Revisiting the Fama Puzzle: An Unexpected Journey

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Key Points

- UIP plays a key role in international macro but empirics at odds with theory (« Fama puzzle »)
- We find that when market expectations are directly measured UIP is more likely to hold
- There is evidence of horizon-dependent results
- There is a (statistical) structural break after the Global Financial Crisis
- JPY was an exception (« safe haven »), but now the US ?

Some Algebra

Uncovered interest parity is an **ex-ante no arbitrage condition.**

$$\mathbb{E}_t^m[\Delta s_{t+1}] = (i_t - i_t^*)$$

The most common way to test for UIP is the **Fama regression** (Fama, 1984):

$$s_{t+1} - s_t = \alpha + \beta(i_t - i_t^*) + u_{t+1}$$

The coefficient of this regression model is given by

$$\beta = \frac{Cov[i_t - i_t^*, s_{t+1} - s_t]}{Var[i_t - i_t^*]}$$

Forward Premium Puzzle

β is generally significantly negative !!

Some Algebra

The Fama regression is actually a test of the **joint hypothesis** of:

1. Risk-neutral, efficient forward markets: $f_t = \mathbb{E}_t^m[s_{t+1}] + rnme_t$
2. Expectations are unbiased: $\mathbb{E}_t^m[s_{t+1}] = s_{t+1} + fe_t$
3. No "political risk": $f_t - s_t = (i_t - i_t^*) + pr_t$

This is the so-called **"Unbiasedness hypothesis"**. Allowing for deviations from the above assumptions shows:

$$\beta = 1 - \underbrace{\frac{Cov[i_t - i_t^*, rnme_t]}{Var[i_t - i_t^*]}}_{\text{(1) risk-neutral market efficiency}} - \underbrace{\frac{Cov[i_t - i_t^*, fe_t]}{Var[i_t - i_t^*]}}_{\text{(2) forecast error}} - \underbrace{\frac{Cov[i_t - i_t^*, pr_t]}{Var[i_t - i_t^*]}}_{\text{(3) political risk}}$$

Outline

1. Empirical evidence of UIP failure

Meese and Rogoff (1988), Bekaert and Hodrick (2001), Burnside et al. (2006), Chinn and Meredith (2004)

2. Usual suspect 1 : Time-varying risk premium

Frankel and Chinn (1993), Backus et al. (2001)

3. Usual suspect 2: Expectations hypothesis

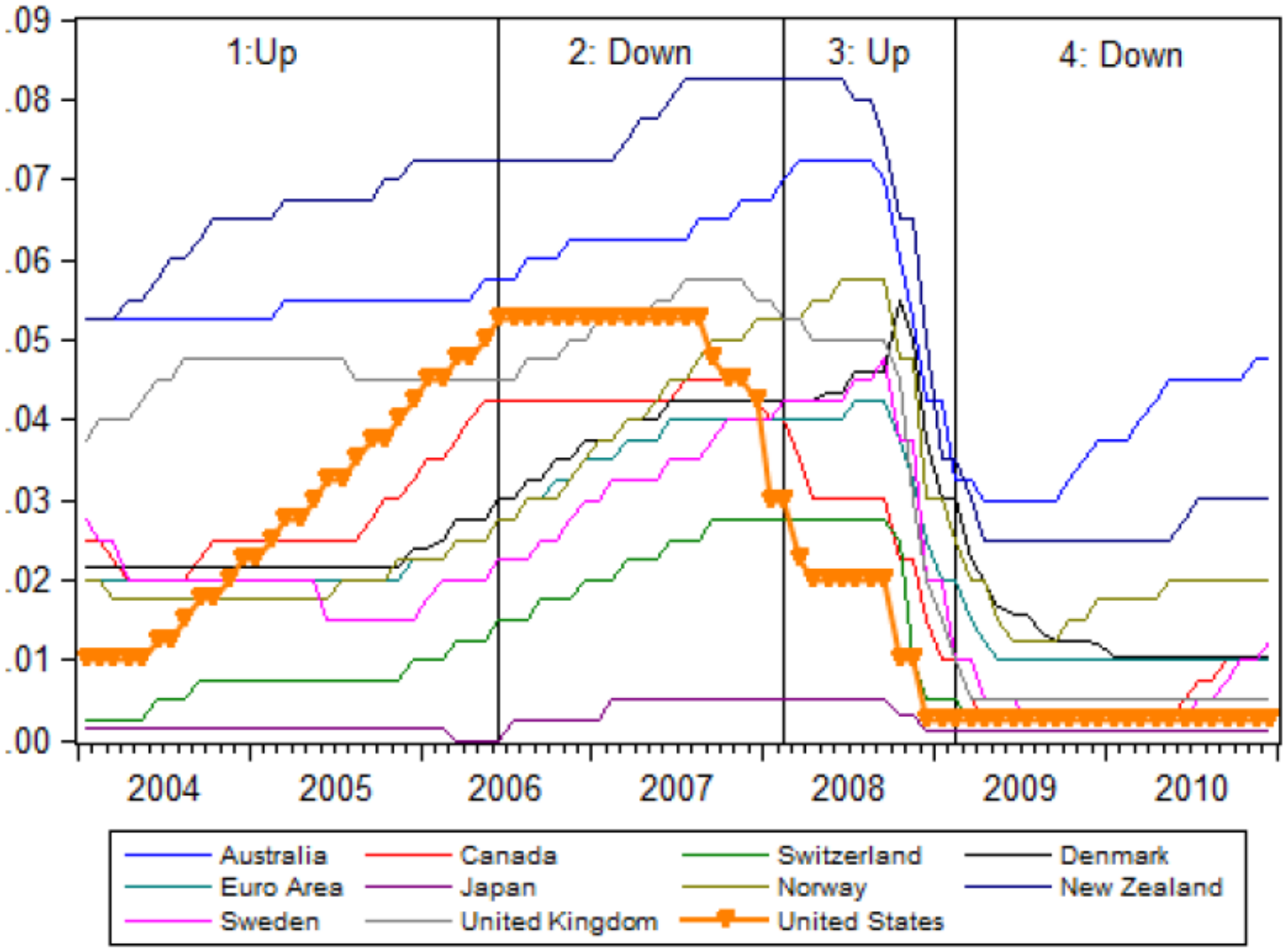
McDonald (2000), McDonald and Nagayasu (2015), Chinn and Frankel (1994)

4. Literature review :

Rossi (2013), Engel (2014)

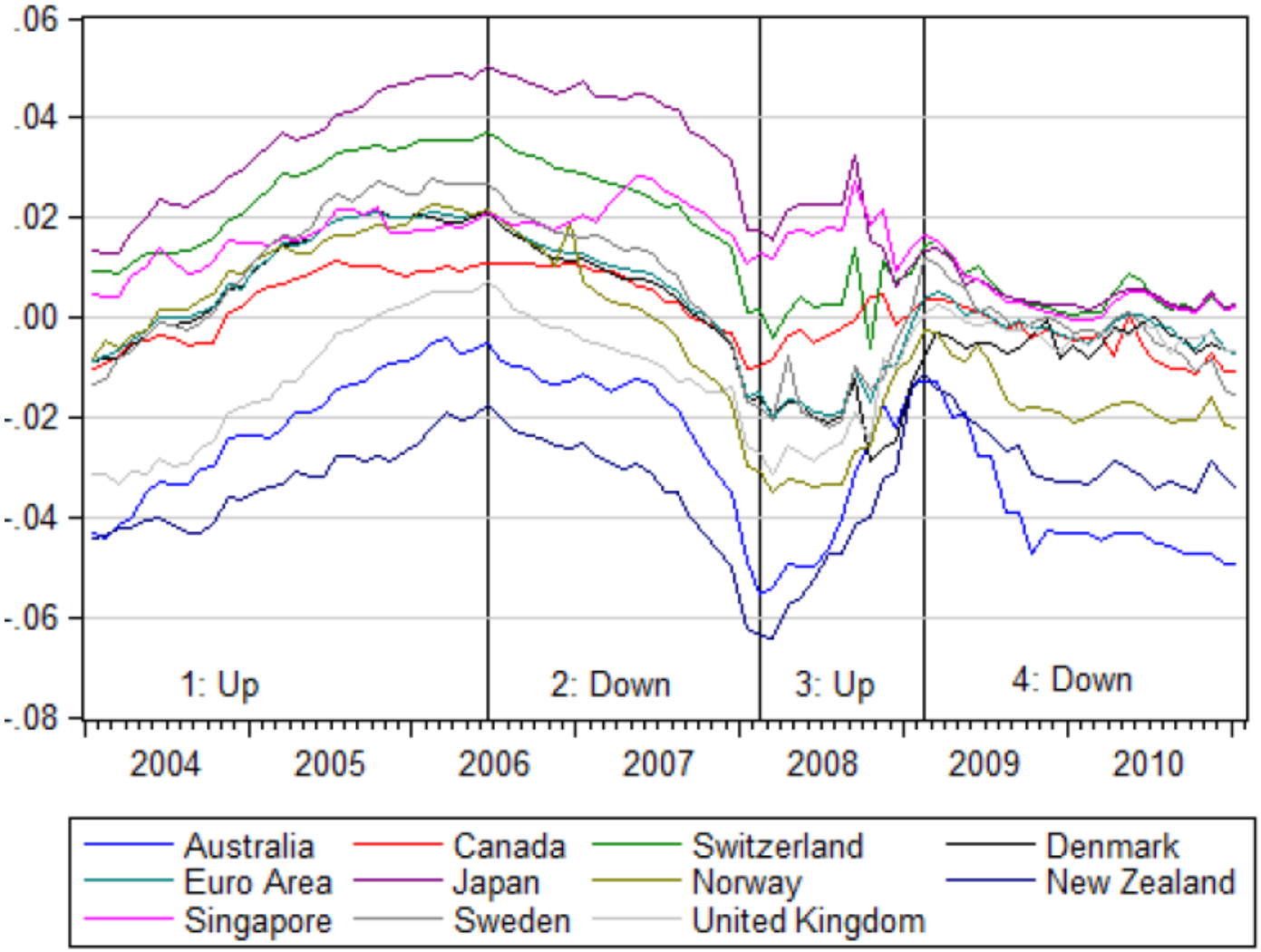
Stylized facts 1/4

Monetary Policy Rates



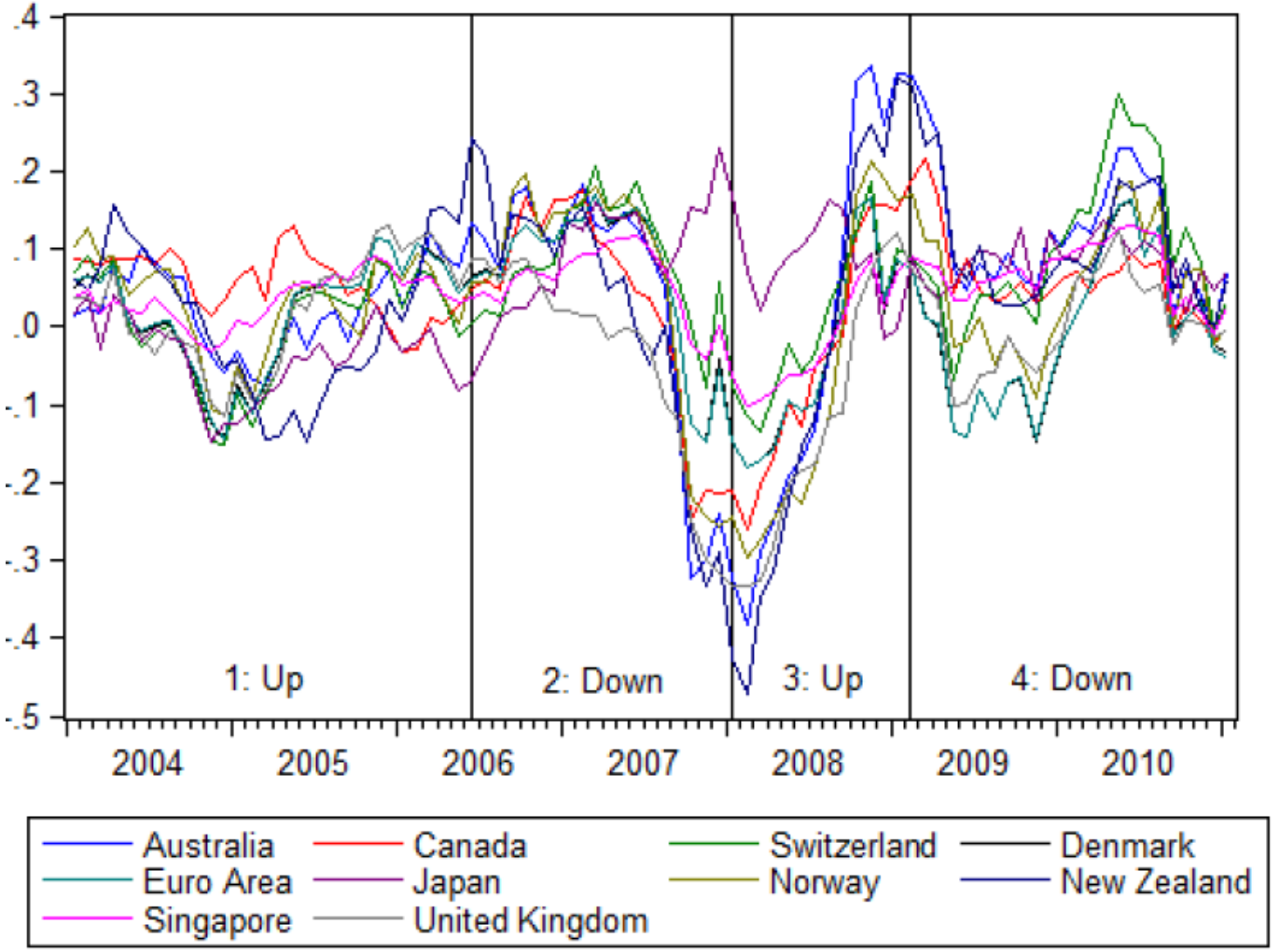
Stylized facts 2/4

Interest differentials vis-à-vis US ($i_{US} - i^*$)



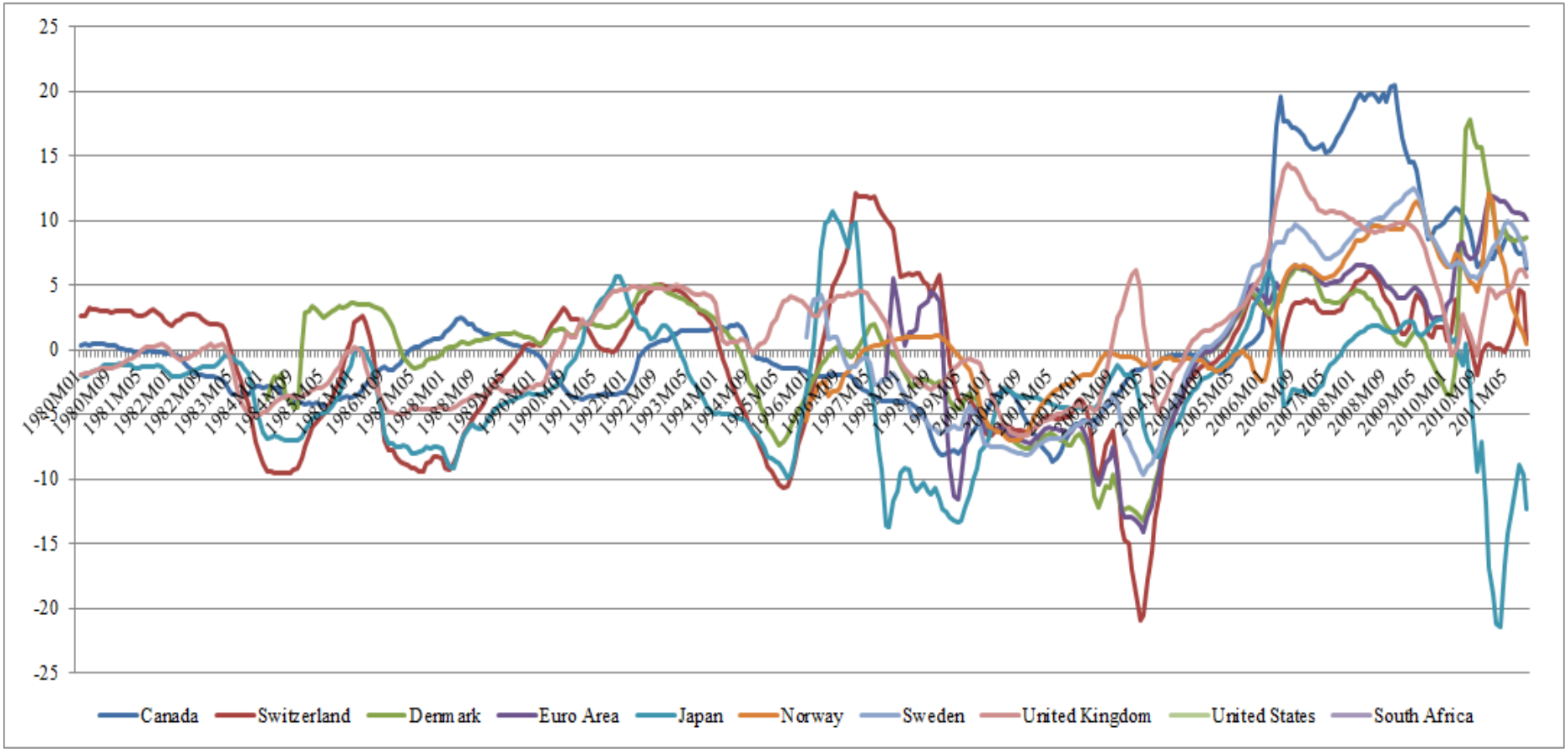
Stylized facts 3/4

Exchange rate depreciation wrt USD



Stylized facts 4/4

Estimated β for h=12m Fama regression (3y rolling window)



-> Time variation + Upward shift with GFC + specific Japan effect

Empirical analysis

We reconsider the UIP hypothesis using recent data until 2014 by testing:

1. Is there any horizon effect?

2. Is there any Global Financial Crisis effect?

3. Is there any variable that accounts for the time-varying nature of the risk premium?

4. Can expectations solve to some extent the UIP puzzle?

Sample, Data, etc.

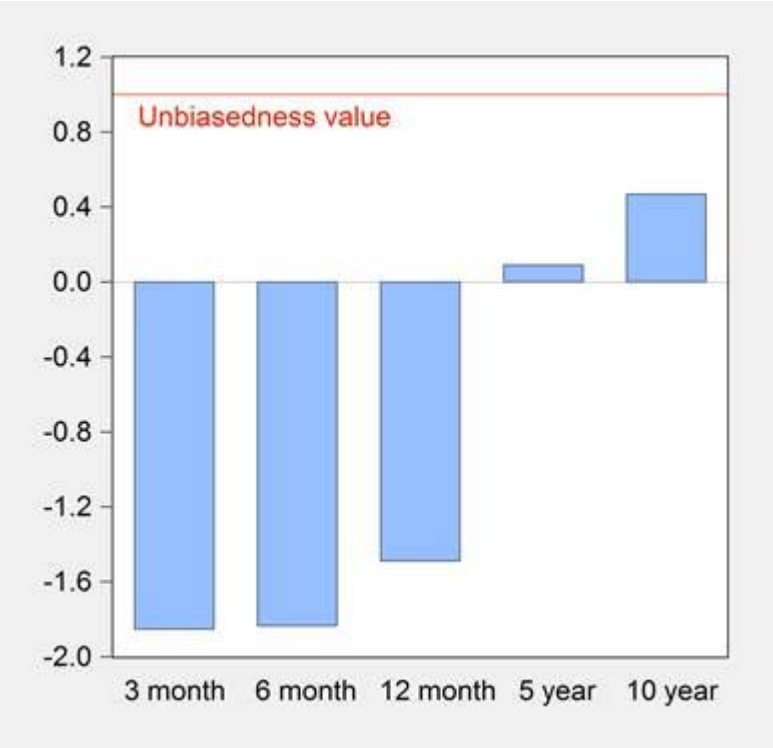
- We take the US as domestic country
- We consider 8 advanced economies (Canada, Switzerland, Japan, Denmark, Norway, Sweden, UK and the Euro area)
- We use off-shore interest rates (so no political risk)
- We use expectations from Consensus Forecasts and other marked-based surveys

Horizon effect

From the recent literature (Chinn and Meredith, 2005, Chinn and Quayyam, 2012, Valchev, 2015)

(i) Negative estimated β for short horizons

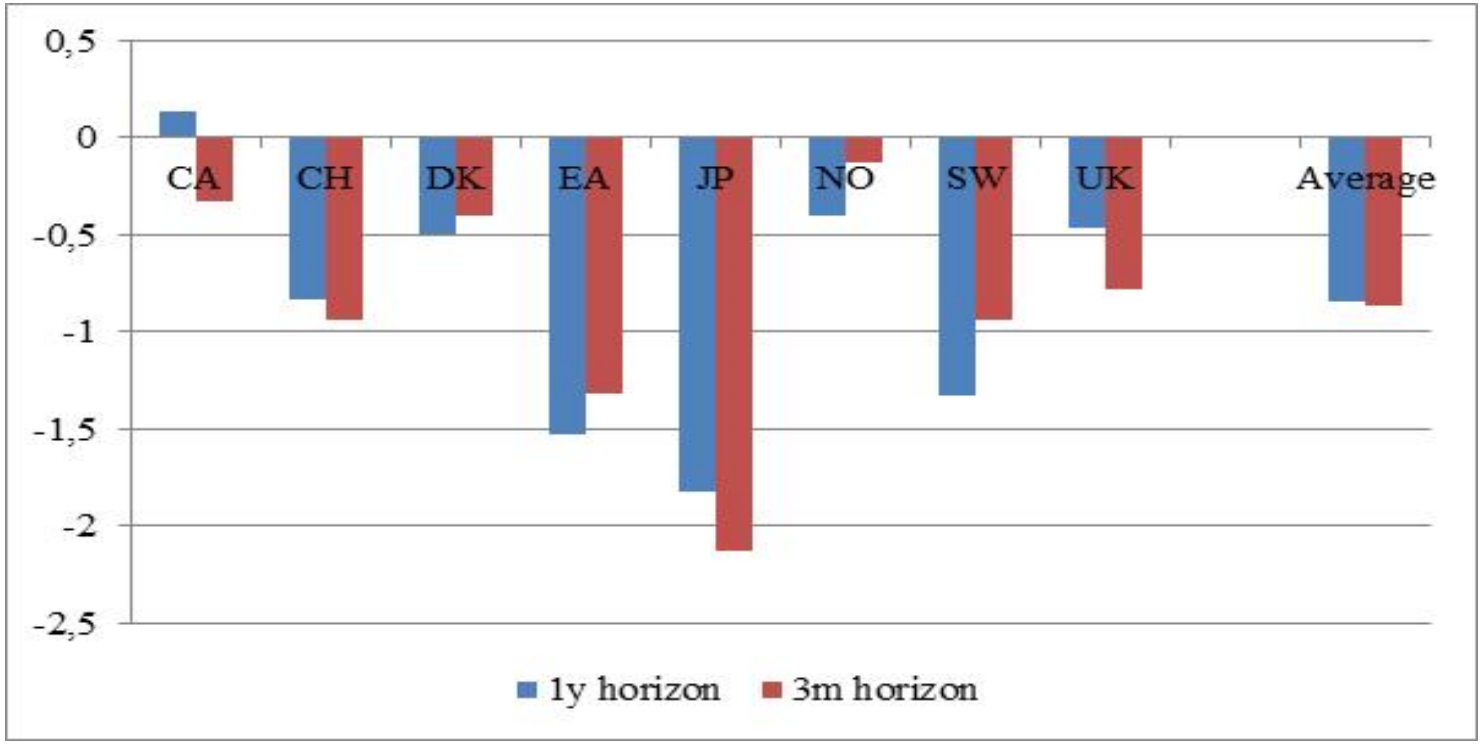
(ii) Interest differential point to the right direction at longer horizons



See Chinn and Zhang (2015) for an explanation using a NK DSGE model

Horizon effect

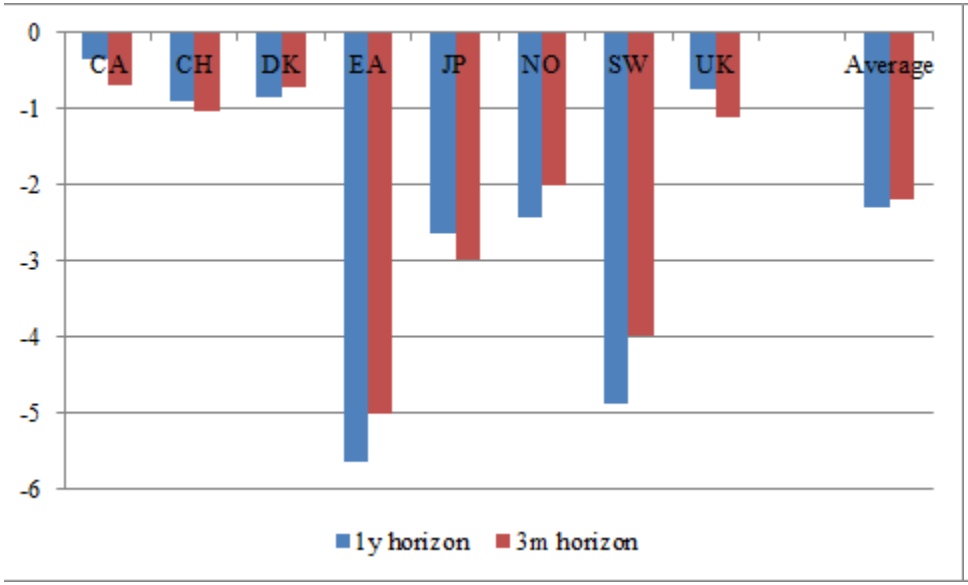
For h=3m and h=12m, we obtain similar empirical results from 1986 to 2014 for estimated β



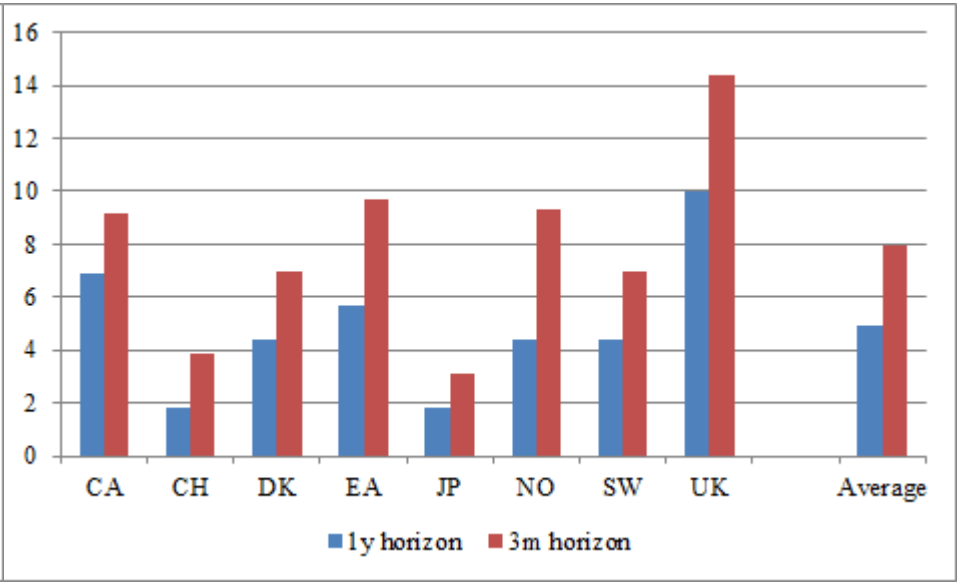
Horizon + GFC effects

… but evidence of a break after the GFC

Before Dec. 2006



After Jan. 2007



Positive β are associated with USD appreciation + Fed ZLB

β (3m) > β (12m)

Carry-trade effect + Safe haven effect seem at play

Augmented Fama regressions

Using CPI differential for the h=12m regression (Taylor rule fundamentals)

	CA	CH	DK	EA	JP	NO	SW	UK
Constant	0.000	0.052***	0.015	0.020	0.079***	0.008	0.012	-0.017
	(0.970)	(0.002)	(0.287)	(0.222)	(0.000)	(0.603)	(0.482)	(0.227)
Interest rate differential: i_us - i*	0.131	-0.832**	-0.492	-1.528	-1.822***	-0.406	-1.330	-0.468
	(0.771)	(0.020)	(0.461)	(0.268)	(0.000)	(0.634)	(0.249)	(0.406)
R^2	0.1%	3.7%	0.9%	3.7%	11.7%	0.5%	3.3%	0.9%
Prob(F-statistic)	0.570	0.000	0.080	0.011	0.000	0.329	0.011	0.047
Constant	-0.001	0.036**	0.011	0.008	0.089***	-0.009	0.012	0.003
	(0.883)	(0.035)	(0.468)	(0.633)	(0.005)	(0.528)	(0.709)	(0.843)
Interest rate differential: i_us - i*	0.018	-1.382***	-0.445	-2.987**	-1.749***	-0.866	-1.332	0.387
	(0.967)	(0.001)	(0.512)	(0.023)	(0.000)	(0.246)	(0.227)	(0.687)
Risk premium proxies								
Consumer price inflation	0.479	1.577***	0.841	4.639***	-0.481	3.361***	0.032	0.998
	(0.104)	(0.011)	(0.551)	(0.006)	(0.560)	(0.001)	(0.985)	(0.331)
R^2	1.4%	9.9%	1.7%	14.0%	12.2%	20.7%	3.3%	4.0%
Prob(F-statistic)	0.040	0.000	0.054	0.000	0.000	0.000	0.040	0.002

Augmented Fama regressions

Using IPI differential for the h=12m regression (Taylor rule fundamentals)

	CA	CH	DK	EA	JP	NO	SW	UK
Constant	0.000	0.052***	0.015	0.020	0.079***	0.008	0.012	-0.017
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Prob(F-statistic)	0.570	0.000	0.080	0.011	0.000	0.329	0.011	0.047
Constant	0.007	0.051	0.012	0.030	0.081	-0.010	0.015	-0.018
	(0.529)	(0.002)	(0.431)	(0.078)	(0.000)	(0.609)	(0.375)	(0.222)
Interest rate differential: i_us - i*	-1.409	-0.824**	-1.648	-3.278**	-1.868***	-0.705	-1.812*	-0.454
	(0.156)	(0.028)	(0.155)	(0.031)	(0.000)	(0.347)	(0.084)	(0.422)
Risk premium proxies								
Industrial production growth	0.963**	0.023	0.201	-1.177**	-0.019	0.568**	-0.487**	0.076
	(0.019)	(0.919)	(0.105)	(0.028)	(0.895)	(0.026)	(0.023)	(0.753)
R^2	13.2%	3.7%	7.0%	11.0%	12.1%	11.4%	7.8%	1.0%
Prob(F-statistic)	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.112

Augmented Fama regressions

Using the VIX (S&P 500) for the h=12m regression

	CA	CH	DK	EA	JP	NO	SW	UK
Constant	0.000	0.052***	0.015	0.020	0.079***	0.008	0.012	-0.017
	(0.970)	(0.002)	(0.287)	(0.222)	(0.000)	(0.603)	(0.482)	(0.227)
Interest rate differential: i_us - i*	0.131	-0.832**	-0.492	-1.528	-1.822***	-0.406	-1.330	-0.468
	(0.771)	(0.020)	(0.461)	(0.268)	(0.000)	(0.634)	(0.249)	(0.406)
R^2	0.1%	3.7%	0.9%	3.7%	11.7%	0.5%	3.3%	0.9%
Prob(F-statistic)	0.570	0.000	0.080	0.011	0.000	0.329	0.011	0.047
Constant	0.008	0.031*	0.003	0.019	0.057**	0.009	0.010	0.018
	(0.407)	(0.073)	(0.823)	(0.263)	(0.010)	(0.537)	(0.565)	(0.157)
Interest rate differential: i_us - i*	1.078*	-0.967	-0.179	-1.351	-1.547**	-0.124	-0.879	1.502**
	(0.066)	(0.170)	(0.790)	(0.337)	(0.022)	(0.900)	(0.461)	(0.049)
Risk premium proxies								
VIX	-0.456***	-0.049	-0.183	-0.171	0.052	-0.293	-0.418**	-0.314**
	(0.000)	(0.686)	(0.156)	(0.259)	(0.690)	(0.129)	(0.018)	(0.044)
R^2	26.2%	3.9%	2.7%	6.4%	8.9%	7.1%	15.0%	14.9%
Prob(F-statistic)	0.000	0.004	0.024	0.004	0.000	0.001	0.000	0.000

Horizon + GFC effects

Recap of Fama and Fama augmented:

- Oddity of having UIP working better when risk is high (ie : after the GFC)
- Estimated β largely greater than 1 after the GFC

  => From « excess returns on foreign bonds » to « excess returns on US bonds » after the GFC ?

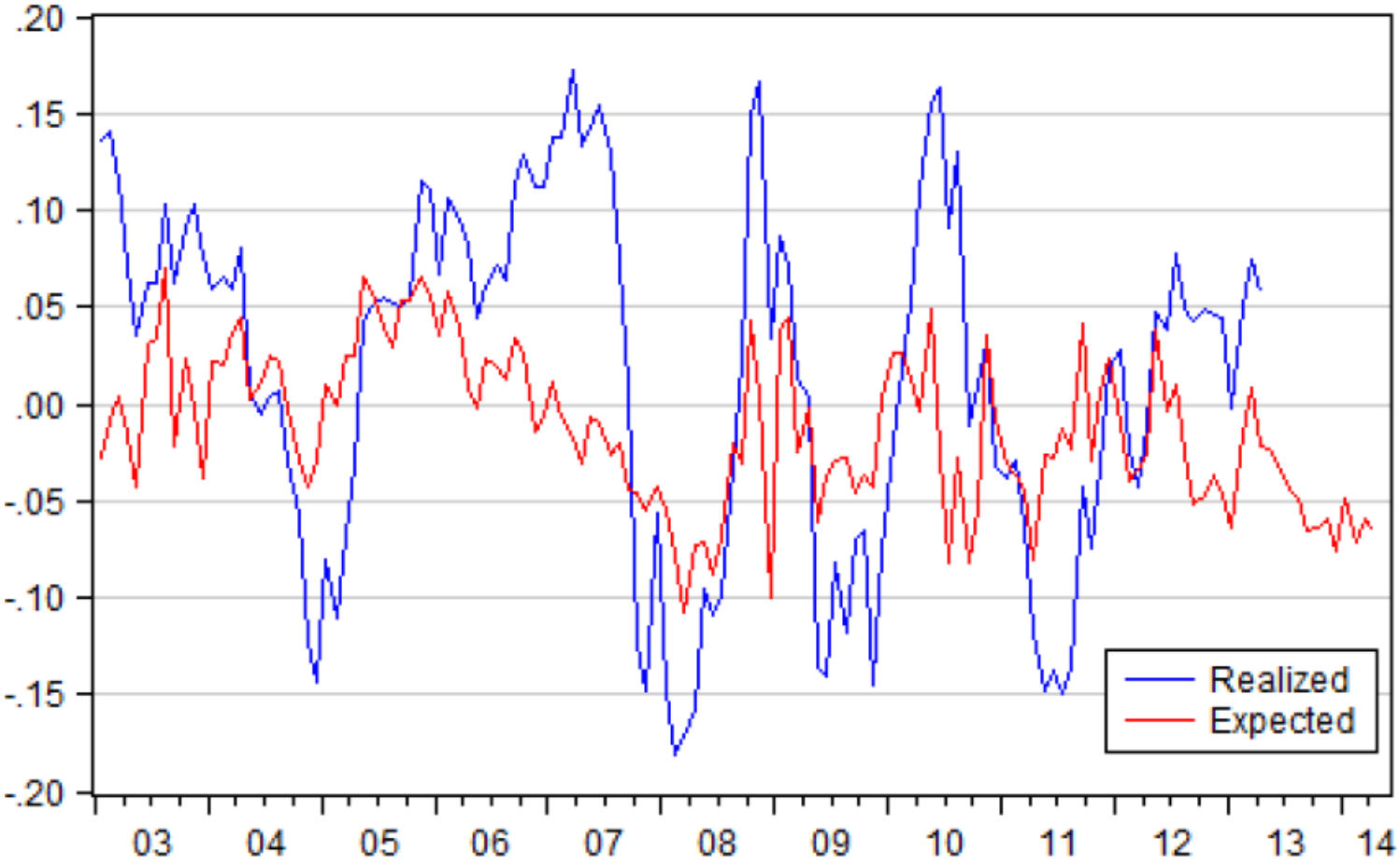
- Significant negative effect of the VIX :

$\Rightarrow$ A volatility shock tends to a USD appreciation

$\Rightarrow$ UIP holds for some countries (Canada, UK)

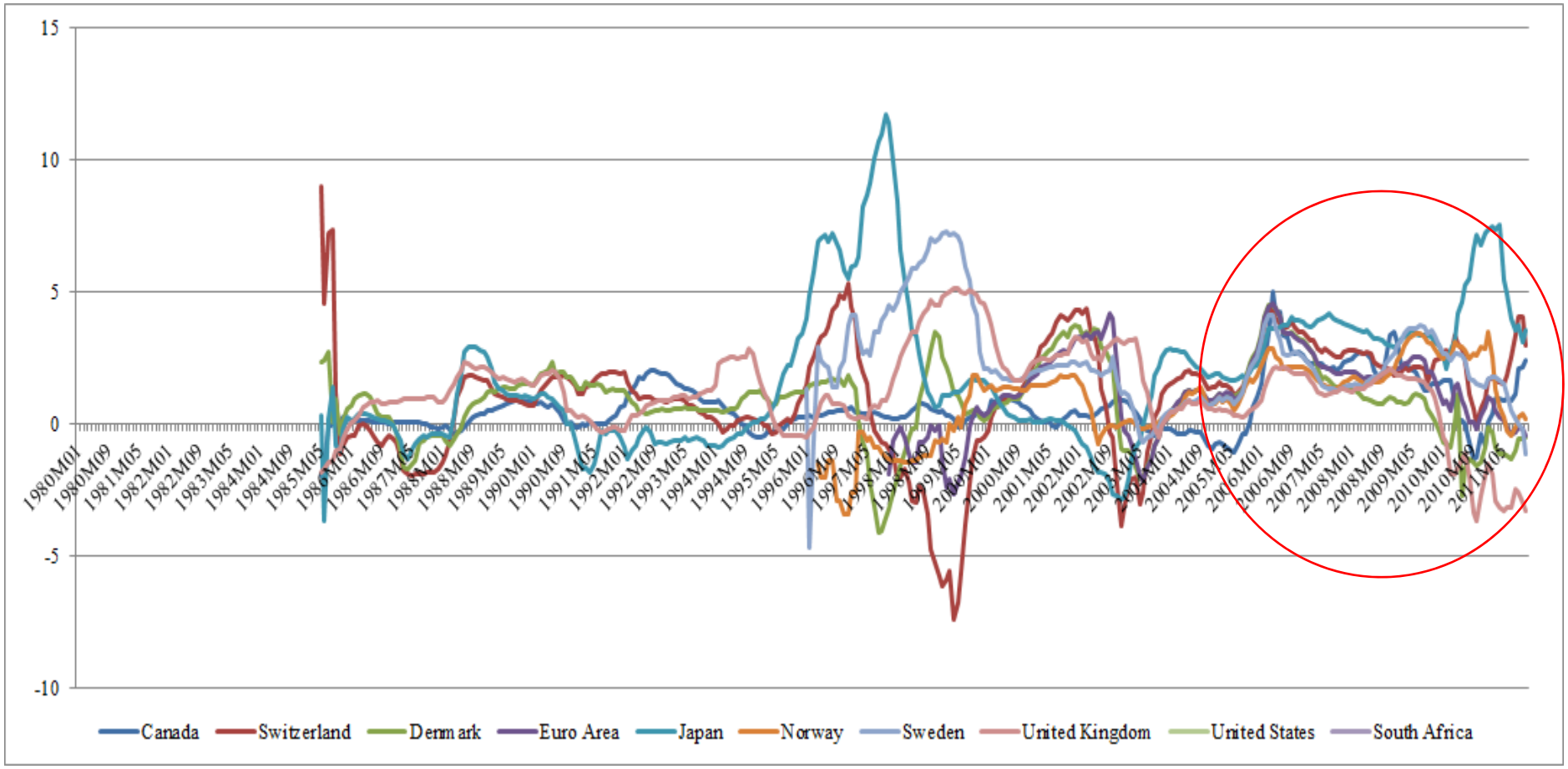
Do expectations matter?

1Y-ahead depreciation of USD against EUR



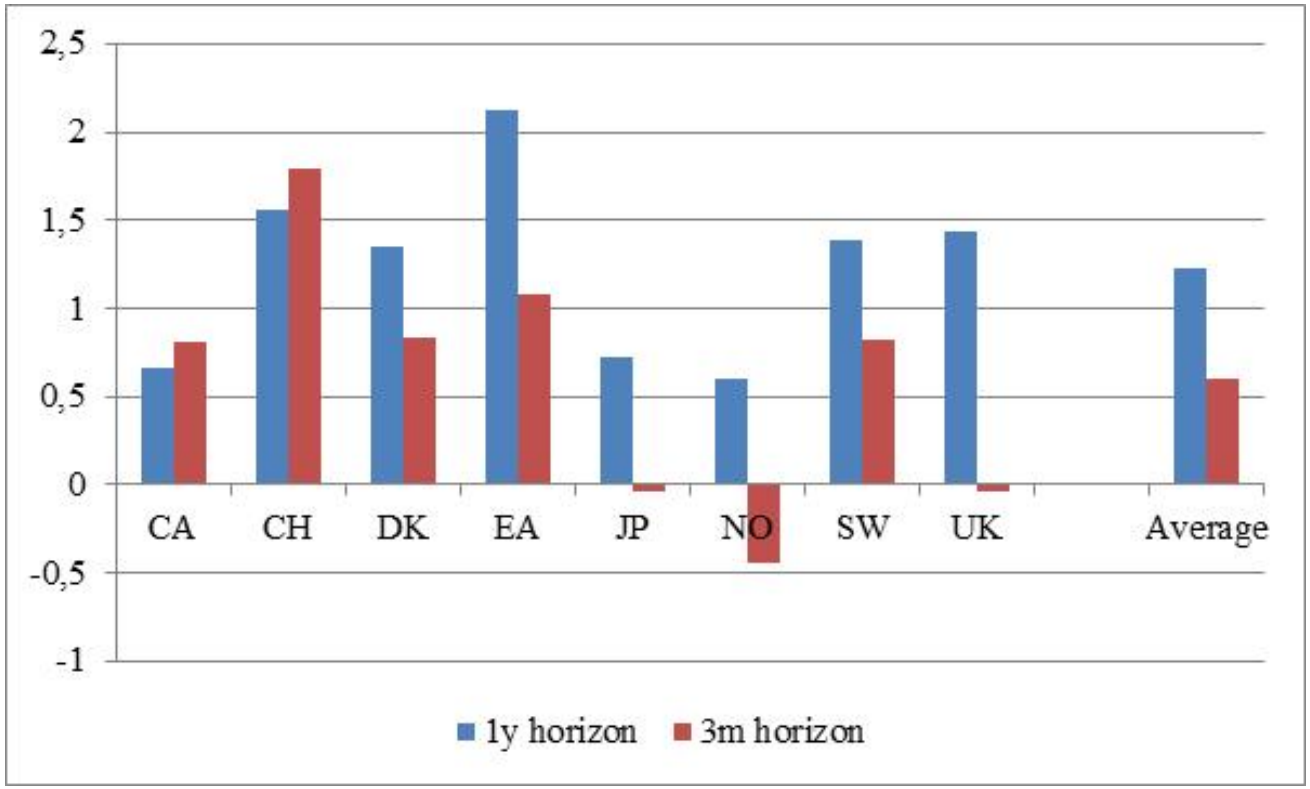
Do expectations matter?

Estimated β for h=12m expectations regression (3Y window)



Expectation effect

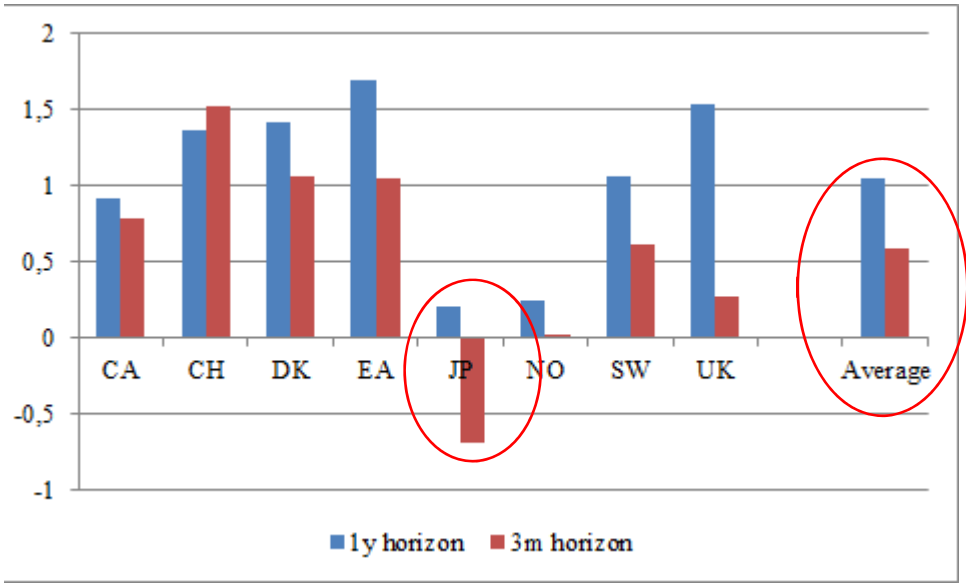
Using expectations data over the full sample, UIP seems to hold for h=12m, less so for h=3m



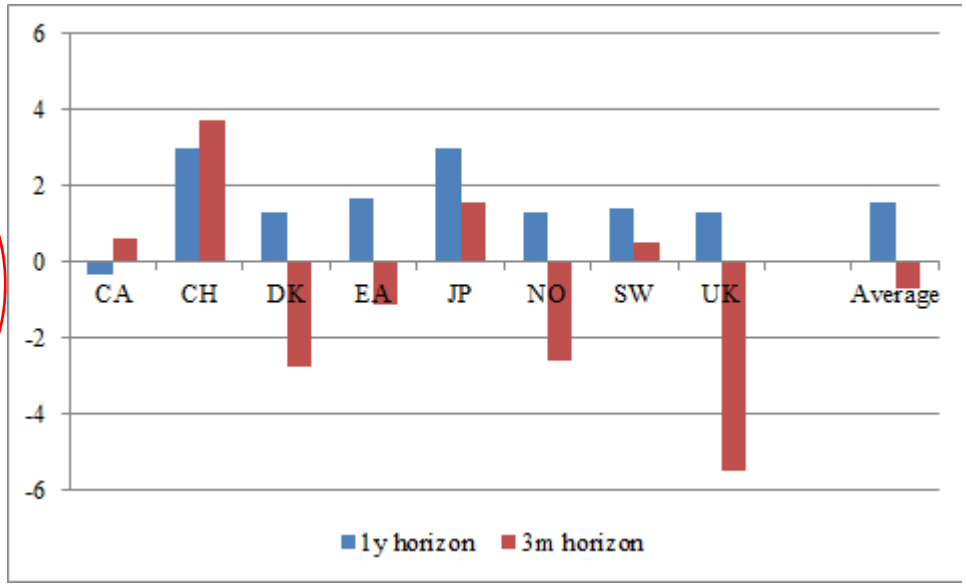
Expectation + GFC effects

… but evidence of a break after the GFC

Before Dec. 2006



After Jan. 2007



Forecasters do believe in UIP except for Japan (mainly for h=3m)

Divergence of behavior between h=3m and h=12m

UIP holds at h=3m for Switzerland and Japan

Expectation + GFC effects

How to interpret the results after the GFC?

- UIP seems to hold for h=12m
- Still a puzzle for h=3m for all the countries except Japan and Switzerland
- Forecasters anticipate a USD appreciation in spite of the ZLB => US as safe haven

  => Carry trade active during financial turmoil + specific role of the ZLB ? See McDonald and Nagayasu (2015)

Expectations and augmented regressions

Using the VIX (S&P 500) for the h=12m regression using expectations

	CA	CH	DK	EA	JP	NO	SW	UK
Constant	0.007**	-0.037***	-0.003	0.009	-0.038***	0.033***	0.033***	0.006
	(0.041)	(0.000)	(0.699)	(0.181)	(0.000)	(0.000)	(0.000)	(0.396)
Interest rate differential: i_us - i*	0.663***	1.562***	1.345***	2.125***	0.718**	0.603***	1.392***	1.441***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.020)	(0.030)	(0.000)	(0.000)
R^2	10.7%	21.9%	23.1%	27.0%	6.6%	6.0%	19.9%	27.3%
Prob(F-statistic)	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Constant	0.008**	-0.038***	-0.004	0.008	-0.038***	0.034***	0.032***	0.006
	(0.019)	(0.000)	(0.595)	(0.225)	(0.000)	(0.000)	(0.000)	(0.407)
Interest rate differential: i_us - i*	0.822***	1.769***	1.687***	2.237***	0.544*	0.718**	1.585***	1.648***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.090)	(0.011)	(0.000)	(0.000)
Risk premium proxies								
VIX	-0.104***	-0.093**	-0.152***	-0.105**	0.079*	-0.127***	-0.174***	-0.137***
	(0.002)	(0.037)	(0.000)	(0.024)	(0.095)	(0.002)	(0.000)	(0.000)
R^2	18.8%	24.5%	35.7%	30.7%	7.3%	13.2%	31.1%	34.4%
Prob(F-statistic)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Negative signifcant effect except in JP + no change in estimated β

Conclusions

1. Using expectations data seems to improve empirical results on the UIP condition

2. Dependence of the results to the forecast horizon (in line with the literature)

3. A possible switch after the GFC from a Japanese safe haven to a US one

=> From « excess returns on foreign bonds » to « excess returns on US bonds » after the GFC ?

Next steps

1. More robustness checks to be done (post-GFC sample is short)
2. Check for statistical evidence of breaks
3. Inclusion of variables to catch to some extent the risk premium
4. Possible non-linearities in the data
5. Introduce proxies for carry-trade volumes (if any)

Survey data: Critique and rebuttal

- Are these informed agents?

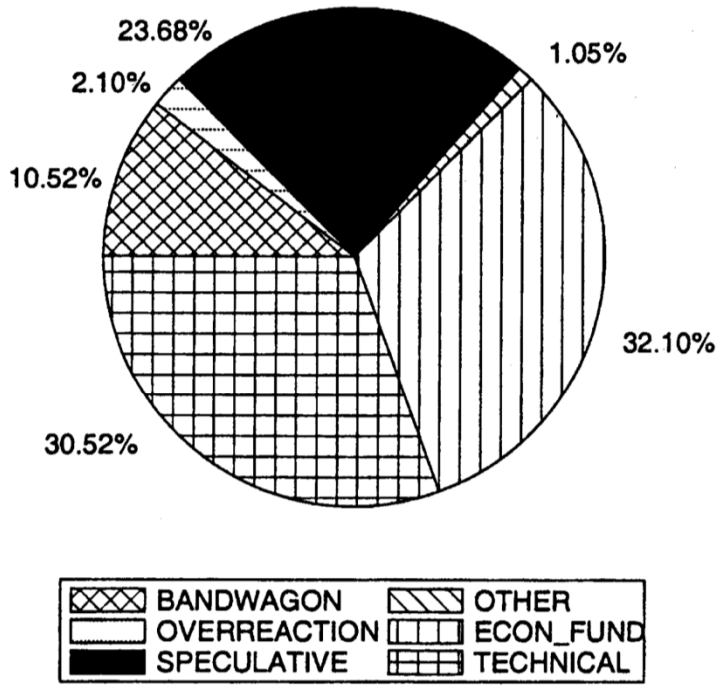
  Answer: Usually forex economists at major banks or consulting firms

- Aren't the expectations just read off of interest differentials?

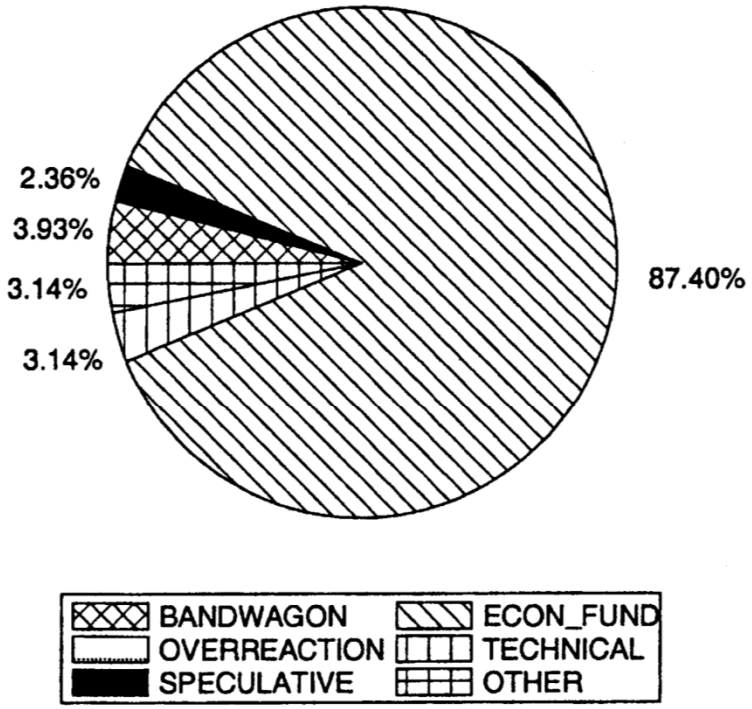
  Answer (1): In Frankel and Chinn (1993), about half of covariation of depreciation with forward premium seems to be expectational, half risk premium

Survey data: Critique and rebuttal

Answer (2): Forex market participants seem to pay attention to other things. From Cheung and Chinn (2001):



Medium Run (up to 6 months)



Long Run (over 6 months)