Exchange Rate Behavior with Negative Interest Rates: Some Early Negative Observations

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Motivation

- In last decade, five economies experienced (non-trivial) negative *nominal* interest rates
  - Denmark, EMU, Japan, Sweden, Switzerland
- Most focus on consequences of Negative Interest Rate Policy (NIRP):
  - Growth, inflation
  - Bank profitability, micro-structural effects
  - Financial Stability
- Here, focus on *exchange rate behavior*
  - Volatility, Uncovered Interest Parity Deviations (UIP)
  - Literature: little work, no strong results

Summary of Findings

- Negative Nominal Interest Rates have almost no observable consequences for exchange rate behavior
  - Exchange Rate Volatility
  - Deviations from Uncovered Interest Parity
  - Carry Trade Returns

Data Set

- Time span short, hence maximize scope of necessarily limited data set
  - Include 61 currencies/economies “countries”
- Begin January 2010 (post GFC), continue through May 2016
- Daily (highest frequency with many countries)
- Switzerland usually base
  - First negative nominal rates; longest span of time; most negative rates
  - Sensitivity with US$, GBP, Euro as alternatives

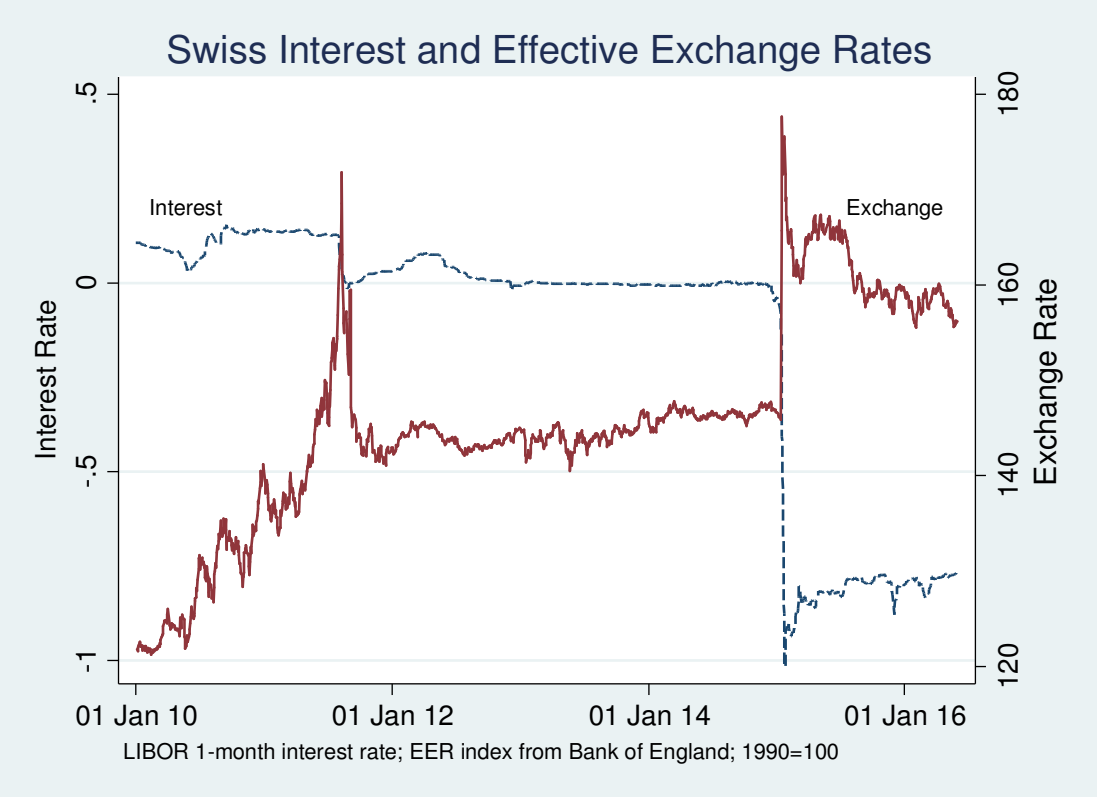
Country List

Argentina	Australia[1]	Bahrain[3]
Brazil	Botswana[4]	Bulgaria[3]
Canada[1]	Chile	China[2,4]
Colombia	Croatia[4]	Czech. Rep.[1,4]
Denmark[1,3]	Egypt[4]	EMU[1]
Estonia[1,3]	Ghana	Hong Kong[1,2,3]
Hungary	Iceland[1]	India[2]
Indonesia[2]	Israel[1]	Japan[1,2]
Jordan[3]	Kazakhstan[2,4]	Kenya
Korea[1,2]	Kuwait[3]	Latvia[1,3]
Lithuania[1,3]	Malaysia[2]	Mexico
Morocco[3]	Norway[1]	New Zealand[1]
Oman[3]	Pakistan[2]	Peru
Philippines[2]	Poland	Qatar[3]
Romania	Russia	Saudi Arabia[3]
Serbia	Singapore[1,2]	South Africa
Sri Lanka[2]	Sweden[1]	Switzerland
Taiwan[1,2]	Thailand[2]	Tunisia[4]
Turkey[2]	Uganda	UK[1]
United Arab Rep.[3]	USA[1]	Vietnam[2,4]
Zambia		

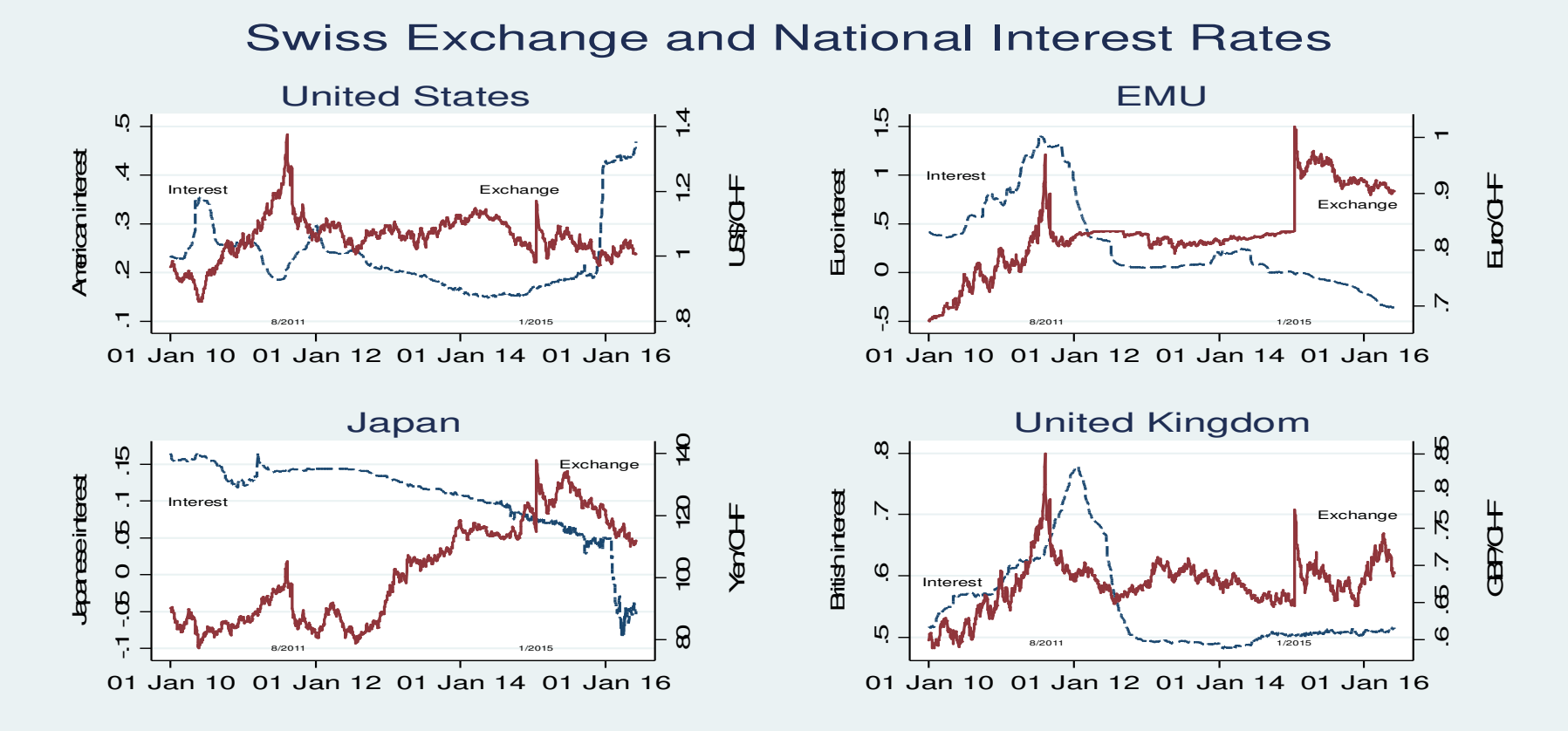
First Look

- Swiss interest rates go negative briefly in August 2011
  - Follows sudden Swiss Franc appreciation
  - SNB diagnoses “massive overvaluation”, loosens to protect competitiveness, reduce deflationary pressure
    - September 2011: SNB places floor on Euro/Swiss Franc exchange rate
    - January 2015: exchange rate constraint removed, jump appreciation, NIRP begins in earnest

Swiss Interest and Effective Exchange Rates



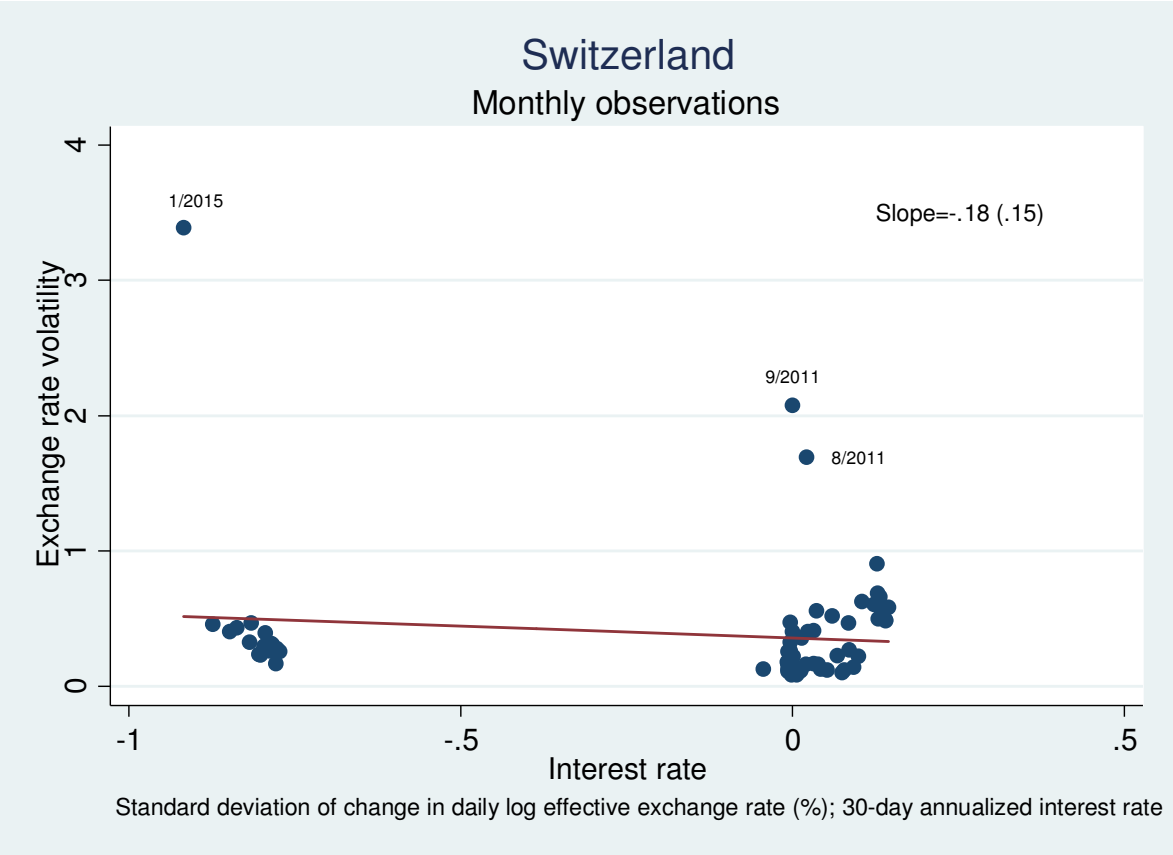
Bilateral (Swiss) Exchange Rates and National Interest Rates



Little Linkage Between EER Volatility and Interest Rate Level

- Measure volatility as standard deviation (over month) of first-differences of natural logarithms
- No relationship between exchange rate *volatility* and interest rate *level*
  - Even for negative nominal interest rates!

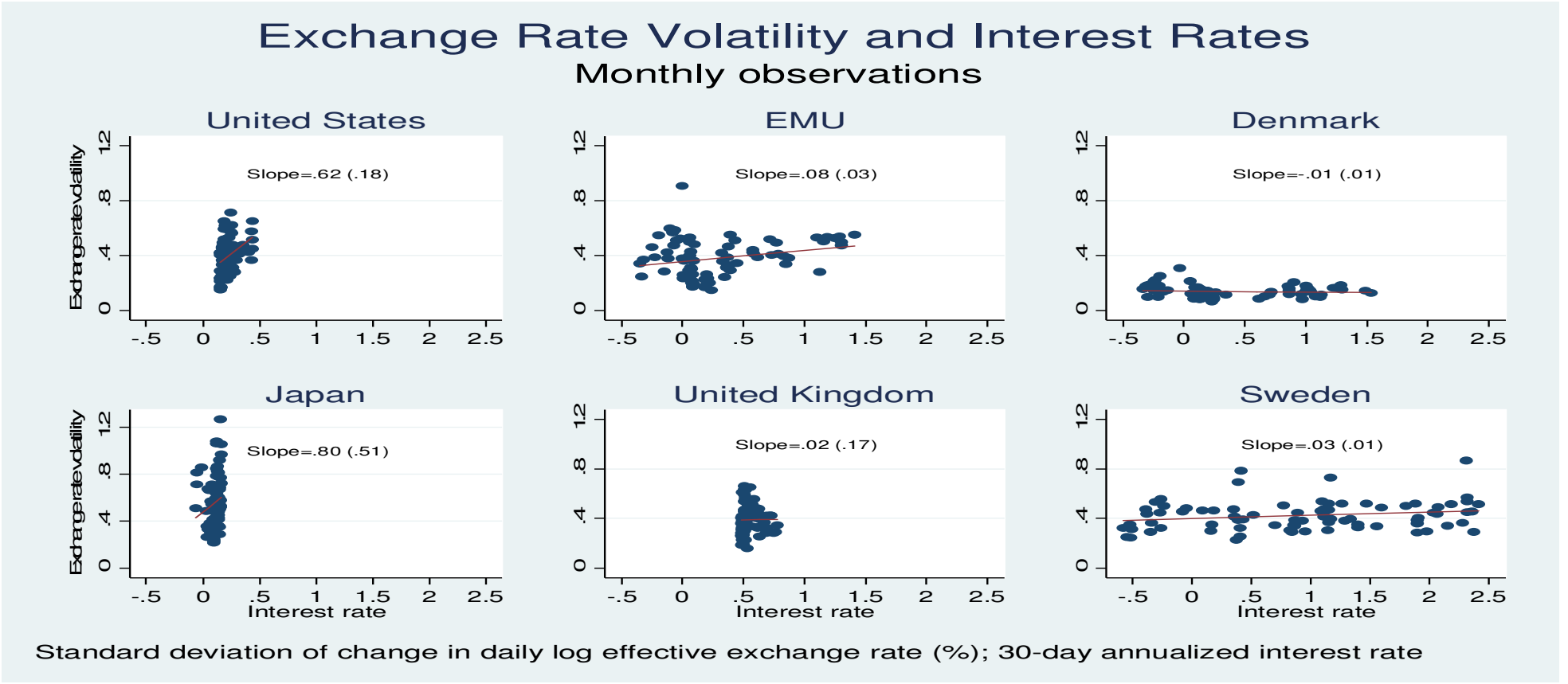
Effective Exchange Rate Volatility and Interest Rates: Switzerland



Also True of Other Currencies

- US $, Euro, Yen, Pound Sterling, Danish Krone, Swedish Krone
  - 4 more currencies with NIRP
  - Still no strong linkage between exchange rate volatility and interest rate level
    - Some signs of positive linkage
    - Nothing unusual when nominal interest rate becomes negative!

Effective Exchange Rate Volatility and Interest Rates: Others



Econometric Verification

- Regress effective exchange rate volatility against interest rate level and dummy for NIRP
  - 11 economies with effective rates (Australia, Canada, Denmark, Euro, Japan, New Zealand, Norway, Sweden, Switzerland, UK, and USA)
    - 5 have NIRP (Denmark, Euro, Japan, Sweden, Switzerland)
  - Include country-specific FE
  - $\sigma(eff_{i,\tau}) = \alpha + \beta interest_{,\tau} + \gamma NegDummy_{i,\tau} + \xi_{i,\tau}$
    - $NegDummy_{i,\tau}$ is 1 if i has negative nominal interest rate at time τ, 0 ow

Regressions of Effective Exchange Rate Volatility on Interest Rates

	Interest Rate Level	Dummy, Negative Interest Rate	Obs.
Default	.90 (1.52)	1.22 (2.78)	869

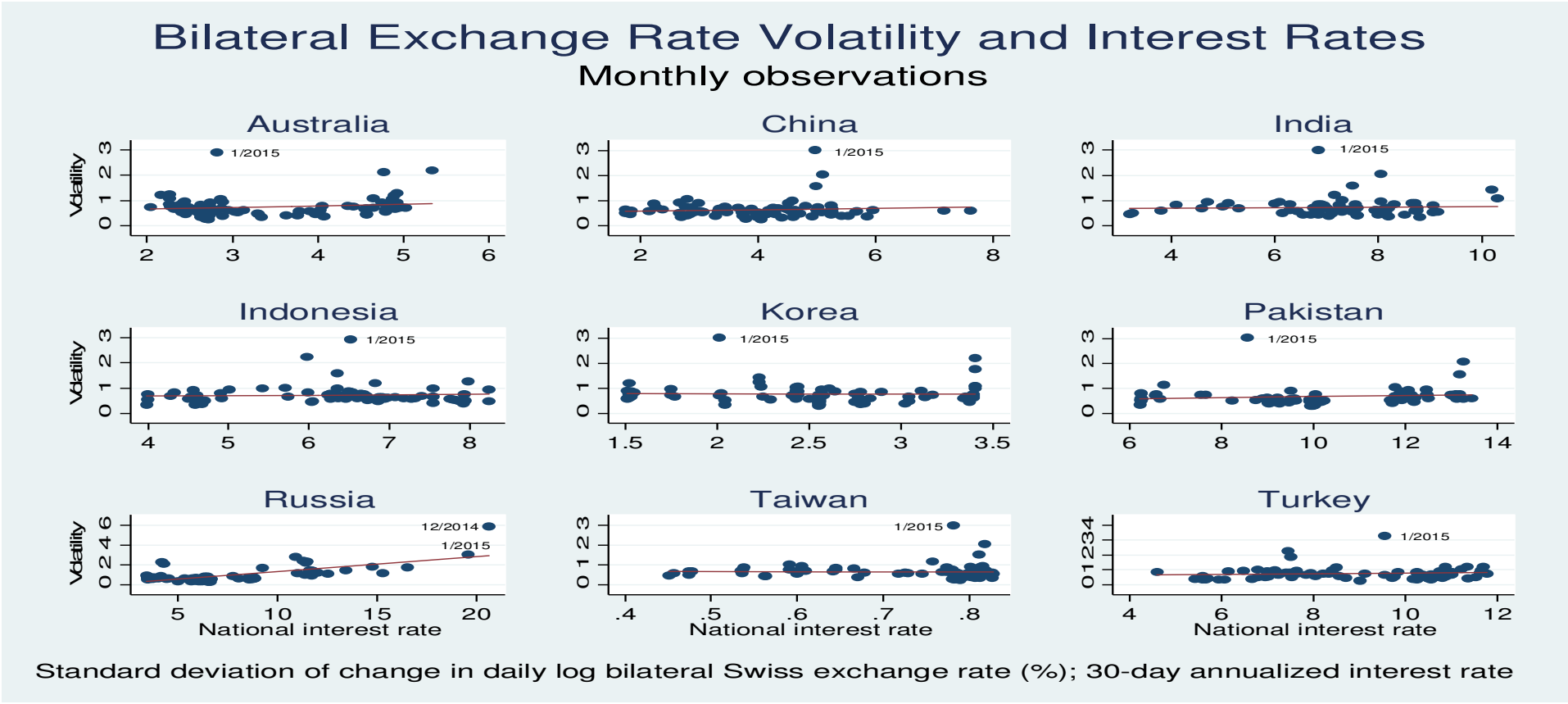
Sensitivity Analysis

	Interest Rate Level	Dummy, Negative Interest Rate	Observations
Add Time FE	-2.48 (1.50)	-4.81 (2.52)	869
Without Country FE	4.54** (.58)	-12.9** (3.1)	869
Official (not market) interest rates	2.70 (1.62)	7.35* (3.01)	869
2011	.38 (10.9)	n/a	132
2012	9.62** (3.19)	7.04 (4.37)	143
2013	-15.7 (16.7)	3.12 (7.42)	132
2014	-.70 (5.52)	-2.91 (5.66)	143
2015	-11.84 (15.53)	-9.17 (23.29)	132
Without Fixers	-.88 (1.63)	.39 (3.34)	790
Only lowest half by interest rate	-10.75 (7.16)	-2.54 (4.40)	435
Without > |2σ| Outliers	.56 (1.08)	1.53 (1.92)	844

True in Bilateral Rates too …

- Russia only exception to insignificant slope
  - But minimal Russia interest rate >3% (average >7%)
  - No sign that *negative* nominal rates matter

Bilateral Exchange Rate Volatility and Interest Rates



Quick Summary

- Little evidence that negative nominal interest rates have affected exchange rate *volatility*
- But NIRP sometimes prompted by concerns about *level* of exchange rate (Denmark, Switzerland)
- Now move from second- to first-moment of exchange rate

Uncovered Interest Parity

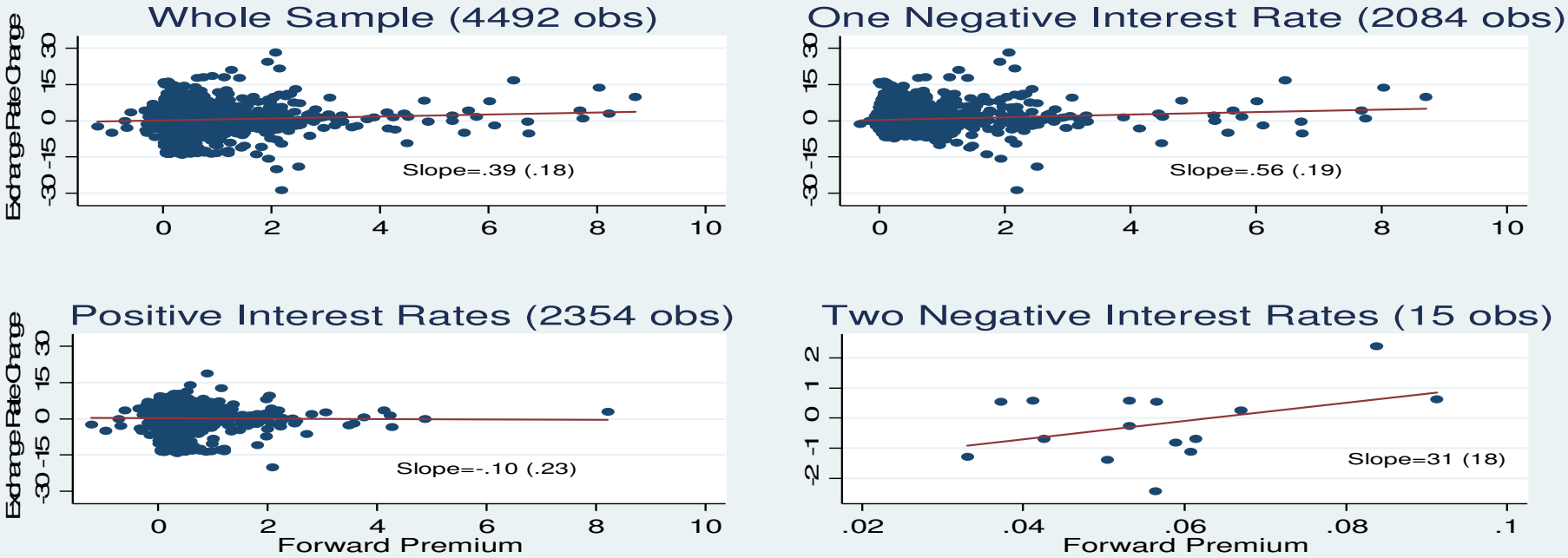
- Well-known: UIP fails badly in literature
  - Often *ex post* changes in exchange rates *negatively* correlated with forward premium!
- Does the UIP relationship change in the presence of negative nominal interest rates?
  - Essentially compare *ex post* one-month change in bilateral Swiss exchange rate to forward premium

What Does the Data Say?

- Pooling entails *much* dependency across
  - Time (prediction horizon > data frequency) – handle with monthly data
  - Countries (cross-sectional dependency) – handle with care!

- Little sign of any strong positive relationship
  - But slope is *positive, both* for a) whole sample; b) observations with one negative interest rate (half of sample)

Monthly Exchange Rate Changes and Forward Premia

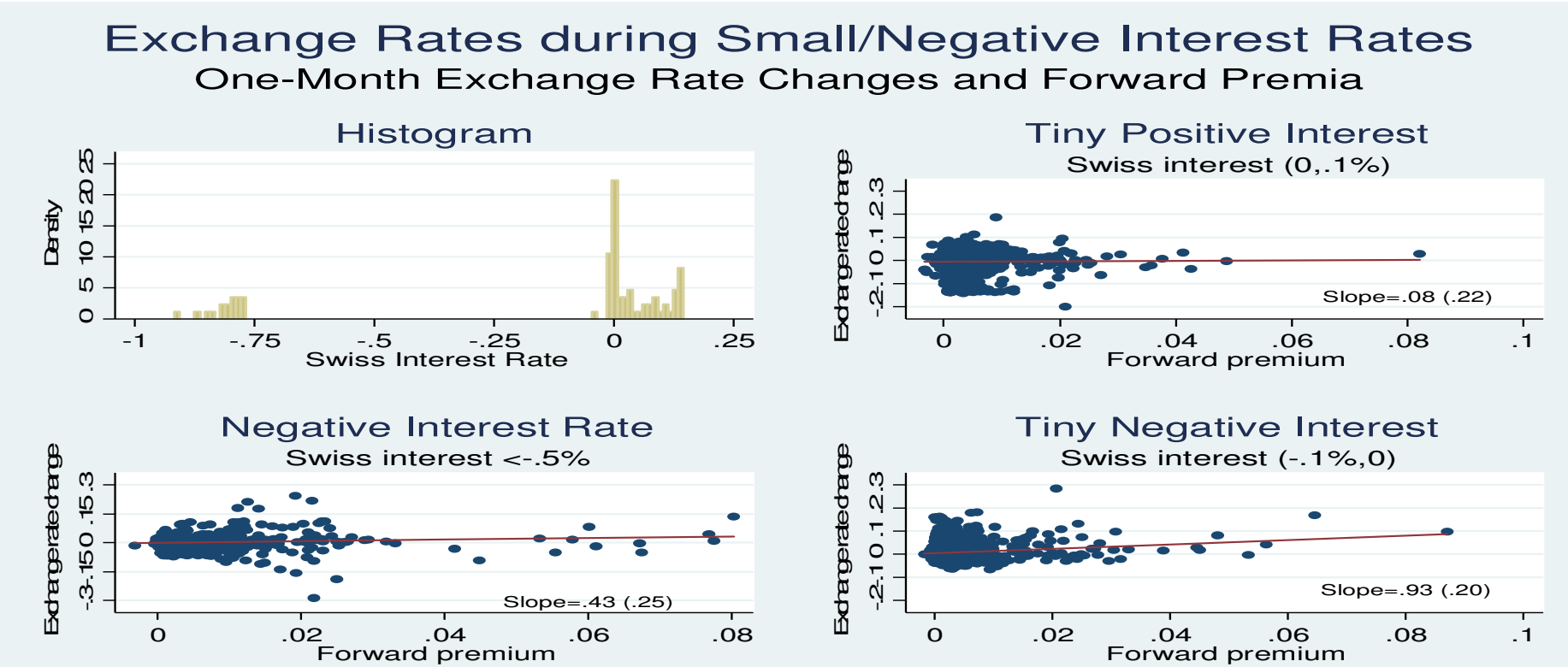


Positive Results Warrant Further Investigation

- Zoom into periods of different Swiss interest rates
  - Histogram suggests: a) periods of very negative rates; and b) periods ≈ 0

- Swiss interest rates *very* negative(<-.5%): no relationship
- Swiss interest rates *tiny positive* (<.1%): no relationship
- Swiss interest rates *tiny negative* (>-.1%): *positive* relationship
  - Statistically significant but poor fit, few observations
  - Statistically different slope as interest rates positive/negative

Monthly Exchange Rate Changes and Forward Premia: Zooming In

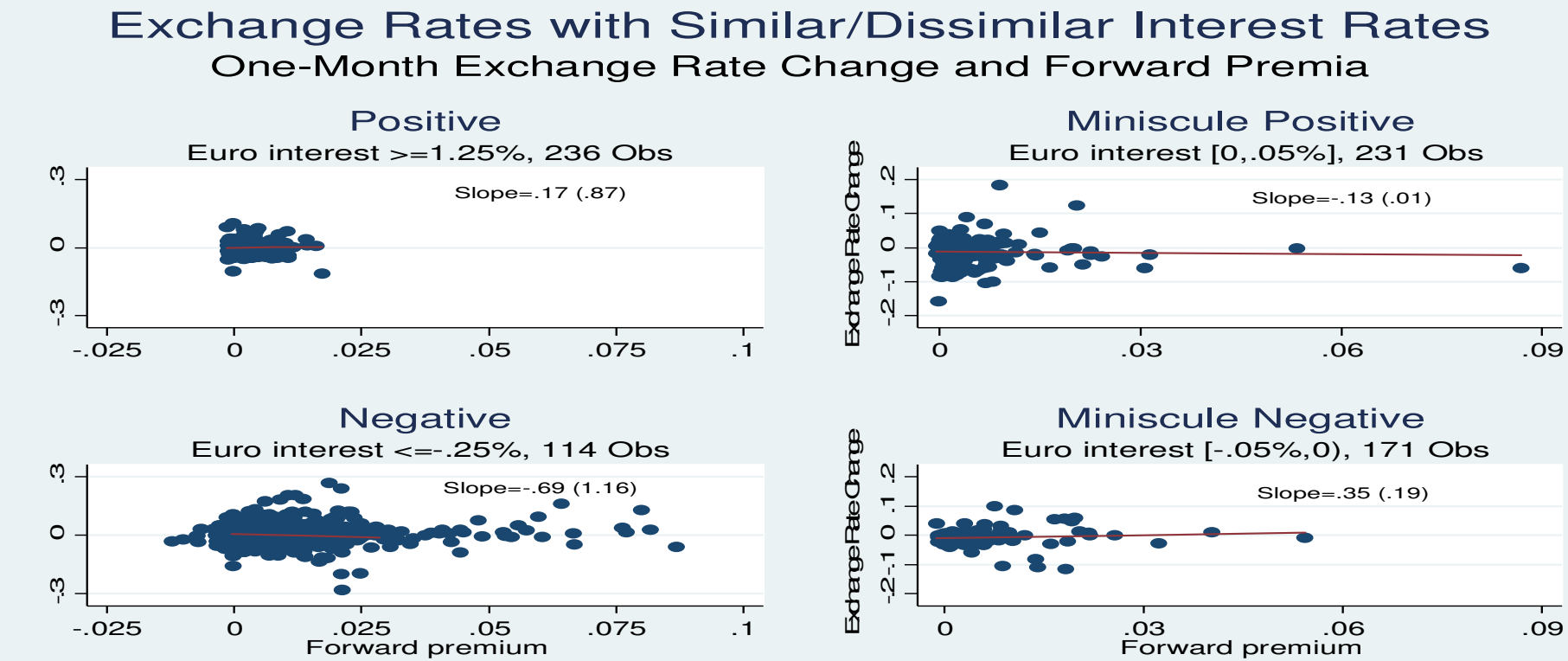


Even More Investigation …

- Switch to Euro; *many* more observations with interest rates close to zero (both positive and negative)

- Euro interest rates *miniscule positive* (<.05%): negative relationship
- Euro interest rates miniscule *negative* (>-.05%): no relationship
  - Quite different from Swiss Franc (none/significantly positive)
  - Statistical analogue to come

Monthly Exchange Rate Changes and Forward Premia: Zooming Into the Euro



Testing UIP

Estimate:

$$\log(s_{i,t+21})-\log(s_{i,t}) = \alpha + \beta[\log(f_{i,t+21,t})-\log(s_{i,t})] + \gamma One_{i,t} + \delta Both_{i,t} + \varepsilon_{i,t+21,t}$$

Notes:

- No risk premium, rational expectations, large sample: $\alpha=0$, $\beta=1$, $\gamma=\delta=0$
- Much of literature has $\beta<1$ (often negative)
- MA errors, so use Newey-West standard errors

Fama Regressions: NIRP as intercept

	Slope	Intercept	One Negative Interest Rate	Two Negative Interest Rates	Observations
Prevalence		50%	49%	1%	93,937
Common Intercept	.59** (.12)	.16** (.06)			93,937
Default	.58** (.13)	.13* (.07)	.07 (.08)	-.57** (.16)	93,937
Country FE	.61** (.16)	n/a	.10 (.08)	-.87** (.20)	93,937

Results

- UIP works poorly: easily reject $\alpha=0$, $\beta=1$
  - Doesn't change with NIRP dummies
  - Results robust to robustness checks
- *But* UIP works better than usual ($\beta>0$)
- Can also check if *slopes* vary by NIRP (multiplicative, not additive)

Testing for Slope Discontinuity of Fama Regression

Size of Euro Interest rate	Euro Interest Rate		Equality Test (p-value)	Observations
	Positive	Negative		
In +/- .05%	.25 (.32)	-.19 (.20)	1.5 (.22)	9,526
In +/- .10%	.76 (.45)	-.23 (.16)	1.3 (.25)	37,742
In +/- .15%	.42 (.27)	.27 (.16)	.3 (.62)	42,919
In +/- .20%	.77 (.11)	.37 (.17)	4.2* (.04)	47,188
In +/- .25%	.75 (.11)	.47 (.17)	2.0 (.16)	54,689

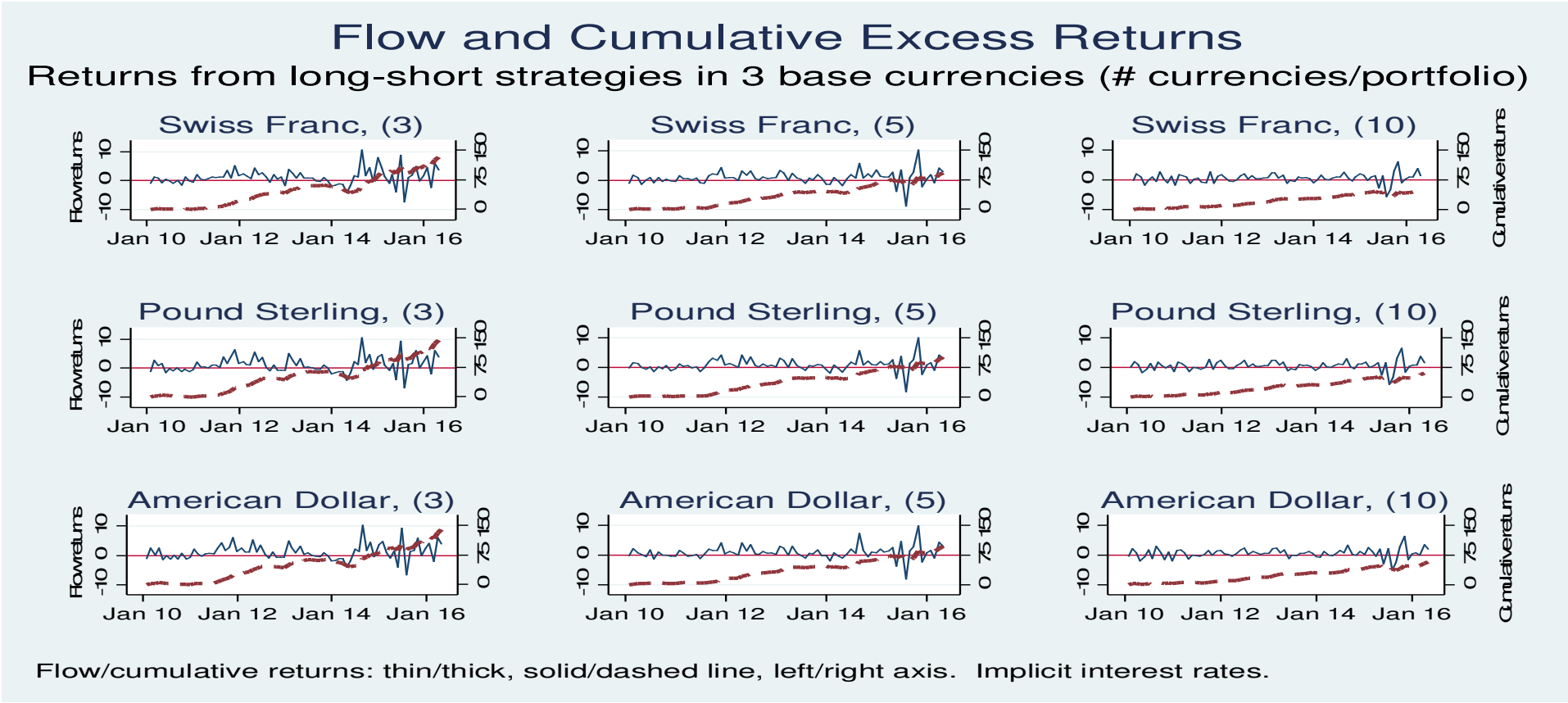
Another Approach: Carry Trade Returns

- Carry trade relies on UIP deviations
- Consensus in literature of positive but risky returns (Burnside et al)
- We ask “Do carry trade returns vary with negative nominal interest rates?”

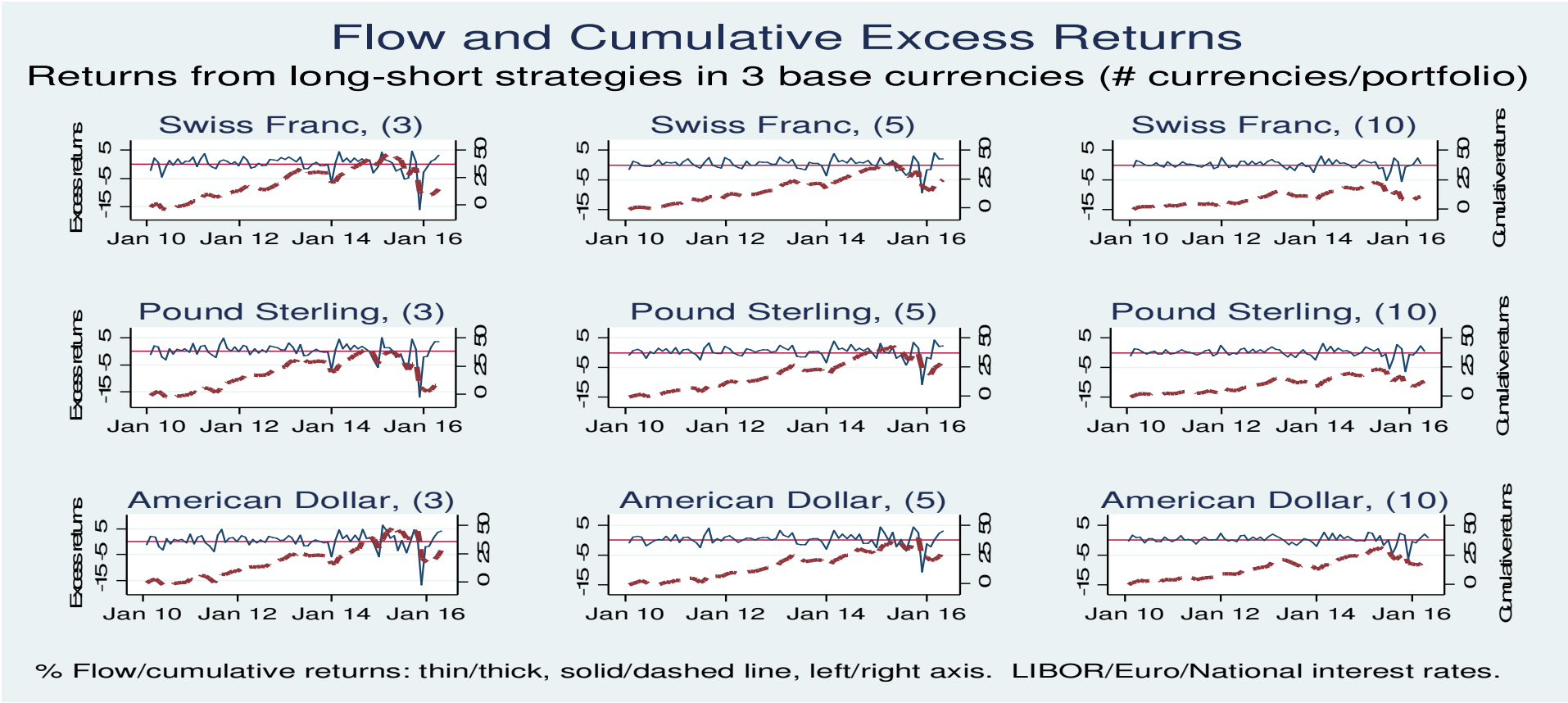
Constructing Carry Trade Returns

1. Begin with Swiss Franc as default currency to measure cumulative returns.
   - Also use Pound Sterling and American dollar for sensitivity
2. Each month, sort all 60 currencies (excluding base) by interest rate
   - Use interest rates implied by CIP through forward premium
   - Also use explicit interest rates
3. Form two portfolios
   - Short portfolio with lowest three interest rates (equally weighted)
   - Long portfolio with highest three interest rates
   - Also consider portfolios with five and ten currencies
4. Construct returns for (long, short and) long minus short portfolios
5. Each month, repeat steps 2-4

Carry Trade Returns



Using Explicit Interest Rates



Carry Trade Returns

- Pervasive but risky
- Higher with fewer currencies in portfolios
- But … do returns vary with NIRP?
- Estimate:

$$CARRY_{c,s,i,t} = \alpha + \beta NEG_t + \varepsilon_{c,s,i,t}$$

  - $CARRY_{c,s,i,t}$ monthly flow carry-trade return measured in currency c, with s currencies in both long/short portfolios, using measure i of interest rates (implicit in forward rates/explicit) at month t,
  - NEG_t importance of negative interest rates at t (Any? number?)

Returns from Long-Short Portfolios and Negative Interest Rates

Currency	Portfolio Size	Interest Rates	Number of Negative Interest Rate	Any Negative Interest Rates
Swiss Franc	3	Implicit	.002 (.002)	.006 (.007)
Swiss Franc	5	Implicit	.001 (.001)	.007 (.006)
Swiss Franc	10	Implicit	.000 (.001)	.002 (.004)
Pound Sterling	3	Implicit	.002 (.002)	.007 (.007)
American Dollar	3	Implicit	.002 (.002)	.006 (.007)
Swiss Franc	3	National	-.003 (.002)	-.005 (.007)

Negative Results

- No evidence that carry trade returns depend on negative nominal interest rates

Conclusion

- No evidence of strong effects of NIRP on exchange rate behavior
  - Volatility unaffected by *level* of interest rates, especially around 0
  - UIP works better recently, but no differences around 0 interest rates
  - Carry trade returns unaffected
- Caveat: have ignored most consequences of NIRP
  - Growth, inflation
  - Bank profitability, micro-structural effects
  - Financial Stability
- Another caveat: limited sample
  - Only 5 economies for limited period of time