



Perspectives on Uncovered Interest Rate Parity and the Carry Trade: Some recent evidence for G10 and Emerging Markets.

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Resumen

- **Según la paridad no cubierta de tasas de interés (UIRP), monedas de países con tasas altas de interés deberían depreciarse proporcionalmente contra monedas de países con tasas bajas de interés. Sin embargo, lo opuesto sucede y esto genera retornos predecibles a través del llamado “carry trade.”**
- **Esta estrategia es exitosa en general y es parte del portafolio usado por la mayoría de administradores de carteras en moneda extranjera y hedge-funds, pero sufre ocasionalmente de pérdidas grandes.**
- **Este artículo confirma la falla de UIRP mediante regresiones individuales y de panel para monedas de los países G10 y de países de mercados emergentes (ME), incluyendo algunos de Latinoamérica, contra el dólar americano.**
- **También muestra la ventaja de usar portafolios de monedas G10 o ME en vez de monedas individuales.**
- **Un resultado importante es que combinando el carry trade con un modelo económico simple del valor fundamental de una moneda ayuda a predecir los puntos de grandes pérdidas del carry trade, a pesar que los modelos económicos per se no pueden predecir la evolución del tipo de cambio o sus puntos de inflexión.**
- **El artículo discute algunas conclusiones para el manejo de carteras de moneda extranjera para la banca privada así como para el manejo del tipo de cambio para la banca central.**

Introduction

- **Uncovered Interest Rate Parity (UIRP):**

Interest differentials reflect depreciation expectations of high-yield currencies vs low-yield currencies.

E.g., Australia = 4% annual y EEUU = 1% annual

AUD should depreciate approximately 3% vs USD in a year. Most likely, USD will depreciate vs AUD

- **Currency Excess Return (or Total return) = Spot Return + Rate Differential**

UIRP: Expected Excess Return = 0.

Failure of UIRP implies predictable excess returns and profitable trading

- **Carry trade: buy high-yield currencies, sell low-yield currencies.**

E.g., buy AUD and sell USD in the example above.

- **UIRP failure discovered in the 1980s: Hansen & Hodrick (1980), Bilson (1981), Fama (1984).**

No full explanation available but recent evidence indicates that carry trade profitability is not a statistical artifact (e.g. small sample bias or omitted variables)

However the carry trade suffers from large infrequent losses.

I. UIRP Regression Tests

- Consider “s” the log FX rate (units of currency J per dollar), “Δs” indicates the dollar appreciation against currency J, “i^J” the 1-month interest rate for country J and “i^{US}”, the US interest rate:

- (1)
$$\Delta s_{t+1} = \alpha + \beta (i_t^J - i_t^{US}) + U_{t+1}$$

- Under UIRP, the expected dollar appreciation exactly offsets any favorable rate differential for the other currency (and viceversa).
- Thus the expected regression slope is unity and the intercept is usually left unconstrained to allow for a constant risk premium, specific to each currency.
- Alternately, Bilson (1981) rearranges the above equation to have excess returns in the left hand side. UIRP requires zero excess returns:

- (2)
$$XR_{t+1} \equiv [\Delta s_{t+1} - (i_t^J - i_t^{US})] = \alpha + [\beta - 1] (i_t^J - i_t^{US}) + U_{t+1}$$

- I estimate (1): end-of-month spot rates from Thompson Reuters, 1-month Libor rates from Bloomberg.
- Eq. (2) is a linear transform of (1), used to forecast excess returns, which in turn will be used as an alternative to the typical carry trade later.
- RESULTS: Below Tables 1 and 2- general violation of UIRP for G10 and EM; but results for EM are more favorable to the parity condition.

Individual regression tests for G10 and EM

Table 1. G10 currencies vs the USD. Sample: Sept 1981 - June 2010

	intercept	t(intercept)	beta	t(beta)	R2 adj	dw	NOBS
AUD	0.000	0.054	0.258	0.298	-0.003	1.781	345
CAD	0.000	0.170	-0.875	-1.465	0.001	2.000	345
CHF	-0.004	-1.477	-1.227	-1.311	0.004	1.950	345
EUR	-0.002	-0.862	-0.667	-0.729	-0.001	1.861	345
GBP	0.003	1.562	-1.587	-1.228	0.006	1.813	345
JPY	-0.009	-3.470	-2.727	-2.932	0.020	1.983	345
NOK	-0.001	-0.587	0.409	0.481	-0.002	1.784	293
NZD	0.003	0.946	-0.695	-0.825	0.000	1.934	345
SEK	0.001	0.501	0.215	0.197	-0.003	1.739	345

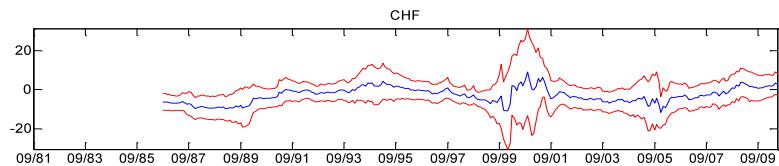
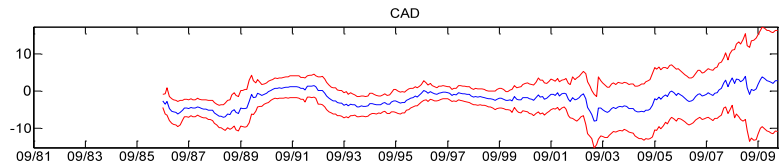
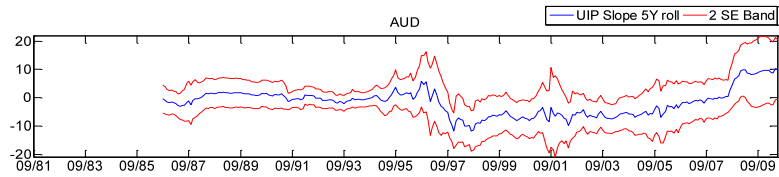
AUD= Aussie dollar, CAD= Canadian dollar, CHF= Swiss franc, EUR= euro, GBP = pound.
 JPY= yen, NOK= Norwegian krona, NZD= New Zealand dollar, SEK= Swedish krona.
 Source: Bloomberg and Source: Thomson Reuters.

Table 2. EM currencies vs the USD. Sample: June 1998 - June 2010

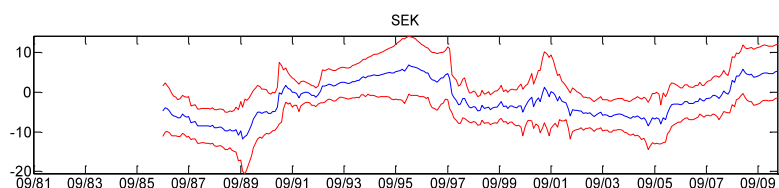
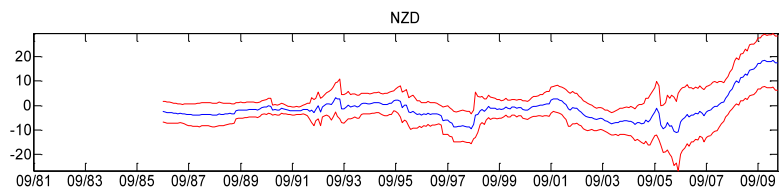
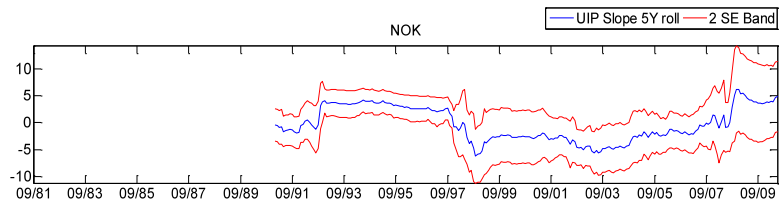
	intercept	t(intercept)	beta	t(beta)	R2 adj	dw	NOBS
'ARS'	-0.009	-2.135	0.783	3.62	0.473	2.902	144
'BRL'	-0.005	-0.544	0.727	0.767	-0.003	1.943	144
'CLP'	0	0.056	0.41	0.609	-0.006	1.577	144
'CNY'	-0.001	-4.564	0.434	3.765	0.203	1.255	144
'COP'	-0.004	-0.884	0.914	1.908	0.017	1.711	144
'CZK'	-0.003	-0.954	-0.255	-0.143	-0.007	1.819	144
'HKD'	0	0.313	-0.046	-0.695	-0.006	1.884	144
'HUF'	0.007	1.097	-1.142	-1.465	0.002	1.758	144
'IDR'	-0.005	-1.011	0.751	0.938	0.016	1.652	96
'ILS'	0	-0.052	0.286	0.314	-0.006	1.871	144
'INR'	0	-0.013	0.14	0.51	-0.006	1.494	144
'KRW'	0	0.106	-0.798	-0.452	-0.003	2.044	144
'MXN'	0.004	1.167	-0.251	-0.616	-0.005	1.541	144
'PHP'	0.002	0.68	-0.166	-0.603	-0.004	1.696	144
'PLN'	-0.003	-0.461	0.515	0.648	-0.005	1.663	144
'SGD'	-0.003	-1.066	-1.164	-0.791	0	1.91	144
'RUB'	-0.006	-2.296	1.479	1.772	0.14	1.667	90
'THB'	0	0.221	-1.178	-1.785	0.025	2.035	144
'TRY'	-0.004	-0.56	0.586	3.411	0.047	1.749	144
'TWD'	0	-0.171	0.318	0.705	-0.003	1.504	144
'ZAR'	0.019	2.119	-2.825	-1.926	0.019	1.885	144

ARS= Argentina, BRL=Brazil, CLP= Chile, CNY= China, COP= Colombia, CZK= Czeck,
 HKD= Hong Kong, HUF= Hungary, IDR= Indonesia, ILS= Israel, INR= India, KRW= South
 Korea, MXN= Mexico, PHP= Philippines, PLN= Poland, SGD= Singapore, RUB= Russia,
 THB= Thailand, TRY= Turkey, TWD= Taiwan, ZAR= S. Africa.
 Source: Bloomberg and Source: Thomson Reuters.

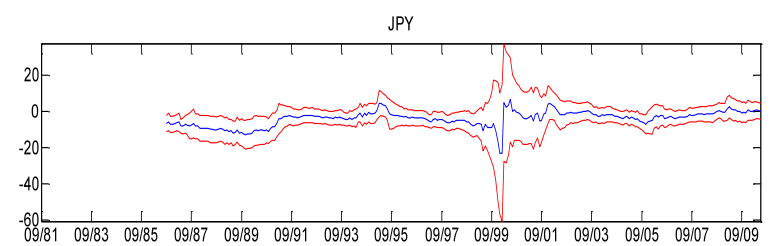
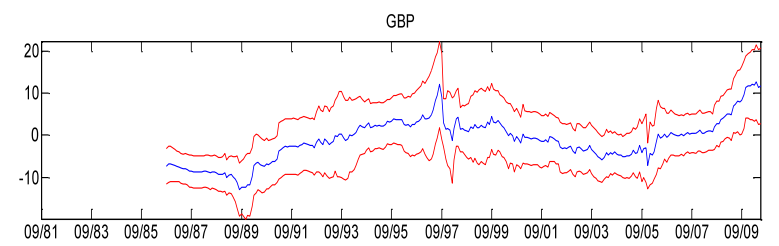
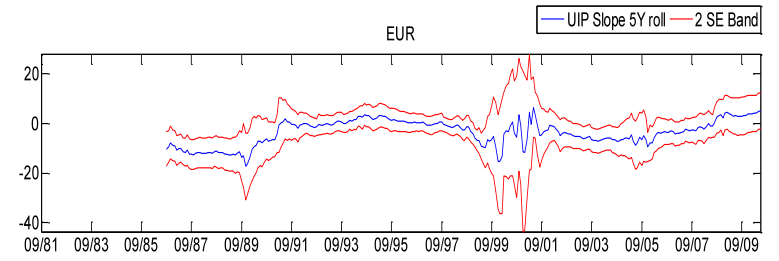
Rolling UIRP Slope (5 yr) for G10



Source: Bloomberg and Source: Thomson Reuters.



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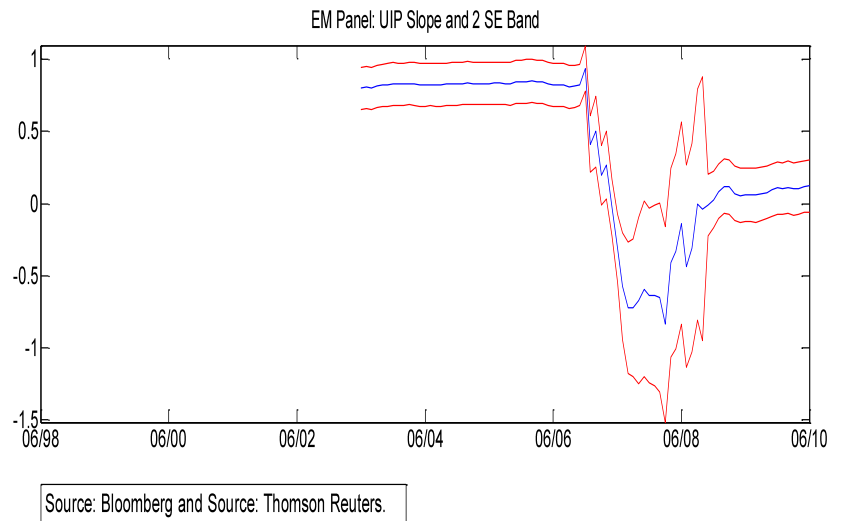
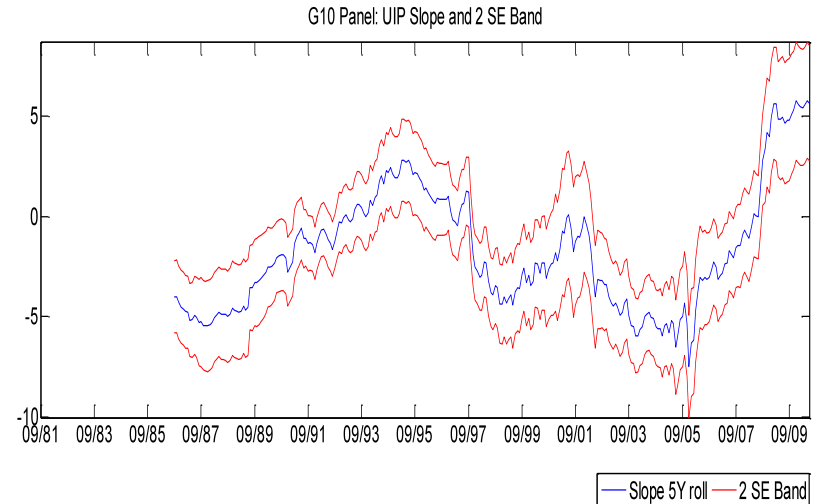
Panel Regression with Fixed Effects and 5 yr rolling slopes

Table 3. Panel Regression with Fixed Effects (omitted in the table).

A. G10 Panel: NOK omitted.				
	beta	t(beta)	R2 adj	NOBS
Sample Sep 1981- Jun 2010	-0.708	-2.451	0.004	345x8
Sample Sep 1981- Jun 1998	-0.956	-2.951	0.010	201x8
Sample Jun 1998- Jun 2010	-0.842	-1.093	0.003	144x8
B. EM Panel: Jun 1998- Jun 2010				
	beta	t(beta)	R2 adj	NOBS
Omit IDR, RUB.	0.716	14.439	0.094	144x19
Omit IDR, RUB, ARS	0.385	2.460	0.014	144x18
C. Latam.: Jun 1998- Jun 2010				
	beta	t(beta)	R2 adj	NOBS
Latam – All	0.775	15.366	0.183	144x5
Latam - Omit ARS	0.518	1.364	0.004	144x4

Source: Bloomberg and Source: Thomson Reuters.

- Small sample in individual regressions?
- Evidence: Correcting for econometric bias does not recover UIP. E.g., Bekaert & Hodrick (2001), Bekaert, Wei & Xin (2007), Villanueva (2007).
- Another possibility is to use panel regressions to improve sample size, assuming a common theoretical parameter for all country but allowing for individual intercepts (fixed effects).
- Panel results shown in Table 3 and 5-yr rolling betas.
- Although UIP still rejected, evidence for EM is much more stable and closer to UIP than G10.



Profitability and Risk of the Carry Trade

■ **Typical carry trade:**

At end of each month compare each G10 vs USD (and EM vs USD) interest rates.
If J's rate > USD rate then buy currency J vs the USD (and viceversa)
You get the excess return of J vs USD, if bought; the negative of that if you sold.
Use 3 basis points (bp) as the transaction cost (one-way) for G10 and 20 bp for EM (one-way).

■ **Using regression forecasts**

Instead, use forecasts from eq (2) above: If excess return for J vs USD is positive then buy J (sell USD) and viceversa.

■ **Villanueva (2007): G4 carry performance strong (MC and bootstrap)**

■ **Performance here: See below Tables 4 (G10) and 5 (EM)**

All G9 currencies vs USD are profitable but risky (see max drawdown) although results for more recent sample 2003-2010 are mixed.

Most EM are profitable vs USD. Several (ARS, BRL, COP, IDR, THB, TRY) are a lot more profitable than G9 during 2003-2010, despite regressions being more consistent with UIRP

Performance of Individual carry trades G10 and EM vs USD

Table 4. G10 Performance Simple Carry: Individual currency vs USD.

	mean	stddev	IR	maxDD	hit ratio
A. Sample Sep 1986 – June 2010 (to compare with regression)					
AUD	0.0706	0.1117	0.6326	-0.3824	0.6246
CAD	0.03	0.0712	0.4218	-0.3004	0.5825
CHF	0.0107	0.1146	0.0937	-0.4721	0.5263
EUR	0.0318	0.1058	0.3006	-0.3802	0.5439
GBP	0.018	0.1015	0.1778	-0.4775	0.5298
JPY	0.028	0.1156	0.2422	-0.2915	0.5474
NOK	0.0261	0.1063	0.2451	-0.4209	0.5451
NZD	0.0667	0.1144	0.5827	-0.4127	0.6211
SEK	0.0492	0.1122	0.4385	-0.4113	0.5439
B. Sample June 2003 - June 2010					
AUD	0.0604	0.1412	0.4274	-0.3824	0.5952
CAD	0.0174	0.1072	0.1623	-0.3004	0.5238
CHF	-0.0158	0.1131	-0.1395	-0.2386	0.5238
EUR	-0.0132	0.1062	-0.1243	-0.3802	0.4524
GBP	-0.033	0.0977	-0.3377	-0.4775	0.4643
JPY	-0.0163	0.0988	-0.1651	-0.2915	0.4762
NOK	-0.0161	0.114	-0.1413	-0.4209	0.5119
NZD	0.0582	0.1474	0.3951	-0.4127	0.6071
SEK	0.0319	0.1251	0.2551	-0.2936	0.4762

Source: Bloomberg and Source: Thomson Reuters.

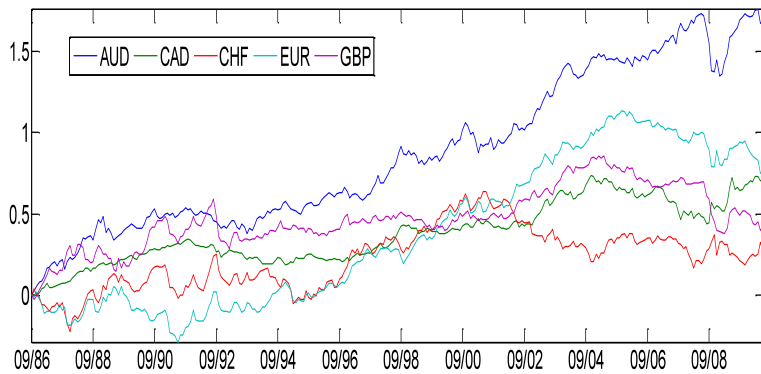
Table 5. EM Performance Simple Carry. Sample June 2003 - June 2010.

	mean	stddev	IR	maxDD	hit ratio
EM indiv pairs vs USD					
'ARS'	0.0699	0.089	0.7852	-0.0838	0.7024
'BRL'	0.1811	0.1494	1.212	-0.3546	0.7262
'CLP'	0.0348	0.1311	0.265	-0.4172	0.5952
'CNY'	0.0032	0.0141	0.2283	-0.05	0.6667
'COP'	0.1099	0.1402	0.784	-0.3048	0.6905
'CZK'	-0.0004	0.1326	-0.0028	-0.3585	0.5
'HKD'	0.0043	0.0068	0.6302	-0.0214	0.6905
'HUF'	0.0561	0.1592	0.3523	-0.4164	0.5833
'IDR'	0.0905	0.1467	0.6168	-0.2329	0.6389
'ILS'	-0.0158	0.0859	-0.1835	-0.3048	0.5
'INR'	0.0146	0.0739	0.1982	-0.1978	0.5833
'KRW'	-0.0115	0.1389	-0.0826	-0.4999	0.5595
'MXN'	0.0179	0.0979	0.1829	-0.3699	0.619
'PHP'	0.0517	0.0613	0.8437	-0.1791	0.6429
'PLN'	-0.0204	0.1577	-0.1296	-0.6153	0.5476
'SGD'	-0.0161	0.0535	-0.3006	-0.2136	0.4286
'RUB'	0.0141	0.1537	0.092	-0.311	0.5667
'THB'	0.0674	0.0757	0.8908	-0.1521	0.6429
'TRY'	0.1323	0.153	0.8645	-0.2923	0.7024
'TWD'	-0.011	0.0507	-0.218	-0.1191	0.5238
'ZAR'	0.06	0.1771	0.3386	-0.3703	0.5833

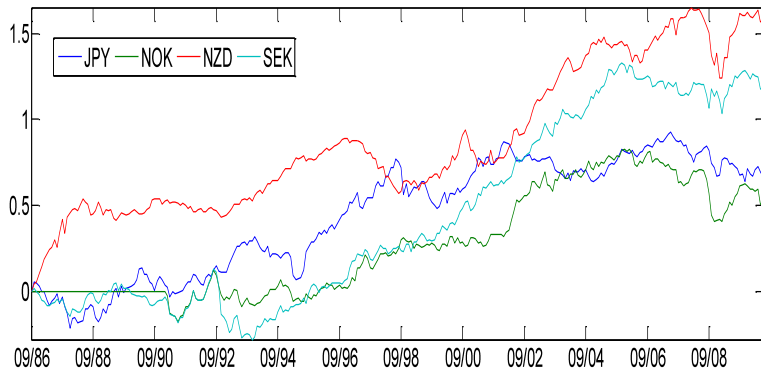
Source: Bloomberg and Source: Thomson Reuters.

Cumulative returns of individual carry trades G10 and EM

Cum Rets Individual Carry Strategy

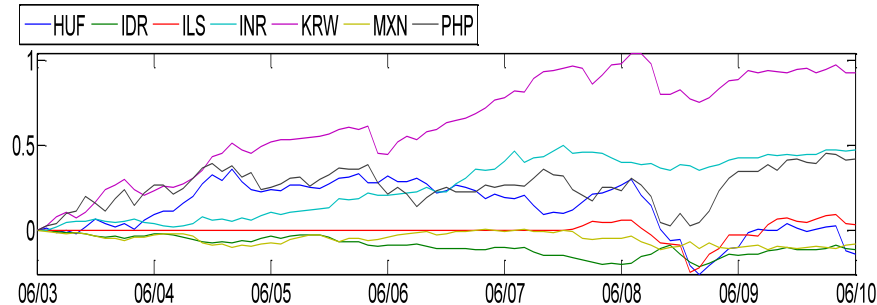
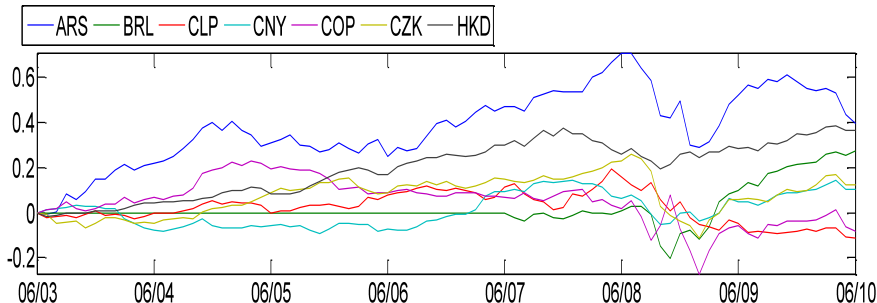
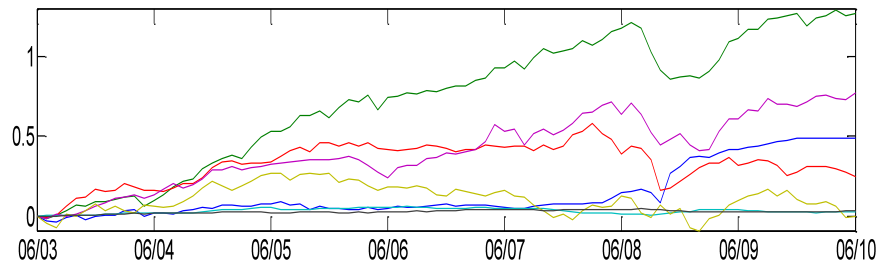


Cum Rets Individual Carry Strategy



Source: Bloomberg and Source: Thomson Reuters.

Cum Rets Individual EM Carry Strategy



Source: Bloomberg and Source: Thomson Reuters

Using a portfolio of currencies

Table 6. Performance of Portfolios of G9 and EM Currencies.

A. Equal Weight Portfolio: G8 (omit NOK) vs USD

	mean	stddev	IR	maxDD	hit ratio
1986-2010	0.0381	0.0515	0.7408	-0.1923	0.6491
2003-2010	0.0112	0.0541	0.2072	-0.1923	0.5833

B. Carry Weighted Portfolio: G8 (omit NOK) vs USD

1986-2010	0.0603	0.0747	0.808	-0.3237	0.6912
2003-2010	0.0228	0.0908	0.2506	-0.3237	0.631

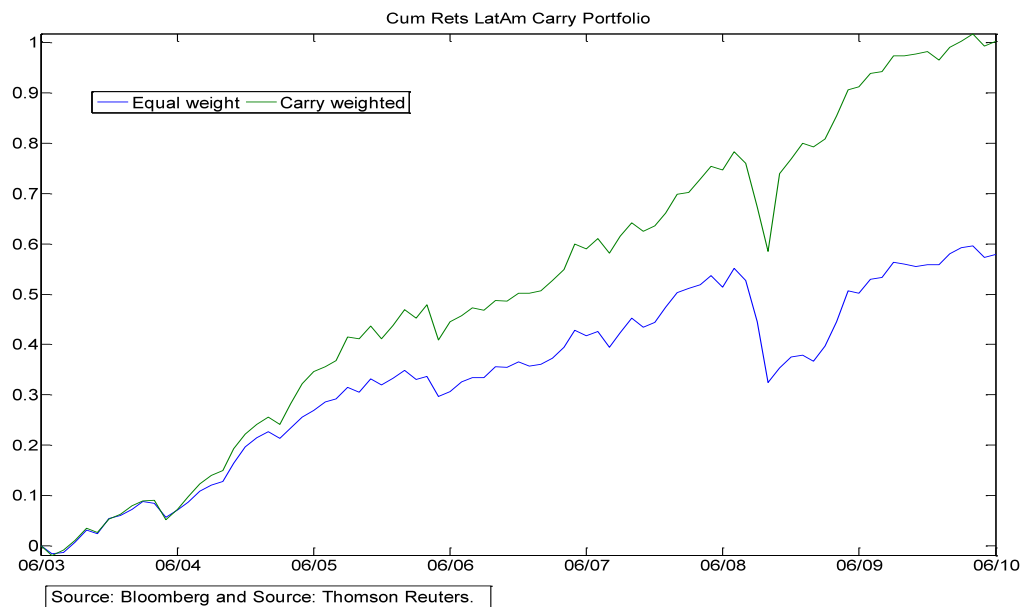
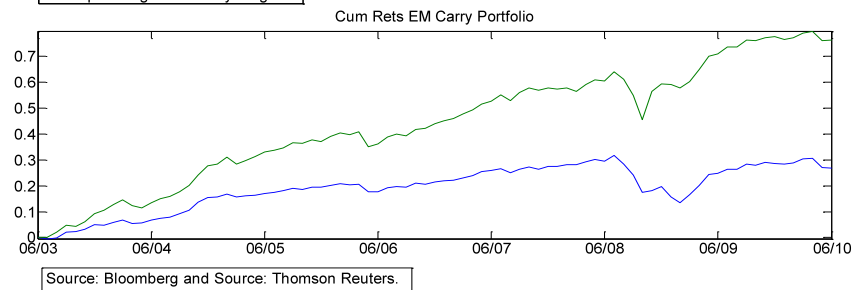
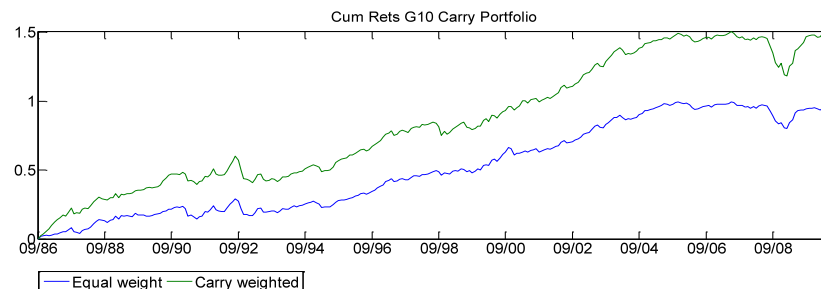
C. Equal Weight Portfolio: EM vs USD. Sample 2003-2010.

All EM	0.0383	0.057	0.6717	-0.1815	0.7143
Latam	0.0827	0.0873	0.9479	-0.2267	0.7024

D. Carry Weighted Portfolio: EM vs USD. Sample 2003-2010.

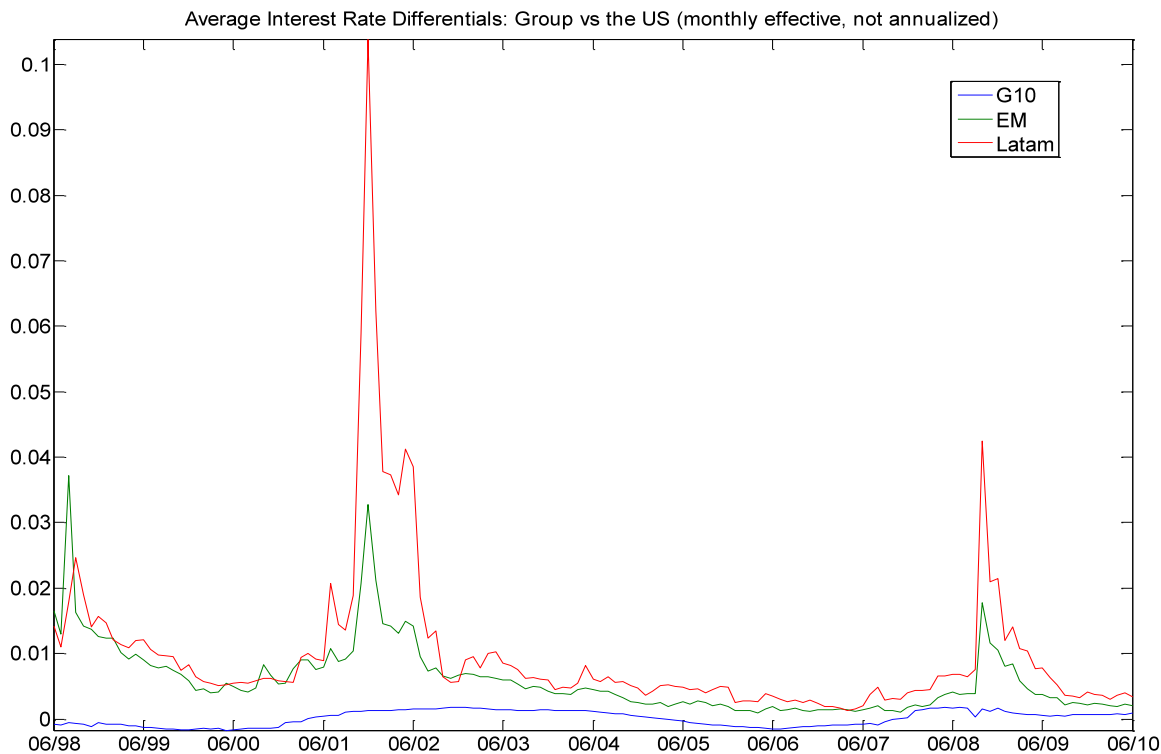
All EM	0.1087	0.0869	1.2511	-0.1825	0.7262
Latam	0.1432	0.1061	1.3495	-0.1985	0.75

Source: Bloomberg and Source: Thomson Reuters.



Importance of the size of the rate differential

- **In the previous slide we see that carry trade portfolios for EM have stronger performance than for G10.**
- **Furthermore, carry trade portfolios for Latam have stronger performance than for all EM.**
- **Argument that this is so because of the size of the rate differential. See monthly (not annualized) average interest rates for G10, EM, Latam in Fig. 5 below.**



Source: Bloomberg and Source: Thomson Reuters.

Performance of Regression Forecasts

Table 7. Performance G10 Regression Models

	mean	stddev	IR	maxDD	hit ratio
A. Individual G10 vs USD (using regression forecasts). Sample 1986-2010					
AUD	0.0471	0.1126	0.4186	-0.4583	0.5895
CAD	0.0242	0.0715	0.3389	-0.3026	0.586
CHF	0.0384	0.1141	0.3366	-0.3629	0.5614
EUR	0.0433	0.1054	0.4107	-0.3245	0.5754
GBP	0.0316	0.1011	0.3122	-0.3602	0.5544
JPY	0.0418	0.1152	0.3632	-0.367	0.5368
NOK	0.0213	0.1064	0.1998	-0.3341	0.5365
NZD	0.0896	0.113	0.7927	-0.2513	0.614
SEK	0.0373	0.1126	0.3317	-0.5131	0.5684

B. Portfolio of currencies aggregating individual regression forecasts

Equal Weight					
1986-2010	0.0442	0.0594	0.7433	-0.2132	0.6281
2003-2010	0.0245	0.0693	0.3544	-0.2132	0.5595
Forecast Weighted					
1986-2010	0.0497	0.0755	0.6584	-0.2458	0.6211
2003-2010	0.0288	0.0862	0.3342	-0.2458	0.5595

C. Portfolio of currencies using panel forecasts

Equal Weight					
1986-2010	0.0357	0.0653	0.5471	-0.2444	0.607
2003-2010	0.0216	0.0786	0.2752	-0.2444	0.5833
Forecast Weighted					
1986-2010	0.0324	0.0792	0.4092	-0.2845	0.5825
2003-2010	0.0164	0.0884	0.1851	-0.2845	0.5714

Source: Bloomberg and Source: Thomson Reuters.

Table 8. Performance EM Regression Model. Sample 2003-2010.

	mean	stddev	IR	maxDD	hit ratio
A. Individual EM vs USD (using regression forecasts).					
'ARS'	0.0182	0.092	0.198	-0.2729	0.6905
'BRL'	0.1651	0.1511	1.093	-0.3546	0.7262
'CLP'	-0.0153	0.1303	-0.117	-0.2399	0.4881
'CNY'	0.002	0.0143	0.1381	-0.0694	0.631
'COP'	-0.0475	0.1435	-0.331	-0.7062	0.4048
'CZK'	0.0419	0.1318	0.3177	-0.2724	0.5357
'HKD'	0	0.0079	0.0062	-0.0283	0.619
'HUF'	0.0424	0.1594	0.2663	-0.4164	0.5476
'IDR'	0.0011	0.149	0.0071	-0.3773	0.6111
'ILS'	-0.0293	0.086	-0.3403	-0.3138	0.4524
'INR'	0.0227	0.0725	0.3132	-0.2039	0.5714
'KRW'	-0.0041	0.1383	-0.0297	-0.3445	0.5
'MXN'	-0.026	0.0976	-0.2665	-0.3552	0.5
'PHP'	0.014	0.0629	0.2224	-0.178	0.5357
'PLN'	0.0852	0.1561	0.5458	-0.5597	0.5714
'SGD'	-0.0211	0.0526	-0.4003	-0.259	0.5
'RUB'	-0.0278	0.1535	-0.181	-0.2249	0.4667
'THB'	0.0532	0.0768	0.6931	-0.1521	0.5952
'TRY'	0.0913	0.1557	0.5865	-0.4596	0.6667
'TWD'	-0.023	0.0503	-0.458	-0.2029	0.4524
'ZAR'	0.0085	0.1776	0.0477	-0.5854	0.4762

B. Portfolio of currencies aggregating individual regression forecasts

Equal Weight					
All EM	0.0199	0.0425	0.4682	-0.1622	0.6786
Latam	0.0189	0.0647	0.2925	-0.204	0.5833
Forecast Weighted					
All EM	0.0381	0.0687	0.5551	-0.2632	0.6667
Latam	0.0346	0.0863	0.4008	-0.2794	0.7143

C. Portfolio of currencies using panel regression forecasts

Equal Weight					
All EM	0.0382	0.0584	0.6535	-0.177	0.6786
Latam	0.055	0.0856	0.6419	-0.2267	0.6548
Forecast Weighted					
All EM	0.077	0.0864	0.8908	-0.1966	0.6667
Latam	0.089	0.1012	0.8786	-0.2258	0.7143

Source: Bloomberg and Source: Thomson Reuters.

Performance of regression forecasts vs simple carry trade

For G10:

- **Individual carry trades vs individual regression forecasts show mixed results (Table 7-A vs Table 4)**
- **Portfolios of equal-weight indiv. regressions do better than indiv. regressions alone. (Table 7-B vs 7-A)**

Further weighting by size of forecast does NOT help. (Within Table 7-B)

Panel regression forecasts worse than individual regression forecasts. (Table 7-C vs 7-B)

- **Portfolios of simple carry vs regression forecasts: Mixed (Table 7-B vs 6-A,B)**

For EM:

- **Most cases, indiv. carry trades do better than indiv. regressions: Table 8A vs 5**
- **Portfolios of equal-weight indiv. regression forecasts do better than individual regressions alone. See Table 8-B vs 8-A.**

Further gains obtained weighting according to size of forecast: Within table 8, section B.

Further, portfolios based on panel regressions do better than portfolios based on individual regressions: Table 8-C vs 8-B.

- **Yet simple carry portfolios do better than portfolios based on regression forecasts: Table 8-B, 8-C vs. 6-C and 6-D.**

Some recent ideas to help explain failure of UIRP...or corrections towards UIRP

- **Volatility (e.g., Clarida, Davis & Pedersen (2009)). UIRP fails during periods of low volatility and tends to hold in periods of high volatility.**

Intuition: volatile spot returns may more than offset rate differentials

- **Convergence or correction to equilibrium value: Large “misvaluations” eventually get reversed despite rate differential signals. Theme in Molodtsova & Papell (2008) and Jorda & Taylor (2009).**

- **Can a simple PPP model overimposed on the carry trade strategy work? Answer seems to be yes.**

- (6)
$$s^{PPP} = p^J - p^{US}$$

- (7)
$$s_t^{PPP} = \bar{q} + p_t^J - p_t^{US}$$

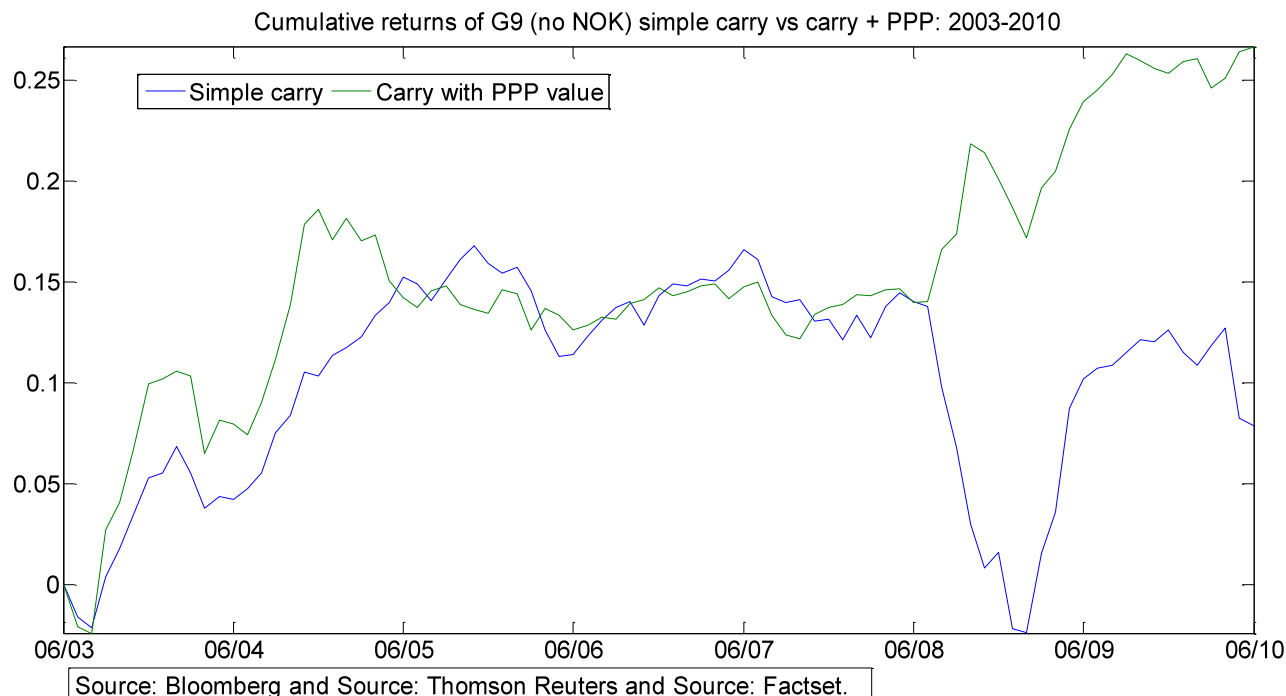
- **PPP value vs actual spot indicates a future return due to valuation correction. We combine this with the expected carry return.**
- **Performance of this corrected carry trade vs simple carry trade is in Table 9 and figure below.**
- **Note in the figure that the large drawdown of Q3-2008 is avoided. Before that, performance is similar with or without an equilibrium value correction.**
- **However, this is enough to drastically improve the profitability of the strategy. Interesting outcome since PPP models per se are not good predictors of FX rates.**

Performance of carry trade combined with PPP valuation

Table 9. Monthly Performance of Carry Trade with and without PPP value.
June 2003-June 2010.

	mean	stddev	IR	maxDD	Sortino	hit ratio
A. Carry Trade with PPP valuation. G8 (no NOK)						
2003-2010	0.0381	0.0499	0.7646	-0.0643	1.4584	0.5952
B. Simple carry trade. G8 (no NOK)						
2003-2010	0.0112	0.0541	0.2072	-0.1923	0.2883	0.5833

Source: Bloomberg and Source: Thomson Reuters and Source: Factset.



Conclusions

- **Failure of UIRP confirmed for G10 and many EM for a recent sample, individual and panel regressions.**
- **Portfolios do better than single currency trades. But carry trades suffer occasionally from large drawdowns.**
- **Simple carry portfolios do better than regression-based portfolios, especially for EM.**

This confirms idea of econometric problems to estimate slope

However the basic direction of the simple carry trade is correct thus econometric corrections to statistical problems will not salvage UIRP.

- **Conditioning for a measure of equilibrium value for currencies, one can drastically improve the performance of carry portfolios (avoids or minimizes drawdown).**
- **Thoughts for central bank: Interest Rate defense of a depreciating currency may work if volatility is low and if actual value is not far from equilibrium value.**
- **If policy goal is to curb appreciation due to excess speculation chasing carry trade returns then inducing uncertainty/volatility about FX or intervention is consistent with the objective.**
- **Although economic models are bad per se to predict FX out of sample, once combined with carry, they may shed light on the turning points of the carry strategy.**



Perspectives on Uncovered Interest Rate Parity and the Carry Trade: Some recent evidence for G10 and Emerging Markets.

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