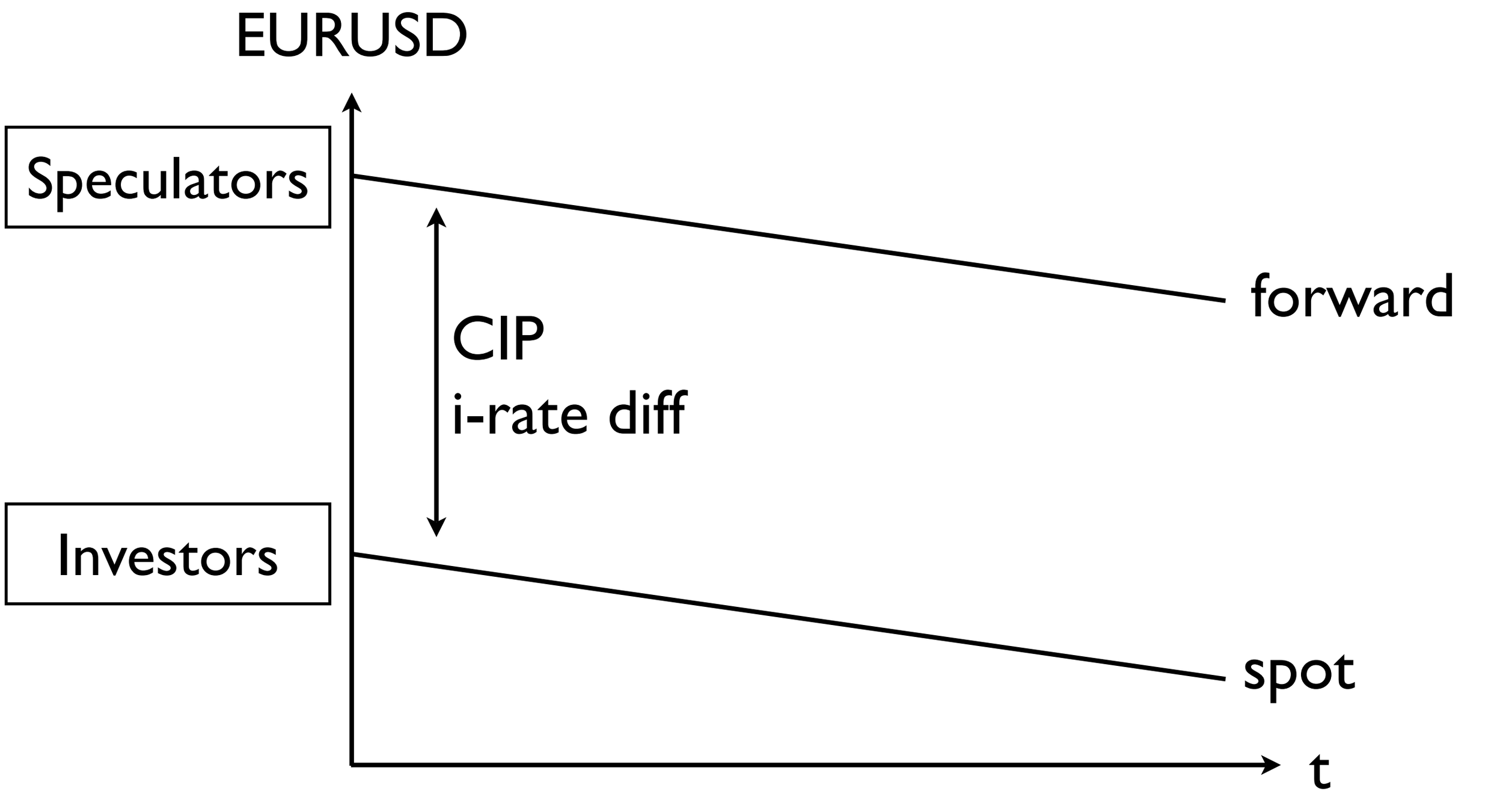

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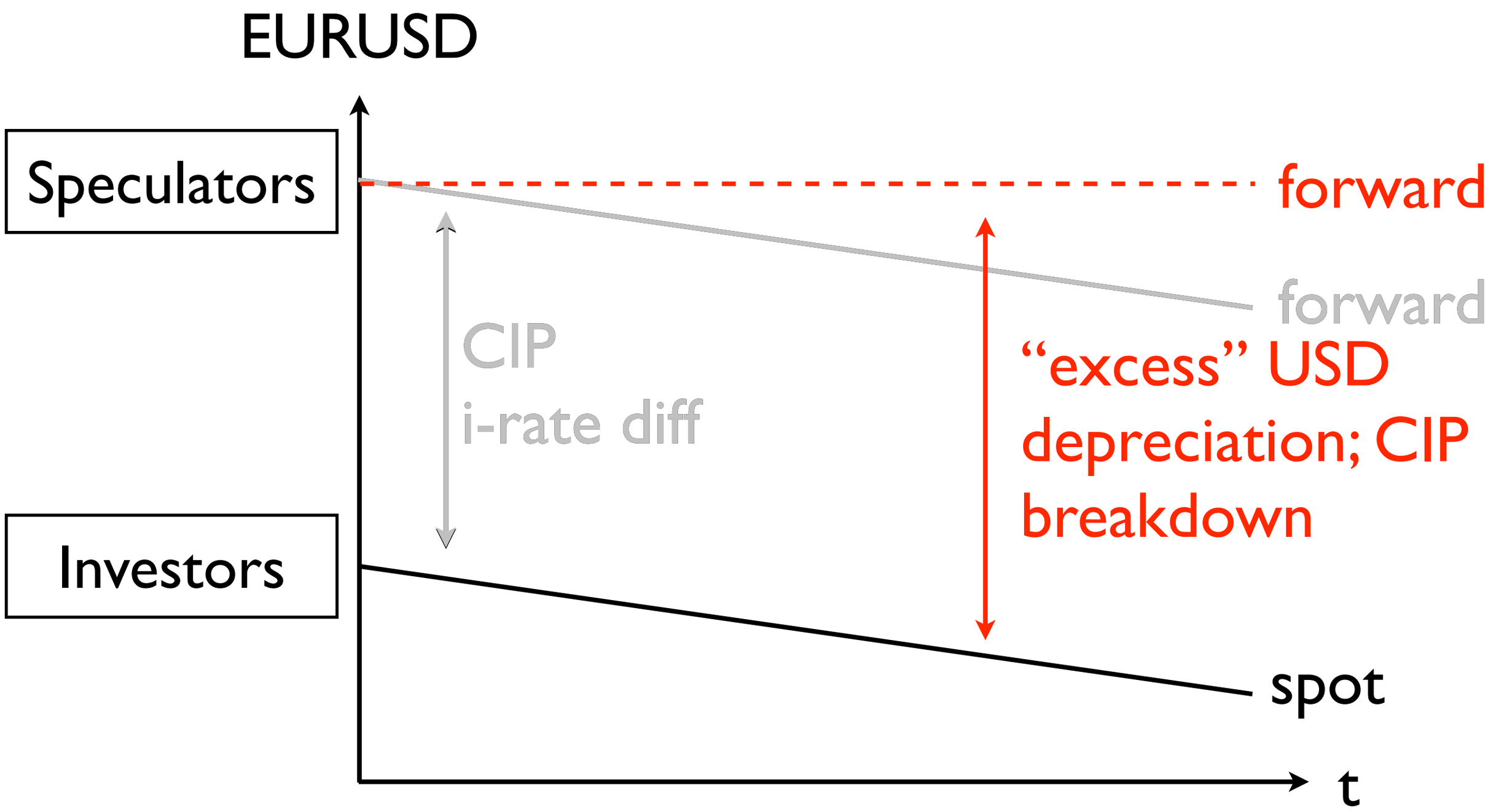

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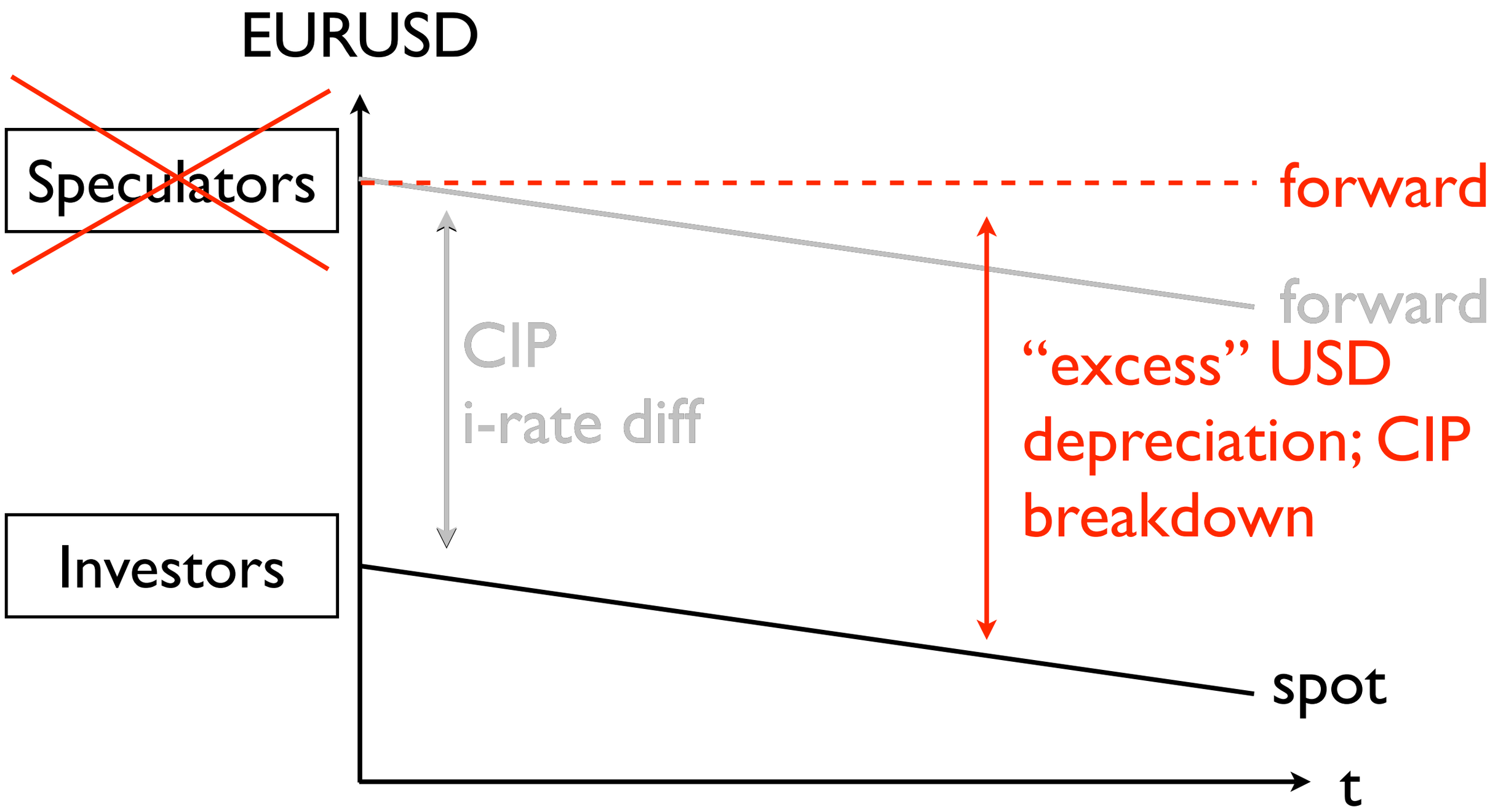

The short USD experience

- Enormous pressure to obtain USD ➡ spot USD appreciation
- Speculators should have shorted USD
- But... insufficient USD available to borrow
- Thus insufficient pressure on USD forward
- Resulting in "excess" USD future depreciation inducing positive CIP profits

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> - No notion of risk!
> - A funding liquidity constraint!

Long USD unprofitable, same story from flip side

- Positive profits with short USD position

- Negative profits with long USD position
- Except if bid-ask spreads are particularly high relative to profits

Regressions support our story

	Long USD	Short USD
BAS fwd		
BAS spot		
Balance sheet		
TED		
VIX/ CDS		

Regressions support our story

Funding liquidity constraint

	Long USD	Short USD
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Regressions support our story

Funding liquidity constraint

Risk

	Long USD	Short USD
BAS FWD		
BAS spot		
Balance sheet		
TED		
VIX/ CDS		

Regressions support our story

		Long USD	Short USD
Funding liquidity constraint	BAS FWD	–	+
	BAS spot	+	–
	Balance sheet	+	–
	TED	–	+
Risk	VIX/ CDS	no	no

Regressions support our story

	Long USD	
BAS fwd	–	– 5.7 ***
BAS spot	+	4.9 ***
Balance sheet	+	4.4 ***
TED	–	– 1.7 ***
VIX/ CDS	no	not signft

Regressions support our story

	Long USD	
BAS fwd	– √	– 5.7 ***
BAS spot	+ √	4.9 ***
Balance sheet	+ √	4.4 ***
TED	– √	– 1.7 ***
VIX/ CDS	no √	not signft

Summary

- CIP deviations, can you believe it?
- CIP arbitrage is complex,
- Literature is too superficial
- Our measure excludes default risk and includes transaction costs (& other benefits)
- But still, deviations exist, although smaller, less frequent and persistent

Summary

- Study across various currency pairs reveals
  - short USD positions profitable
- A theory: funding liquidity constraints limit arbitrage
  - forward price is stale and spot deviations determine CIP arbitrage profitability
- Supported by evidence & regression analysis

Summary

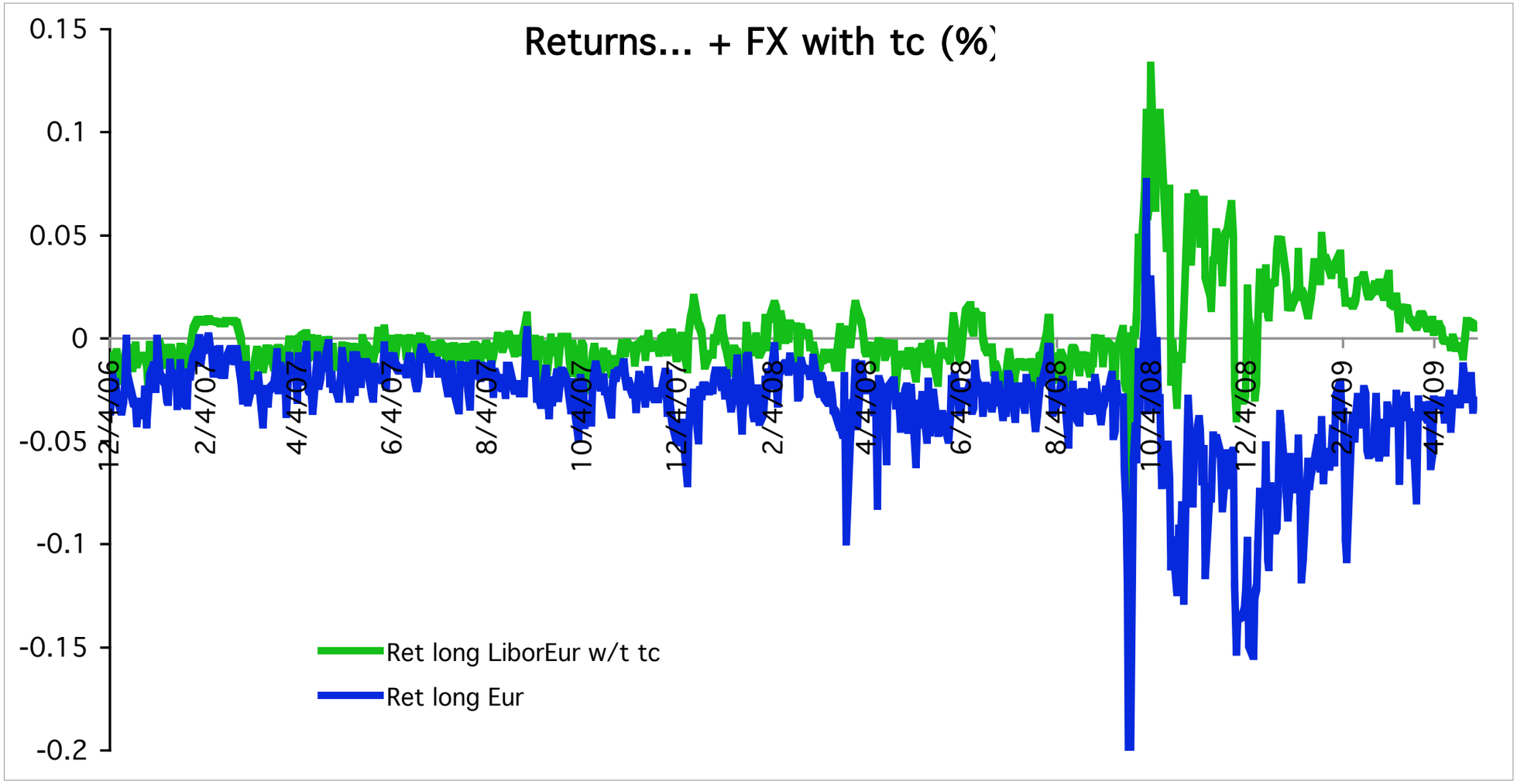
- More perspective:
  - find limits to theoretical zero-risk arbitrage conditions at heart of finance,
  - more concretely, find which currencies were in excessive demand due to technical reasons during the crisis... USD and CHF

Appendix

CHF story similar to above

- Great pressure to obtain CHF
- Spot CHF appreciation but limited short CHF speculation (funding liquidity constraint),
- Leaving CHF "too cheap" on fwd market,
- Thus offering profitable short CHF arbitrage

CHF story similar to above



- ... as seen in Libor CIP measure,
- but not with our measure due to significant increase in transaction costs

USDEUR, Libor and Net