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ABSTRACT

Many studies have replicated the finding that the forward rate is a biased predictor of the future change in the spot exchange rate. Usually the forward discount actually points in the wrong direction. But virtually all those studies apply to advanced economies and major currencies. We apply the same tests to a sample of 14 emerging market currencies. We find a smaller bias than for advanced country currencies. The coefficient is on average positive, i.e., the forward discount at least points in the right direction. It is never significantly less than zero. To us this suggests that a time-varying exchange risk premium may not be the explanation for traditional findings of bias. The reasoning is that emerging markets are probably riskier; yet we find that the bias in their forward rates is smaller. Emerging market currencies probably have more easily-identified trends of depreciation than currencies of advanced countries.

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Thirty years ago, researchers found the forward exchange rate to be a biased predictor of the future spot exchange rate. Worse, in a regression of the future change in the spot rate against the forward discount, the exchange rate was found on average to move in precisely the *opposite* direction from what was predicted.[1] This surprising finding has been replicated many times since, on many sets of data, and with many refinements. But virtually all the tests have been applied to major currencies and industrialized countries, not to currencies of developing countries. By now enough emerging market currencies are represented by forward markets that it is possible to apply the same tests to them.[2]

1. Introduction: Tests of Bias in the Forward Discount

Although many explanations have been given for the finding of bias in the forward market, they fall broadly into two categories. The first category of explanations, to which an apparent majority of authors subscribe, maintains the assumption of rational expectations, and interpret the systematic component of the forward market's prediction errors as a risk premium. The second category attributes the systematic component of the forward rate's prediction errors to expectation errors on the part of market participants that are themselves systematic, at least within the sample.[3] Algebraically, the regression equation is:

$$\Delta s_{t+1} = \alpha + \beta fd_t + \varepsilon_{t+1} \quad ,$$

where

Δs_{t+1} is ex post future percentage depreciation, defined as $s_{t+1} - s_t$,

[1] The first tests included Rogoff (1977), Hansen and Hodrick (1980), and Frankel (1980); they included consideration of two problems of the error term distribution: moving average errors (from overlapping contracts) and non-normal distributions (from the "peso problem"). Tryon (1997) was the first to run the regression in the form of changes relative to the contemporaneous spot rate, and Fama (1984) made this specification famous. Useful surveys of the literature include Hodrick (1987), Froot and Thaler (1990), Engel (1995) and Lewis (1995). More recent contributions to the literature include Bacchetta and van Wincoop (2005), Backus, Foresi and Telmer (2002), Breuer (2000), Lustig and Verdelhan (2005) and Verdelhan (2006).

[2] Bansal and Dahlquist (2000) test whether the *interest differential* for developing countries is an unbiased forecast of future exchange rate changes. Similarly, Flood and Rose (2002) find that the bias in the interest differential is less for crisis countries, while not significantly different between developed versus developing. But one cannot invoke covered interest parity, and thereby associate such findings with forward rate bias, in the same way one could for advanced countries. The reason is that many of these countries have capital controls, default risk, and interest rates that are not freely determined in the marketplace.

[3] This phrasing is intended to be broad enough to include the peso problem, learning, and other sources of error patterns that appear statistically significant within the sample. The definition need not imply that market participants are irrational.

fd_t is the forward discount, of a maturity matching that of the ex post depreciation, defined as $f_t - s_t$,
$s_t \equiv$ log of the spot exchange rate at time t (defined as domestic units per foreign), and
$f_t \equiv$ log of the forward exchange rate at time t.
The null hypothesis of unbiasedness is $\beta = 1$. The null would imply that there is no systematic time-varying component to the prediction errors:

$$E_t \Delta s_{t+1} - fd_t = \alpha.$$

The null hypothesis is actually a joint hypothesis, comprising of two distinct conditions:
rational expectations: $E_t \Delta s_{t+1} = \Delta s_t^e$, plus
no time-varying risk premium: $rp_t \equiv E_t \Delta s_{t+1} - fd_t - \alpha = 0$,
where $E_t \Delta s_{t+1}$ is the mathematical expectation (within-sample), and
Δs_t^e is the expectation held by investors.
ε_{t+1} is the error term, which would be equal to the forward market prediction error under the null hypothesis. But the null hypothesis is almost always rejected statistically, and often the finding is $\beta < 0$. The question then becomes whether the findings of bias are to be interpreted as a time-varying risk premium, or as systematic expectation errors.

The simple purpose of this paper is to test for bias in the forward markets in emerging market currencies, and to see how the bias compares to that for major currencies. One motivation is to shed some possible light on the two competing interpretations of bias. Intuitively, emerging market currencies are probably riskier to hold than major currencies; one might think that the risk premium would therefore be larger and more variable than for major currencies. At the same time, emerging market currencies are more prone to bouts of high inflation and other sources of medium-term trends, so that one might think it would be easier to forecast the direction of movement of the spot rate than is the case for major currencies, where the exchange rate is closer to a random walk.[4] If the bias is greater for emerging market currencies, that would point toward the risk premium interpretation; if less, then the other interpretation. We hasten to add that this suggested motivation is not demonstrated on the basis of formal theory. It would be hard to do so. It would not be easy, for example, to rule out the possibility that even though emerging market currencies have higher variance, their risk is highly diversifiable so that the risk premium could in theory go the other way.[5] However, there is a bit of evidence, from survey data, that investors indeed find it easier to forecast the direction of movement of emerging market currencies than of major currencies.[6]

In the financial markets, efforts to exploit the forward discount bias generally go under different-sounding names. Exploiting the bias means "going long" in the currency that sells at a forward discount, relative to others. By covered interest parity, this is the same thing as going long in the currency that pays a higher short-term nominal interest rate, relative to others. Among European currencies in the early 1990s -- with

[4] Huisman, Koedijk, Kool, and Nissen (1998) find less bias in periods when the forward discount or premium is large.
[5] Poonawala (2004).
[6] Chinn and Frankel (1994, 2002).

Italian interest rates, for example, above German interest rates -- this strategy was known as the *convergence play*. The convergence play may again be relevant for Central European currencies hoping to join the euro. In the mid-1990s, with Japanese interest rates very low, the strategy of borrowing in yen and going long in other currencies -- especially dollar-linked currencies in Asia -- was known as the *yen carry trade*. One striking pattern about these episodes is that there are long intervals during which one would have happily made money on average with these strategies, but that these intervals were dramatically punctuated (though not fully reversed) by crises, in 1992 in Europe and 1997-98 in Asia. During the years 2001-2006, with US interest rates low, the strategy of borrowing in dollars and going long in euros or emerging market currencies has been known as the *dollar carry trade*. Again, all these strategies are equivalent to attempts to exploit the finding of forward discount bias, which constitutes another motivation for testing to see whether the finding extends equally to emerging market currencies.

The paper examines forward markets for 35 currencies, classified under the two broad groupings of emerging market currencies versus the currencies of advanced economies countries (including 11 European Monetary Union countries). The data set starts from December 31, 1996, and runs into 2004.

Our results show that the bias in the forward discount for emerging market economies is smaller than for advanced economies. While we reproduce the standard finding that the coefficient is substantially less than zero for industrialized economies, and generally highly significant statistically, we find that the coefficient is much closer to zero for emerging market currencies: often positive and seldom significantly less than zero. To us the fact that the bias is stronger for advanced country currencies, which are presumably more stable, suggests that it may not be entirely due to an exchange risk premium.

2. The Data Sample

Although many national money markets have been liberalized since the 1970s, there is still only a relatively limited set of currencies in which forward exchange contracts are actively traded by international investors. Thus Asia is more heavily represented in our sample than Latin America or, certainly, Africa. Countries in our analysis have been classified as emerging market economies based on the IMF Country Grouping Classification.[7] These also include some countries that are classified by the IMF as newly industrialized economies: Hong Kong, Singapore and Taiwan.

Our regression analysis proceeds first country by country, and then pooled. We start in December 1996 because data are not available for enough emerging markets before then. We use Seemingly Unrelated Regressions (SUR) to correct for the likely correlation of the error term across currencies.

In order to understand the impact of the Asian Financial Crisis, two sets of regressions have been conducted: one includes the period of financial crisis, while the other does not. The results from the regression analysis starting December 1996 onwards are presented in Section three. Regression results for post Asian financial crises (from December 1998 onwards) are reported in the Appendix.

[7] See Appendix I for more details on data set.

Some in our sample never experienced a large change in the exchange rate. Some countries with tightly fixed exchange rates were not included in the analysis. But if we had left out specifically all those emerging market currencies that had relatively stable currencies during the sample period, it might have biased the sample in favor of volatile emerging market currencies. (Hong Kong has been included; there is a small band which allows some room for movement even though it has a currency board.) Countries with capital controls (India) are not excluded from our sample. An established forward market in these countries shows that there exists a demand for forward exchange transactions. We have 14 currencies classified as emerging. Data details are given in the appendix.[8]

As has long been recognized in this literature, the use of overlapping contracts (3-month forward contracts observed at a one-month frequency) creates a moving average error process. We address this problem in the simplest way possible: by using non-overlapping contracts. Our data are sampled at the same frequency as the horizon of the forward exchange rate -- one month. It is necessary to avoid 'mismatching' which would involve incorrect pairing of the forward exchange rate and the future spot rate to which it pertains. Specifically, we use the forward and spot exchange rates from the last working day of each month.[9] (Raw data series are reported in Appendix VI of the 2004 working paper: http://ksghome.harvard.edu/~jfrankel/currentpubsspeeches.htm#On%20Emerging%20Markets.)

3. Results Country by Country

We begin with the country by country regression results, presented in Table 1. The scatter plots for each country are illustrated in Figures 1 and 2. To repeat the regression equation,

$$s_{t+1} - s_t = \alpha + \beta (f_t - s_t) + \varepsilon_{t+1}$$

The results confirm the usual finding of a strong forward rate bias for most of the industrialized country currencies. All the currencies except for the Greek drachma and Japanese yen show coefficients that are statistically less than one at very high significance levels. Most of the advanced countries show coefficients that are also significantly less than zero at the 5% level. Only Canada, Greece, Italy, Japan and the UK are not significant at the 5% level. Thus we can reject the hypotheses that the coefficient β is zero for sixteen of the twenty-one advanced economies, and we can also reject the hypotheses that $\beta=1$ for nineteen of the twenty-one countries in our advanced country sample.

[8] Indonesia, where the end-date of available forward exchange rate data does not coincide with the data-sets available for other countries was included in individual country regressions, but was dropped from the pooled regression.

[9] Breuer and Wohar (1996) identify timing pitfalls, and suggest that they can be reduced by taking data from the middle of the month instead of the end.

Country By Country Analysis

TABLE I: Individual Advanced Country Regressions (12/31/96 – 04/30/2004)
Coefficients with Robust Standard Errors (Forecast Horizon is One Month)

$$s_{t+1} - s_t = \alpha + \beta (f_t - s_t) + \varepsilon_{t+1}$$

	Dates	*N*	*β (S. E.)*	*t: β=0*	*t: β=1*	*DW*	*F Prob*
Advanced Economies							
1. Australia	12/96-4/04	88	-5.6437 (2.1666)	-2.60	9.40	1.95	0.0108
2. Austria	12/96-4/04	88	-5.2804 (1.9551)	-2.70	10.32	1.75	0.0083
3. Belgium	12/96-4/04	88	-5.5236 (1.9642)	-2.81	11.03	1.75	0.0061
4. Canada	12/96-4/04	88	-3.2183 (1.8926)	-1.70	4.97	1.96	0.0927
5. Denmark	12/96-4/04	88	-5.5150 (2.0319)	-2.71	10.28	1.76	0.0080
6. Euro	12/96-4/04	86	-5.6024 (2.0813)	-2.69	10.06	1.81	0.0086
7. Finland	12/96-4/04	88	-5.4680 (1.9057)	-2.87	11.52	1.78	0.0052
8. France	12/96-4/04	88	-5.1522 (1.9419)	-2.65	10.04	1.74	0.0095
9. Germany	12/96-4/04	88	-5.2964 (1.9384)	-2.73	10.55	1.75	0.0076
10. Greece	12/96-4/04	88	2.4052 (2.0348)	1.18	0.48	1.77	0.2405
11. Ireland	12/96-4/04	88	-5.6322 (2.1612)	-2.61	9.42	1.77	0.0108
12. Italy	12/96-4/04	88	-3.6422 (2.2115)	-1.65	4.41	1.66	0.1032
13. Japan	12/96-4/04	88	-1.2805 (2.0472)	-0.63	1.24	2.14	0.5333
14. Netherlands	12/96-4/04	88	-5.1816 (1.9166)	-2.70	10.40	1.76	0.0083
15. New Zealand	12/96-4/04	88	-3.9942 (2.0142)	-1.98	6.15	1.62	0.0506
16. Norway	12/96-4/04	88	-3.8507 (1.4636)	-2.63	10.98	2.18	0.0101
17. Portugal	12/96-4/04	88	-4.4242 (2.1870)	-2.02	6.15	1.69	0.0462
18. Spain	12/96-4/04	88	-4.8614 (2.2027)	-2.21	7.08	1.68	0.0300
19. Sweden	12/96-4/04	88	-5.5293 (1.8184)	-3.04	12.89	2.01	0.0031
20. Switzerland	12/96-4/04	88	-4.3037 (2.0588)	-2.09	6.64	1.85	0.0395
21. UK	12/96-4/04	88	-3.9999 (2.8715)	-1.39	3.03	2.10	0.1673

TABLE II:

Individual Emerging Market Country Regressions (12/31/96–04/30/2004)

Coefficients with Robust Standard Errors. Forecast Horizon is One Month.

$$s_{t+1} - s_t = \alpha + \beta (f_t - s_t) + \varepsilon_t$$

	Dates	N	β (S. E.)	t: β=0	t: β=1	DW	F Prob
Emerging and Newly Industrialized Economies							
1. Czech Republic	12/96-4/04	88	0.4260 (0.6604)	0.65	0.76	1.90	0.5206
2. Hong Kong	12/96-4/04	88	-0.0439 (0.0376)	-1.17	768	2.44	0.2468
3. Hungary	10/97-4/04	78	0.7541 (1.2594)	0.60	0.04	1.82	0.5511
4. India	10/97-4/04	78	-0.6181 (0.8612)	-0.72	3.53	1.43	0.4751
5. Indonesia	12/96-12/02	73	0.1456 (0.2055)	0.71	17.28	1.55	0.4807
6. Kuwait	12/96-4/04	88	0.4050 (0.9394)	0.43	0.40	1.89	0.6674
7. Mexico	12/96-4/04	88	-0.6399 (0.4079)	-1.57	16.16	1.99	0.1204
8. Philippines	12/96-4/04	88	1.6770 (1.7128)	0.98	0.16	1.87	0.3303
9. Saudi Arabia	12/96-4/04	88	-0.0831 (0.0835)	-1.00	168.17	2.94	0.3223
10. Singapore	12/96-4/04	88	0.1911 (1.2898)	0.15	0.39	1.86	0.8826
11. South Africa	12/96-4/04	88	-3.2693 (1.8403)	-1.78	5.38	1.74	0.0792
12. Taiwan	12/96-4/04	88	0.1442 (0.5252)	0.27	2.65	1.75	0.7842
13. Thailand	12/96-4/04	88	0.9613 (0.6853)	1.40	0.00	1.62	0.1643
14. Turkey	12/96-4/04	88	-0.0031 (0.0284)	-0.11	1241	1.54	0.9133

Note on DW Stat: For the test of null hypotheses (no autocorrelation) at the 5% significance level, the appropriate dL and dU critical values for 80 to 99 observations and one explanatory variable are 1.61 and 1.66 respectively. I.e., we reject if d<1.61 and do not reject if d>1.66. For 60 to 79 observations, dL=1.55 and dU=1.62

TABLE III: Seemingly Unrelated Regressions (Country-wise) [10]				
	Coef.	Std. Err.	z	P>|z|
Advanced Economies				
Australia	-1.24691	1.494352	-0.83	0.404
Canada	-0.010953	1.738178	-0.01	0.995
Denmark	-2.189826	0.623724	-3.51	0.000
European Union	-2.258394	0.624710	-3.62	0.000
Japan	1.032035	1.463353	0.71	0.481
New Zealand	-1.607774	1.337827	-1.20	0.229
Norway	-2.331581	0.768280	-3.03	0.002
Sweden	-2.190423	0.887877	-2.47	0.014
Switzerland	-1.998467	0.799680	-2.50	0.012
UK	-2.040146	1.755574	-1.16	0.245
Emerging and Newly Industrialized Economies				
Czech Republic	-0.268865	0.625856	-0.43	0.667
Hong Kong	-0.025843	0.054466	-0.47	0.635
Hungary	-0.628215	0.642181	-0.98	0.328
India	-0.598888	0.542740	-1.10	0.270
Kuwait	0.897000	0.409053	2.19	0.028
Mexico	-0.863151	0.406361	-2.12	0.034
Philippines	-0.758016	0.701212	-1.08	0.280
Saudi Arabia	-0.070964	0.027124	-2.62	0.009
Singapore	0.174195	0.625553	0.28	0.781
South Africa	-1.638586	1.470407	-1.11	0.265
Taiwan	0.325223	0.410904	0.79	0.429
Thailand	-0.914912	0.465787	-1.96	0.050
Turkey	-0.028603	0.025821	-1.11	0.268

[10] Does not include Euro member countries (to avoid overlap of data with the Euro) and Indonesia (end date of available forward exchange rate data does not coincide with the data-sets available for the remaining countries)

Dates for Seemingly Unrelated Regressions are from 10/31/1997 to 4/30/2004

Equation	Obs	RMSE	R^2	$\chi 2$	P
ausspot	78	.03192	0.0273	.6962491	0.4040
canspot	78	.01854	0.0002	.0000397	0.9950
dnkspot	78	.02658	0.0460	12.32631	0.0004
euspot	78	.02652	0.0522	13.069	0.0003
jpnspot	78	.03639	-0.0074	.4973826	0.4807
nzlspot	78	.03284	0.0275	1.444276	0.2294
norspot	78	.02734	0.0629	9.210043	0.0024
swespot	78	.02688	0.0677	6.086248	0.0136
sfrspot	78	.02711	0.0359	6.24541	0.0125
ukspot	78	.02069	0.0243	1.350468	0.2452
czespot	78	.03500	0.0004	.1845529	0.6675
hkspot	78	.00099	0.0009	.2251411	0.6352
hunspot	78	.02905	-0.0108	.956976	0.3279
indspot	78	.01182	0.0111	1.217607	0.2698
kwtspot	78	.00404	-0.0066	4.808668	0.0283
mexspot	78	.02540	0.0186	4.5118	0.0337
phlspot	78	.03091	-0.0018	1.168581	0.2797
sauspot	78	.00012	0.0791	6.844601	0.0089
sgpspot	78	.01874	0.0001	.0775434	0.7807
safspot	78	.04655	0.0296	1.241833	0.2651
taispot	78	.01624	0.0005	.6264454	0.4287
thaspot	78	.04131	-0.0060	3.858198	0.0495
turspot	78	.05804	-0.0049	1.227079	0.2680

Our key result first appears in Table 2: the emerging market economies have coefficients that are generally less negative than their developed country counterparts. Somewhat more of them are greater than zero than negative. The average coefficient for emerging market economies is also positive: 0.0033, versus -4.3331 for advanced economies. To be sure, the forward market is still a biased predictor for more than half of the emerging currencies: we can easily reject the hypothesis that the coefficient is 1.0 for eight of the fourteen emerging market economies (Hong Kong, India, Indonesia, Mexico, Saudi Arabia, South Africa, Taiwan and Turkey). *But in none of the emerging market currencies is the coefficient statistically less than zero at the 5% significance level.*

Thus far the results support a significant difference between the results of the industrialized economies and the emerging markets. That the absolute values for emerging markets are smaller suggests that the forward exchange rate is a less biased indicator for the future expected spot rate in emerging market economies.[11]

Next, in Table III, we correct for correlation of the error term across countries in the error term, using the technique of Seemingly Unrelated Regressions (SUR).[12] The SUR analysis starts from October 1997, which is the starting point for India and Hungary in our dataset, so as to standardize the number of observation dates. Therefore all currencies have 78 data points.

[11] Appendix 5 presents the regressions results for the data set not including the turbulent period covering the Asian Financial crisis.

[12] Such a correlation is almost inevitable when using bilateral exchange rates. For example, a strong dollar or a contagious currency crisis in a particular month would likely show up across many of the bilateral dollar exchange rates.

Except for South Africa, and Canada and Japan, which appear as outliers in their sets -- emerging market economies and advanced economies respectively -- the emerging markets under SUR all continue to yield coefficient estimates that are less negative than all the industrialized economies. Among advanced currencies, 5 of 10 show coefficients that are clearly significantly less than zero, while among emerging markets only 2 of 14 do so (Mexico and South Africa).

4. Results from Pooled Analysis

We next attempt, in Table IV, to capture more information from our data set by running a pooled country regression analysis with all currencies constrained to have the same coefficient within each class of countries. The pooled analysis lets us bring all the data to bear at once to get the best estimator. We keep separate pools for the emerging market economies and the industrialized economies. (See Figure 3.) To eliminate double counting of observations, only the Euro has been included in the pooled analysis for industrialized economies; individual EMU member countries have been excluded. This brings the number of advanced countries included in the pooled regression analysis from 21 to 10.

The β for the pooled analysis for emerging market currencies is -0.028. This estimate is significantly less than 1.0 at the 5% level. However we cannot reject the hypotheses that β=0. The coefficient for the pooled analysis for advanced economies is -2.023 (shown in graph below). Again, while we can reject the hypothesis β=1 at the 5% level, and we can reject β=0 for the advanced economies, we cannot do so for the emerging markets. Increasing the '*n*' leads us to a sharper difference in the estimated β with a more negative value for the industrialized economies than for the emerging markets.

TABLE IV: Pooled Country Regressions (10/31/97 – 04/30/2004)

Pooled Data	*Dates*	*N*	*β (S. E.)*	*t: β=0*	*t: β=1*	*DW*	*FProb*
Emerging Economies[13]	12/96-4/04	1014	-0.0278 (0.0290)	-0.96	1252	1.68	0.3375
Advanced Economies[14]	02/97-4/04	780	-2.0231 (0.5426)	-3.73	31.04	1.89	0.0002

[13] Pooled Analysis of Emerging Economies does not include Indonesia. All dates are from 10/97 to 4/04.
[14] Pooled Analysis does not include the Euro countries. All dates are from 10/97 to 4/04.

TABLE V: Seemingly Unrelated Regressions (Pooled) [15]				
Pooled Data	***Coef.***	***Std. Err.***	***z***	***P>|z|***
Emerging Market Economies	0.15225	0.189572	0.80	0.422
Advanced Economies	-1.66551	0.450326	-3.70	0.000

Equation	***Obs***	***RMSE***	R^2	$\chi 2$	***P***
Emerging Economies	780	.0254512	-0.0004	.6450539	0.4219
Advanced Economies	780	.0280973	0.0220	13.67853	0.0002

We also run Seemingly Unrelated Regressions in the pooled regression analysis to address cross-currency correlation. (See Table V.) The pooled SUR analysis dropped observations for the last three countries, alphabetically (Taiwan, Thailand and Turkey), to make the number of emerging market observations equal the advanced countries (ten currencies for each).

5. Conclusions

The regression analysis conducted in this paper produces a striking result. While the bias in the forward discount as a predictor of the future change in the spot exchange rate is present among emerging market currencies and advanced country currencies alike, the bias is less severe in the former case than in the latter. Unlike major currencies, which generally show a coefficient significantly less than zero, suggesting that the forward rate actually points in the wrong direction, the coefficient for emerging market currencies is on average slightly *above* zero, and even when negative is rarely significantly less than zero. One implication for traders is that the "yen carry trade" and "dollar carry trade" on average may not be as profitable when the strategy is to go long in emerging market currencies as when it is to go long in major currencies. An implication for international finance theorists, in light of the intuitively high riskiness of emerging currencies, is that the source of forward discount bias may not lie entirely in the exchange risk premium.

[15] Does not include Euro member countries (to avoid overlap of data with the Euro) and Indonesia (end date of available forward exchange rate data does not coincide with the data-sets available for the remaining countries)

References

Bacchetta, Philippe, and Eric van Wincoop, 2005, "Rational Inattention: A Solution to the Forward Discount Puzzle," NBER WP no. 11633, September.

Backus, D., S. Foresi and C. Telmer, 2001, "Affine Models of Currency Pricing: Implications for the Forward Premium Anomaly," *Journal of Finance*, 56, 281-311.

Bansal, Ravi and Magnus Dahlquist, (2000), 'The forward premium puzzle: different tales from developed and emerging economies,' *Journal of International Economics, Volume 51,* 115-144.

Breuer, Janice Boucher, 2000, 'Term effects and time-varying risk premium in tests of forward foreign exchange rate unbiasedness,' *International Journal of Finance and Economics,* Vol. *5,* 211-220.

Breuer, Janice Boucher, and Mark W. Wohar, 1996, 'The Road Less Traveled: Institutional aspects of data and their influence on empirical estimates with an application to tests of forward rate unbiasedness,' *The Economic Journal,* vol. 106, no. 434, 26-38 (January).

Chinn, Menzie, and Jeffrey Frankel, 1994, "Patterns in Exchange Rate Forecasts for 25 Currencies," *Journal of Money, Credit and Banking* 26, no. 24, Nov., 759-770. Reprinted in *New Developments in Exchange Rate Economics*, edited by L. Sarno and M. Taylor, Edward Elgar Pub., 2002.

Chinn, Menzie, and Jeffrey Frankel, 2002, "Survey Data on Exchange Rate Expectations: More Currencies, More Horizons, More Tests," in *Monetary Policy, Capital Flows and Financial Market Developments in the Era of Financial Globalisation: Essays in Honour of Max Fry*, edited by David Dickinson and William Allen, Routledge, London and New York.

Engel, Charles, 1996, 'The forward discount anomaly and the risk premium: A survey of recent evidence,' *Journal of Empirical Finance, Vol. 3,* 123-192.

Fama, Eugene F., 1984, 'Forward and Spot Exchange Rates,' *Journal of Monetary Economics, Volume 14,* 319-338.

Flood, Robert, and Andrew Rose, 2002, "Uncovered Interest Parity in Crisis: The Interest Rate Defense in the 1990s," IMF Working Paper 01/207. *IMF Staff Papers*.

Frankel, Jeffrey, 1980, 'Tests of Rational Expectations in the Forward Exchange Rate Market,' 46, no. 4. April. (First draft, MIT, Jan. 1977.) Reprinted in *On Exchange Rates,* 1997, 189-205. (Cambridge: MIT Press).

Froot, Kenneth, and Richard Thaler, 1990, "Anomalies: Foreign Exchange," *Journal of Economic Perspectives* 4, June, 179-192.

Hansen, Lars Peter, and Robert J. Hodrick, 1980, 'Forward Exchange Rates as Optimal Predictors of Future Spot Rates: An Econometric Analysis,' *The Journal of Political Economy*, Volume 88, Number 5, 829-853 (October).

Hodrick, Robert , 1987, *The Empirical Evidence on the Efficiency of Forward and Futures Foreign Exchange Markets* (New York: Taylor and Francis).

Huisman, Ronbald, Kees Koedijk, Clemens Kool, and Francois Nissen, 1998, "Extreme support for uncovered interest parity," *Journal of International Money and Finance*, vol 17, p. 211-228.

Lewis, Karen, 1995, "Puzzles in International Financial Markets," in *Handbook of International Economics*, vol. 3, G. Grossman and K. Rogoff, eds., North Holland, 1995.

Poonawala, Jumana, 2004, "Are Forward Exchange Rates Biased Indicators of Spot Exchange Rates in Emerging Market Economies?" Second Year Paper Analysis, Kennedy School of Government, Harvard University.

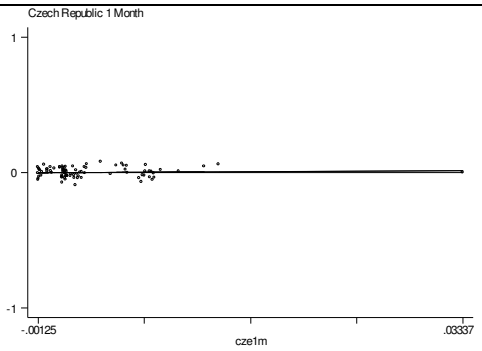
Lustig, Hanno, and Adrien Verdelhan (2005), "The Cross-Section of Currency Risk Premia and US Consumption Growth Risk," NBER WP 11104, February.

Rogoff, Kenneth. 1977. Rational expectations in the foreign exchange market revisited. Unpublished paper, MIT (February).

Tryon, Ralph. 1979. "Testing for rational expectations in foreign exchange markets," *International Finance Discussion Paper* no. 139. Federal Reserve Board (May).

Verdelhan, Adrien, 2006, "A Habit-Based Explanation of the Exchange Rate Risk Premium," April 2006. NBER Summer Institute, July.

Figure 1: Spot on Forward Regression for Emerging Economies 12/1996 – 4/2003



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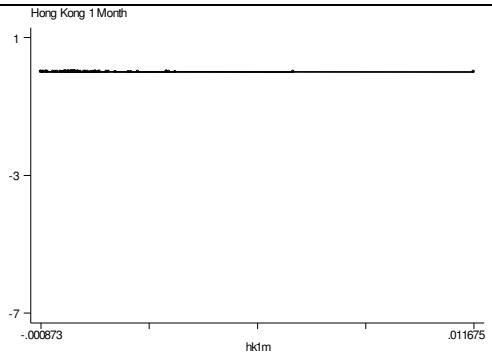

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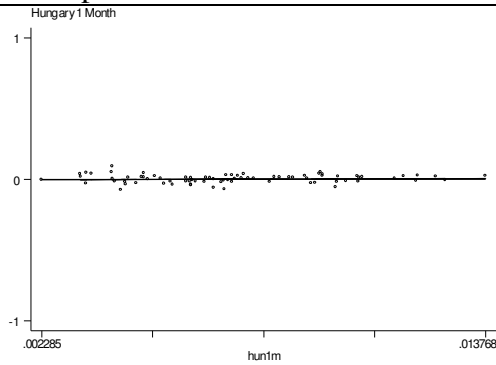

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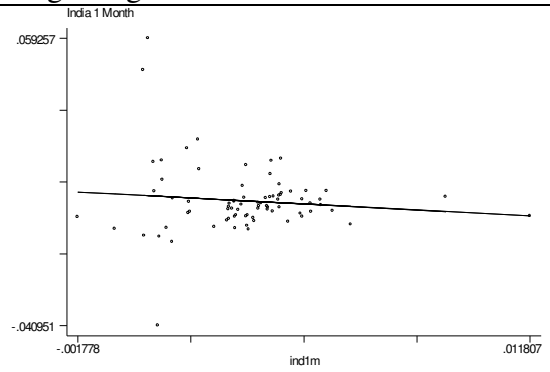

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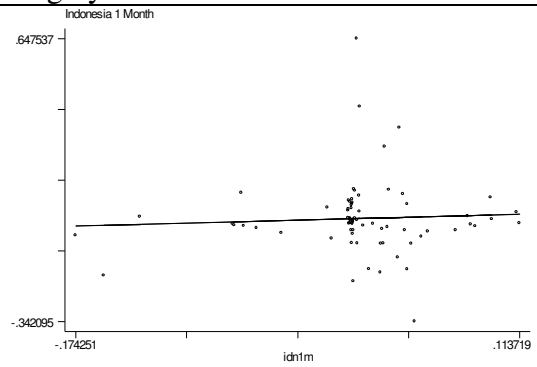

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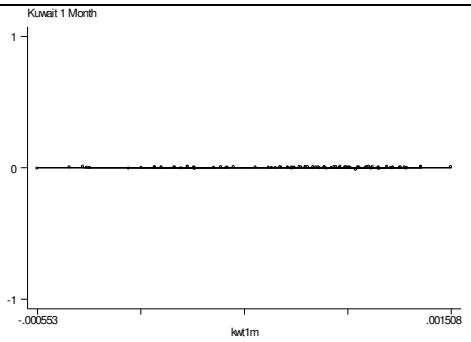

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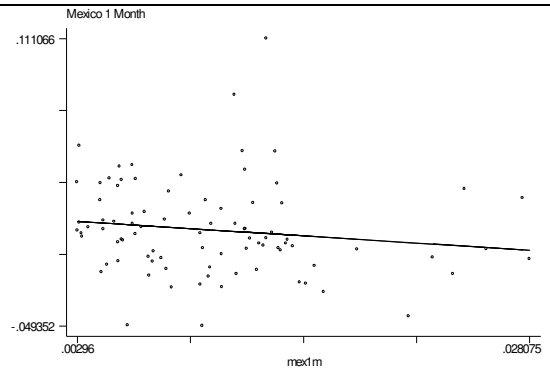

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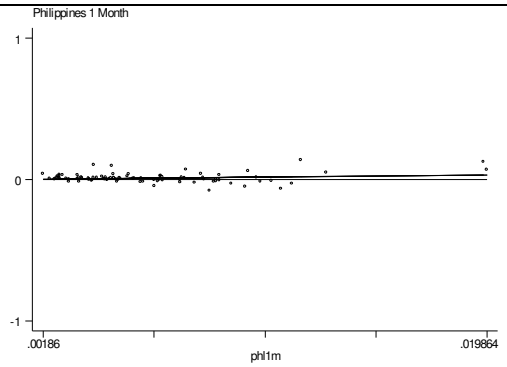

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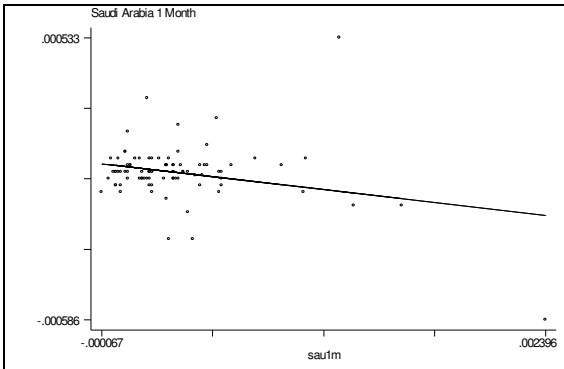

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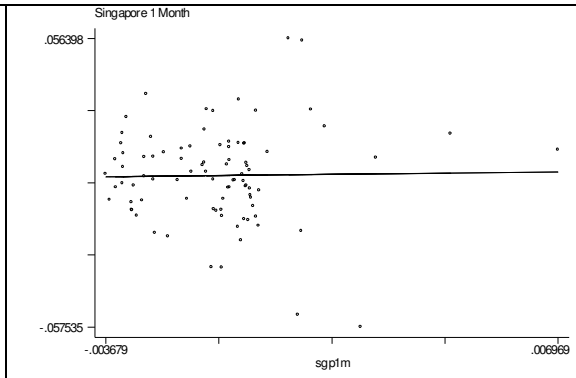

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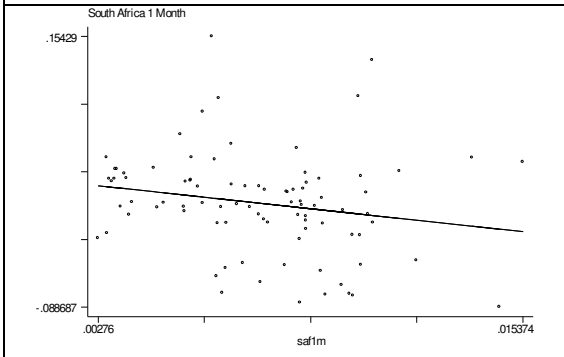

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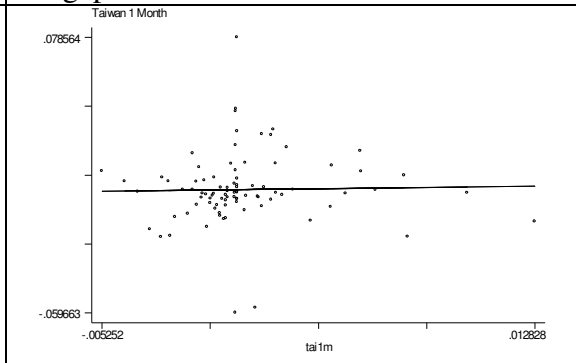

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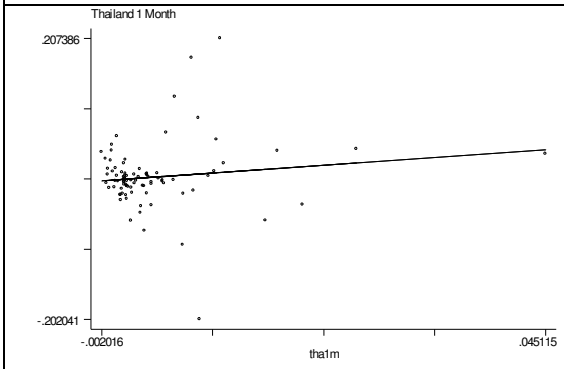

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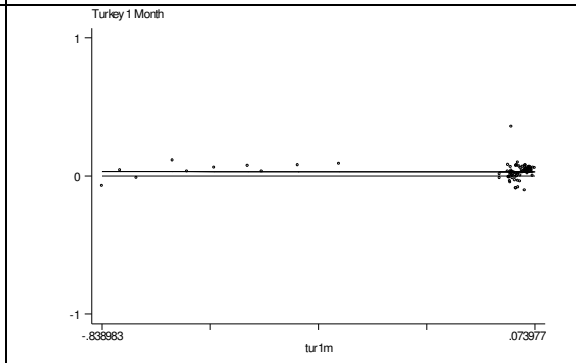
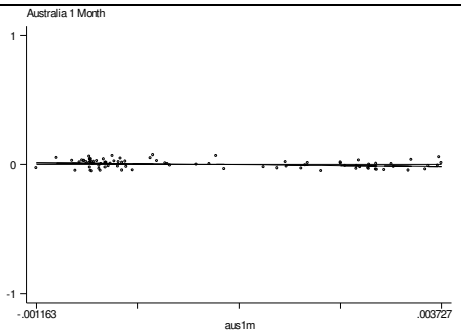


Turkey

Figure 2: Spot on Forward Regression for Industrialized Economies 12/1996 – 4/2003



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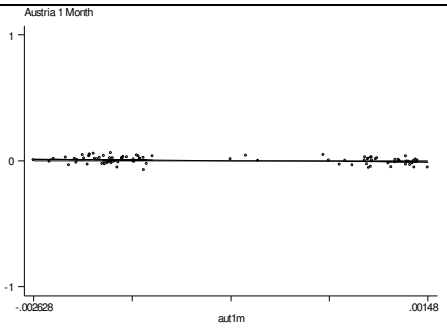

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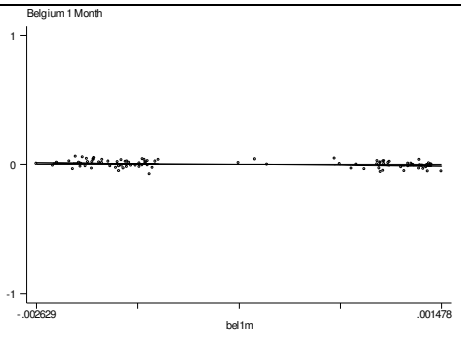

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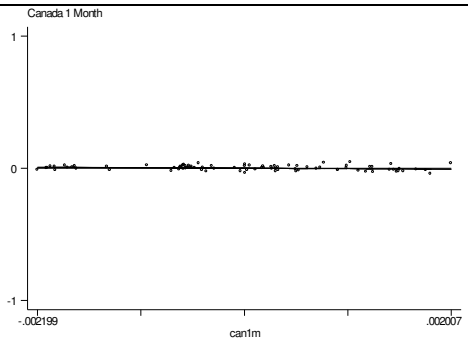

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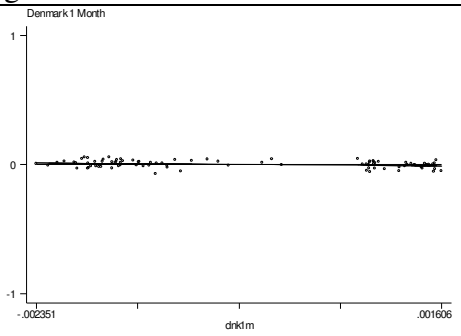

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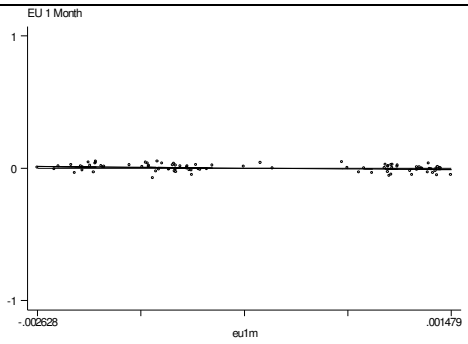

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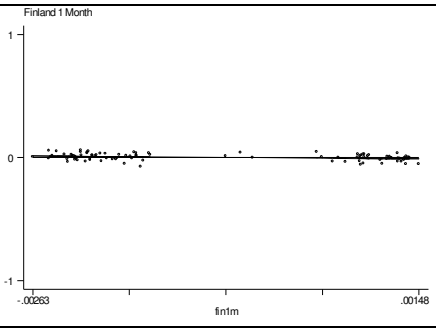

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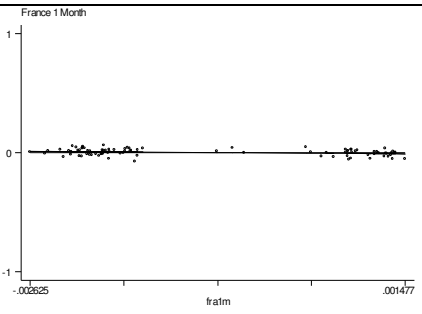

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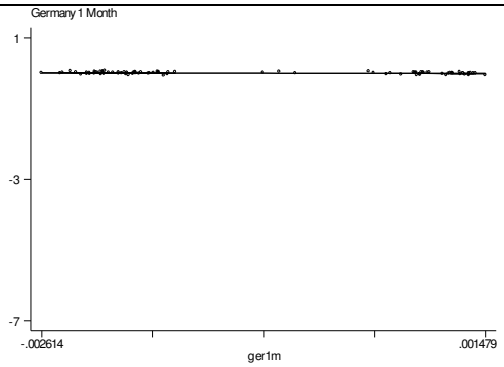

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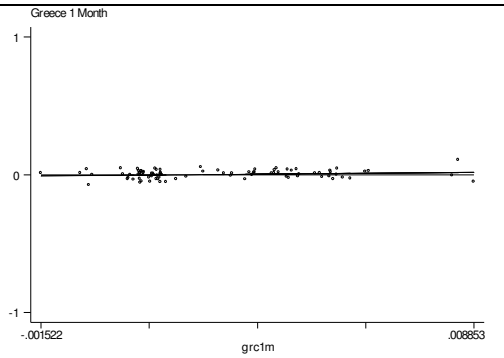

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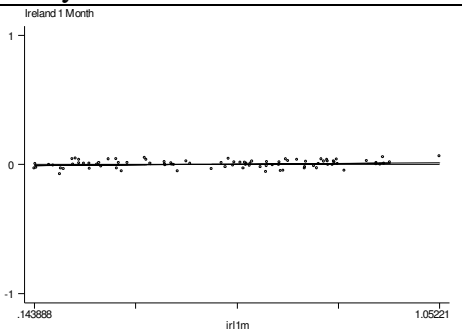

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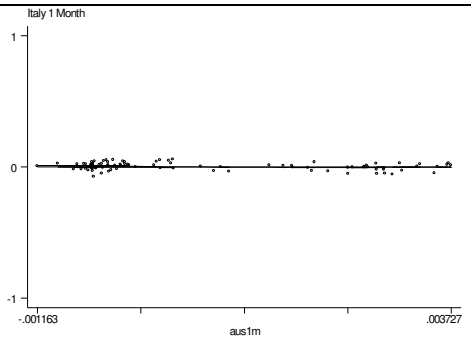

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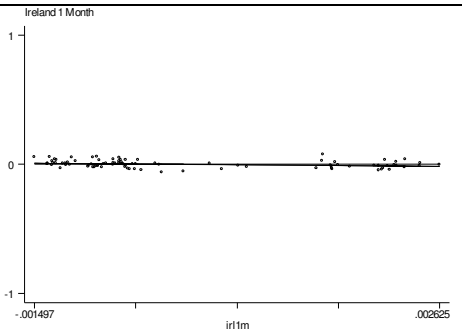

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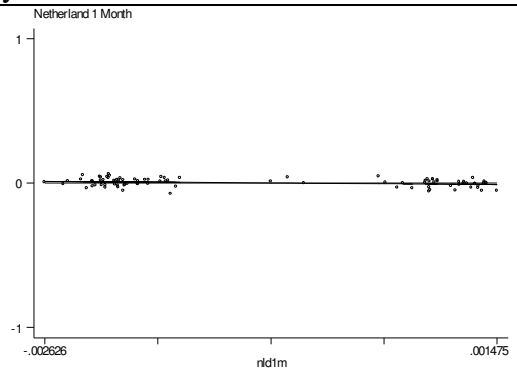

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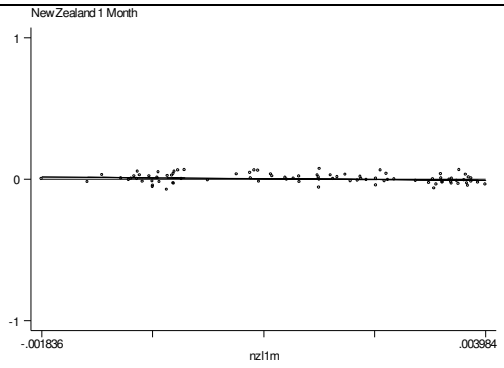

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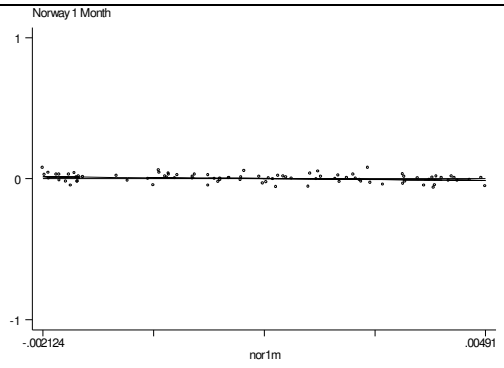

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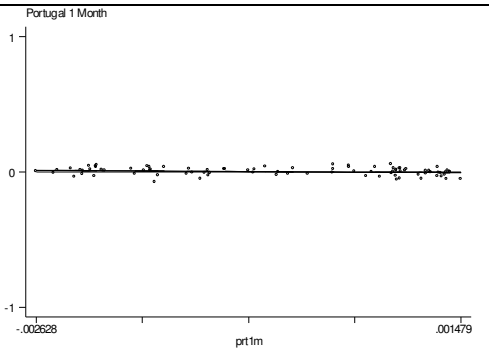

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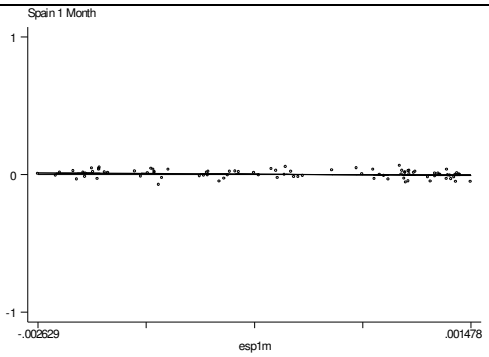

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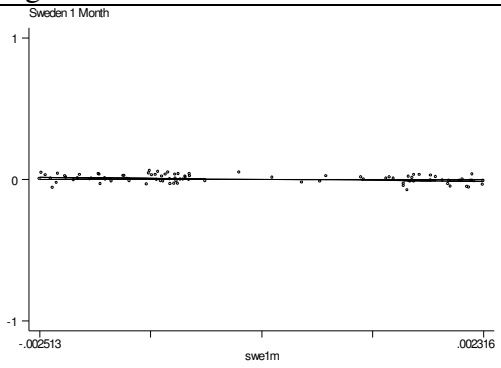

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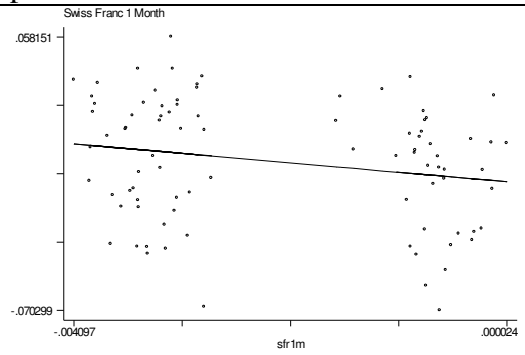

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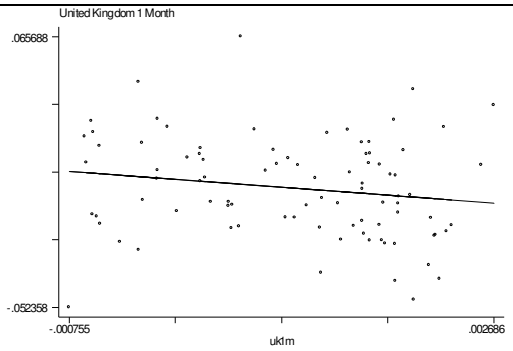


UK

Figure 3: Pooled Analysis (including 13 emerging market currencies)

Pool for Emerging Market Economies[16]	Pool for Industrialized Economies

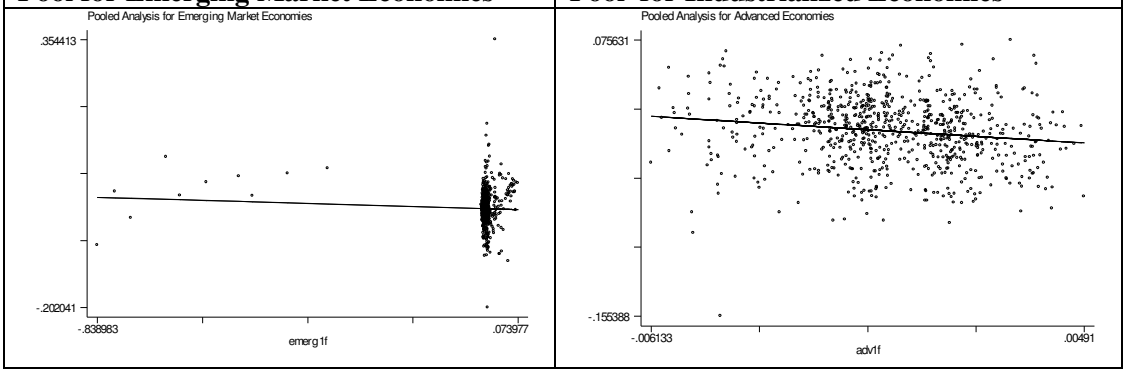
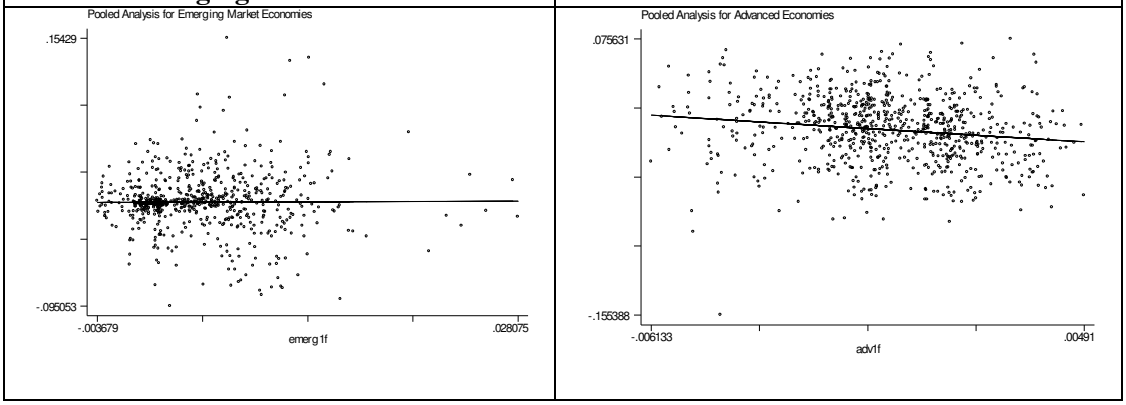


Figure 4: Pooled Analysis (10 currencies in each category)

Pool for Emerging Market Economies	Pool for Industrialized Economies



[16] A reason for the bimodal distribution of data in the emerging market graph is the observations from Turkey, where a large depreciation occurred in early 2001. (Appendix III and IV.)

APPENDICES: TABLE OF CONTENTS

Data Set: Countries and currency dates

Forward Rates:	Start Date	End Date	Data Points
Emerging Economies			(one-month)
Hong Kong	12/31/1996	06/13/2003	77
India	**07/29/1999**	06/13/2003	**46***
Indonesia	12/31/1996	**12/29/2000**	**48****
Mexico	12/31/1996	06/13/2003	77
Saudi Arabia	12/31/1996	06/13/2003	77
Singapore	12/31/1996	06/13/2003	77
South Africa	12/31/1996	06/13/2003	77
Thailand	12/31/1996	06/13/2003	77
Taiwan	12/31/1996	06/13/2003	77
Industrialized Economies			
Canada	12/31/1996	06/13/2003	77
Euro	**02/21/1997**	06/13/2003	**75*****
Germany	12/31/1996	06/13/2003	77
Japan	12/31/1996	06/13/2003	77
Swiss Franc	12/31/1996	06/13/2003	77
UK	12/31/1996	06/13/2003	77

Source: DataStream, Inc.

* Indian Forward Exchange Rates available as of 7/30/1999.

** Indonesian Forward Exchange Rates unavailable for the period 2/29/2001-11/29/2002.

*** EU Forward Exchange Rates available as of 2/28/1997.

Individual Country Regressions (12/31/98 – 04/30/2003) –
Omitting period of East Asia Crisis

TABLE I: Individual Country Regressions (12/1998 – 4/2003)
Coefficients with Robust Standard Errors
$S_{t+1} - S_t = \alpha + \beta (F_t - S_t) + \varepsilon_t$
Forecast Horizon is One Month

	Dates	*N*	*β (Std Error)*	*t: β=0*	*t: β=1*	*DW*	*FProb*
Emerging Economies							
Hong Kong	12/98-4/03	53	0.0695 (0.086)	0.80	115.80	1.30	0.4249
India	7/99-4/03	46	0.5347 (1.0573)	0.51	0.19	1.36	0.6156
Indonesia	12/98-12/00	24	-1.306 (1.916)	-0.68	1.45	2.20	0.5026
Mexico	12/98-4/03	53	-1.196 (0.826)	-1.45	7.06	1.96	0.1538
Saudi Arabia	12/98-4/03	53	-0.0956 (0.113)	-0.85	93.86	3.04	0.4017
Singapore	12/98-4/03	53	-1.7859 (1.589)	-1.12	3.07	1.94	0.2665
South Africa	12/98-4/03	53	-5.752 (2.338)	-2.46	8.34	1.66	0.0173
Taiwan	12/98-4/03	53	0.423 (0.670)	0.63	0.74	1.38	0.5308
Thailand	12/98-4/03	53	-2.005 (1.421)	-1.41	4.47	2.04	0.1642
Industrialized Economies							
Canada	12/98-4/03	53	-5.87 (3.50)	-1.67	3.84	1.94	0.1002
Euro	12/98-4/03	53	-6.87 (2.29)	-3.00	11.78	1.60	0.0042
Germany	12/98-4/03	53	-6.88 (2.29)	-3.00	11.77	1.59	0.0042
Japan	12/98-4/03	53	-1.039 (2.18)	-0.48	0.87	1.85	0.6359
Switzerland	12/98-4/03	53	-6.614 (2.57)	-2.57	8.72	1.72	0.0133
UK	12/98-4/03	53	-4.325 (3.44)	-1.25	2.38	2.39	0.2155

Note on DW Stat: For the test of null hypotheses (no autocorrelation) at the 5% significance level, the appropriate dL and dU critical values for 53 observations and one explanatory valuable are 1.503 and 1.585. In other words, we reject if d<1.503 and do not reject if d>1.585.
For 46 observations, dL=1.475 and dU=1.566
For 24 observations, dL=1.273 and dU=1.446

TABLE II: Pooled Country Regressions (12/1998-4/2003)

	Dates	*N*	*β* *(Std Error)*	*t: β=0*	*t: β=1*	*DW*	*FProb*
Emerging Economies[17]	12/98-4/03	371	-0.3614 (0.3348)	-1.08	16.53	1.74	0.2812
Industrialized Economies[18]	12/98-4/03	265	-2.326 (0.9172)	-2.54	13.15	1.76	0.0118

Seemingly unrelated regression

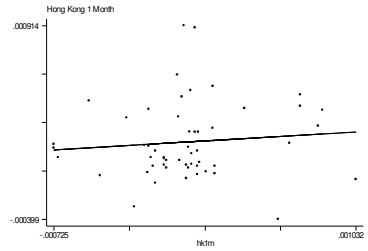
Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
Canada	53	1	0.0164950	0.0624	4.717867	0.0299
EU	53	1	0.0263930	0.1349	18.25692	0.0000
Hong Kong	53	1	0.0002556	0.0096	0.603116	0.4374
Japan	53	1	0.0288413	0.0028	0.073147	0.7868
Mexico	53	1	0.0228451	0.0558	4.259728	0.0390
Saudi Arabia	53	1	0.0001197	0.0925	11.54704	0.0007
Singapore	53	1	0.0138068	0.0108	0.176948	0.6740
South Africa	53	1	0.0419966	0.1084	7.642166	0.0057
Switzerland	53	1	0.0265163	0.1041	14.46804	0.0001
Taiwan	53	1	0.0115301	0.0090	1.674096	0.1957
Thailand	53	1	0.0210364	0.0449	5.39617	0.0202
UK	53	1	0.0203533	0.0395	4.85941	0.0275

	Dates	*B(SE)*	*z*	*P>/z/*
Emerging and Newly Industrialized Economies				
Hong Kong	12/98-4/03	0.0707 (0.910)	0.78	0.437
Mexico	12/98-4/03	-1.2068 (0.5847)	-2.06	0.039
Saudi Arabia	12/98-4/03	-0.1201 (0.0353)	-3.40	0.001
Singapore	12/98-4/03	-0.5178 (1.2311)	-0.42	0.674
South Africa	12/98-4/03	-5.8191 (2.1050)	-2.76	0.006
Taiwan	12/98-4/03	0.5645 (0.4363)	1.29	0.196
Thailand	12/98-4/03	-2.1016 (0.9047)	-2.32	0.020
Industrialized Economies				
Canada	12/98-4/03	-5.8687 (2.7019)	-2.17	0.030
Euro	12/98-4/03	-6.6151 (1.5481)	-4.27	0.000
Japan	12/98-4/03	-0.5625 (2.0801)	-0.27	0.787
Switzerland	12/98-4/03	-6.6025 (1.7358)	-3.80	0.000
UK	12/98-4/03	-5.1323 (2.3282)	-2.20	0.027

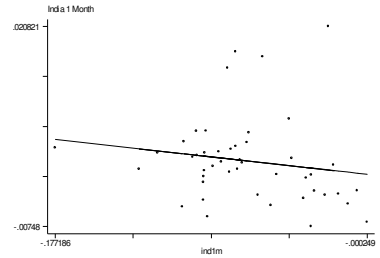
[17] Pooled Analysis of Emerging Economies does not include India or Indonesia to avoid errors due to correlation.

[18] To avoid double counting of data, pooled Analysis includes Canada, EU, Japan, Switzerland & UK (12/98-4/03).

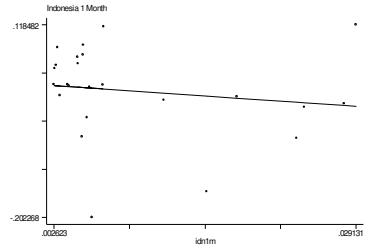
Graph I: Spot on Forward Regression for Emerging Economies 12/1998 – 5/2003
-- Omitting period of East Asia Crisis



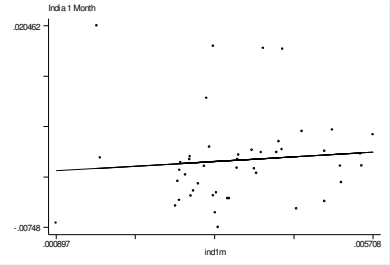
Hong Kong



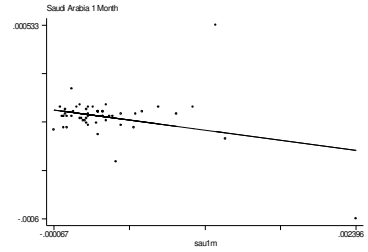
India



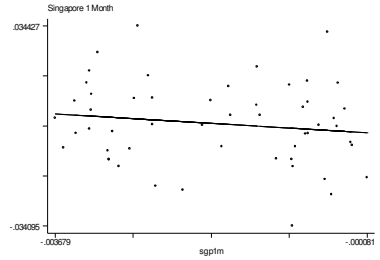
Indonesia



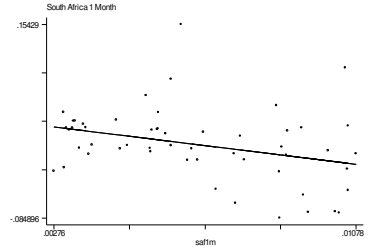
Mexico



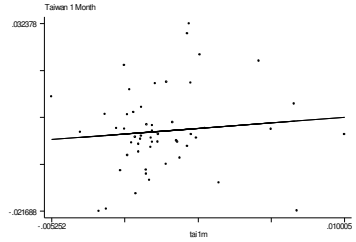
Saudi Arabia



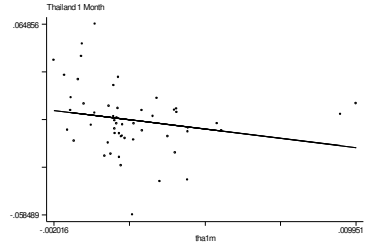
Singapore



South Africa

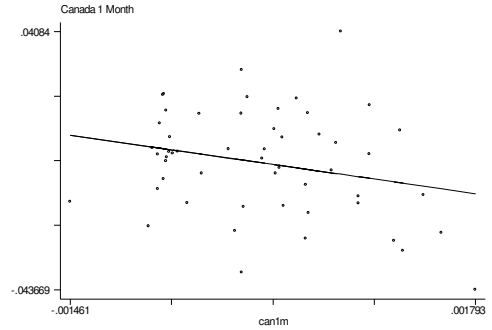


Taiwan

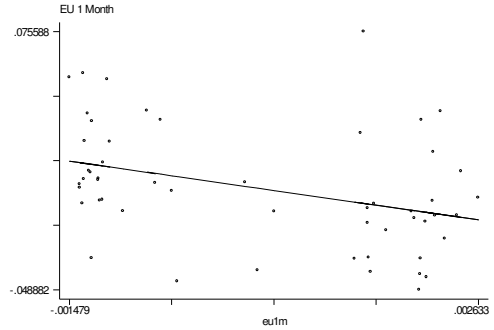


Thailand

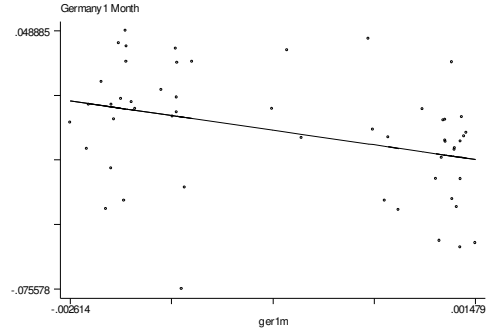
Graph II: Spot on Forward Regression for Industrialized Economies 12/1998 – 5/2003 -- Omitting period of East Asia Crisis



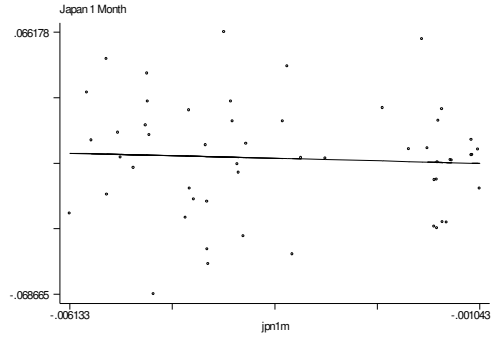
Canada



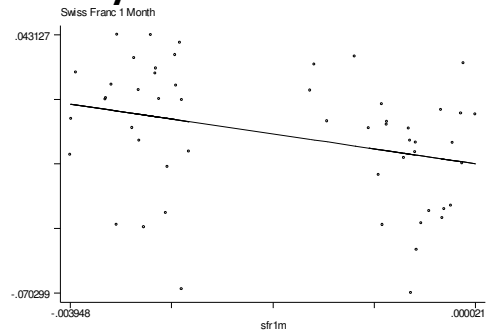
EU



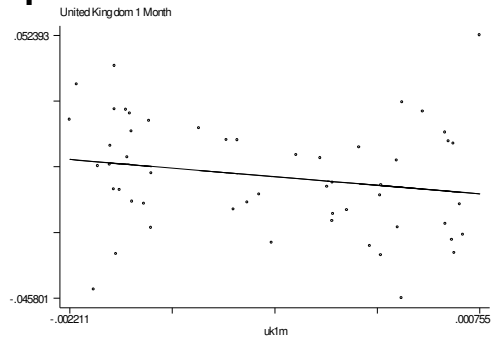
Germany



Japan



Swiss Franc



UK

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