Risk Premium and Forward Discount Bias: A Comprehensive Study of Seventeen Emerging Market Forward Rates

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ABSTRACT

The study investigates forward discount bias for seventeen emerging market currencies focusing on the recent global financial crisis time period. It separates the bias into two components: failure of rational expectations and presence of risk premium using consensus survey data at the short (three month) and the long (twelve month) horizons employing both country specific and panel based regression analysis. The results show that the bias in the forward discount is still smaller for emerging currencies compared to major currencies, but bigger than those reported in Frankel and Poonawala (2010). Both irrationality and time varying risk premium are present in the bias. However, unlike Froot and Frankel (1989), we find strong evidence of presence of risk premium in the forward discount bias both at the short and at the long horizons. Irrationality of expectations plays an insignificant rule in the bias for the three month forward rate, but accounts for almost half of the bias for the twelve month forward rate. However, the results of the irrationality hypothesis is not statistically as significant. Our findings add value to the existing literature as there are no comprehensive study on the issue for the emerging market currencies.

JEL Classification Code: F31, F37

Key Words: Forward market, Forward discount bias, Rational Expectations, Consensus survey data, Panel method

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INTRODUCTION

It is a common finding that forward discount is a biased predictor of future changes in exchange rates. A regression of actual change in spot rates on forward discount shows negative slope coefficient, which signifies that forecasters' even miss the direction of change in future spot rates. This anomaly is known as forward discount puzzle in International Finance literature. There are a large number of studies that investigated the causes of this bias. However, there is no satisfactory solution to the bias yet. Fama (1984) argued that the existence of a time-varying risk premium is the cause of the forward discount bias. Another argument of expectational failure comes from Krasker (1980). Lewis (1989) attributes it to learning effect and Bilson (1981) attributed it to simple irrationality. A comprehensive survey of literature on the issue is available in Engel (1996) and Jongen *et al* (2008).

Using survey data on exchange rate expectations, Froot and Frankel (1989) decompose the measure of the forward discount bias into a component due to risk premium and a component due to irrational expectations. They found that failure of rational expectations was the key factor in the forward discount bias. Few other similar studies including Verschoor and Wolff (2001), Cavaglia, *et al*. (1993, 1990), Taylor (1989) also decompose the bias using various currencies. A fair summary of the literature suggests that both time-varying risk premium and irrationality are responsible for the bias. Most recently, Frankel and Poonawala (2010) found that forward rates in 14 emerging market currencies are less biased than major currencies. They argue that since emerging markets are riskier than developed markets, a finding of less bias in forward rate signifies that the forward discount bias is due to failure of rational expectations. They did not attempt to decompose the bias. The issue of forward discount bias continues to be debated in International Finance literature focusing more on understanding expectation formation process by forecasters, heterogeneity of expectations, and modeling of risk premium, etc. It is an important issue as it has implication on market efficiency and substitutability of assets denominated in different currencies.

Geraats (2009) finds significant improvement in monetary policy transparency across many economies of the world. A recent study by Sellon (2008) shows that during 2003 to 2006, forecast accuracy for survey data on federal fund rate has improved after the Federal Reserve has taken steps to increase transparency, or amount of information it provided to the public. Swanson (2006) also shows that Federal Reserve transparency played a role in making federal

fund forecasting better. Since monetary policy has a significant impact on exchange rate, transparency of monetary policy should also improve exchange rate forecast. Besides, two other significant events had taken place in the recent past, namely September 11, 2001 terrorist attack on World Trade Center in New York City, and the financial crisis of 2007 - 2009. Most recently, few European countries were in financial turmoil, which has affected other member countries in the European Union. In all these situations, governments, and Central Banks have taken extraordinary measures to stabilize financial markets in particular and the economy in general. These events and the measures undertaken by the governments and Central Banks should have significant impact on forecasting in general. It could have been more challenging for the forecaster's to perform forecasting analysis during these periods as the uncertainty about future have increased dramatically. Forecasting industry was also under criticism from different quarters for failure to predict future outcomes using their current forecasting practices. Thus, it will be interesting to analyze how forecasters have performed during these turmoil periods 2006 – 2012.

This study proposes to decompose the bias in the forward rate into risk premium and irrational expectations for the period 2006 – 2012 following the seminal work of Froot and Frankel (1989). The study hypothesizes that due to uncertainty of many events, risk premium components have become larger in magnitude during this time period. However, it might have been easier to perform forecasting for many currencies due to more transparency of Central Banks during the proposed study period. Thus, it is expected that rational expectations component might have been reduced from earlier studies. The objective of this study is to understand if there is any significant change in the forecasting behavior during the recent past due to the reasons mentioned earlier. This study does not attempt to offer any solution to the puzzle, rather shed more light on the puzzle using most recent data of emerging market currencies.

Consensus survey data for this study is collected from Fx4casts.com. Fx4casts.com collects survey opinions of experts for 31 exchange rates, and publishes them in their journal. These are used by financial market professionals for understanding future movements in the exchange rates. This study will utilize data for emerging market currencies only as there are no comprehensive study available on foreign discount bias for these currencies. Please note that all exchange rates are foreign currency units per units of US dollar.

LITERATURE REVIEW:

Froot and Frankel (1989) was the first study that decompose the bias in forward discount using consensus survey data. They collect survey data from three different sources for five major currencies (British Pound, German Mark, Swiss franc, Japanese Yen and French Franc). The decomposition result is reproduced in the table below:

Components of the failure of unbiasedness hypothesis					
Data Set	Dates	N	β_{re}	β_{rp}	β
Economist data	6/81-12/85	525	1.49	0.08	-0.57
Econ 3-month	6/81-12/85	190	2.51 *	-0.30	-1.21 *
Econ 6-month	6/81-12/85	180	2.99 *	-0.00	-1.98 **
Econ 12-month	6/81-12/85	155	0.52	0.19 ***	0.29
MMS 1-month	11/82-1/88	740	4.81***	-2.07	-1.74 ***
MMS 3-month	1/83-10/84	188	6.07 **	1.18 ***	-6.25 ***
AMEX data	1/76-7/85	97	3.25 ***	-0.03	-2.21 ***
AMEX 6-month	1/76-7/85	51	3.63 ***	-0.22	-2.42 ***
AMEX 12-month	1/76-7/84	46	3.11 **	0.03	-2.14 ***

Note: N is the sample size, β_{re} measures irrationality component in the bias, β_{rp} measures risk premium component in the bias, and β is the total bias. *, **, and *** represent significance at 10 percent, 5 percent, and 1 percent levels respectively.

As shown in the above table, their study finds that failure of rational expectations is the prime reason of the bias in forward discount as most of the β_{re} are large and individual parameter tests are statistically significant. Existence of risk premium was not the main cause of the bias as β_{rp} are small in magnitude and parameter tests are not significant. They describe the presence of risk premium as average and it does not vary with time. They also find evidence of excessive speculation by the forecasters.

In a similar study, Cavaglia, Verschoor, and Wolff (1993) investigate six bilateral Asian exchange rates, and finds that both irrationality and presence of time varying risk premium are responsible for the bias in forward discount. The time period was January 1, 1986 – July 1, 1991. Verschoor and Wolf (2001) also analyzes three major exchange rates using data from Business International Corporation from 1/86 to 5/92 and found that both components are responsible for the bias as shown in the table below, and they also find that risk premium is significant and time varying as the individual coefficients, especially β_2, tests are highly significant, which indicates presence of risk premium.

	β	$\beta_1=\beta_{re}$	β_2	β_{rp}	
Cavaglia, Verschoor, and Wolff (1993)					
AD/US	0.4137	-0.1047	0.5184	0.4816	3 months
HK/US	0.4852**	-0.0497	0.5349	0.4651	
SD/US	-0.7107**	-1.6028**	0.8921	0.1079	
JY/US	-3.5223	-5.0382	1.516	-0.516	
JY/AD	-0.2785	-0.2471	-0.0314**	1.0314	
JY/DM	-6.7638***	-7.6627***	0.8989	0.1011	
AD/US	-0.0063	-0.0347	0.2838***	0.7162	6 months
HK/US	0.734	-0.2175	0.9516	0.0484	
SD/US	-1.0018	-2.5447***	1.5429***	-0.5429	
JY/US	-5.1095**	-6.2519***	1.1424	-0.1424	
JY/AD	0.9479	0.8889	0.0590***	0.941	
JY/DM	-707990***	-9.1913***	1.3924	-0.3924	
AD/US	-0.0092	0.2667	-0.2759***	1.2759	12 months
HK/US	0.1505***	-0.5786***	0.7291	0.2709	
SD/US	-0.1039**	-1.0591	0.9551	0.0449	
JY/US	-7.3236	-8.3622***	1.0386	-0.0386	
JY/AD	0.3792	-0.0338	0.413**	0.587	
JY/DM	-4.7717*	-5.5116*	0.7399	0.2601	
Verschoor and Wolf (2001)					
NK/US	0.8226	0.6599 **	0.1627***	0.8373	3 months
SK/US	0.9829	0.8555***	0.1274***	0.8726	
SK/DM	0.9152	0.5093**	0.4060***	0.54	
NK/US	0.6994	0.3642	0.3209***	0.6791	6 months
SK/US	0.9138	0.5924	0.4407***	0.5593	
SK/DM	0.7945	0.3237	0.4435***	0.5565	
NK/US	0.5351	0.0223	0.5246***	0.4754	12months
SK/US	1.4454	0.7074***	0.7672	0.2328	
SK/DM	0.5916	0.2355	0.2731***	0.7269	

Note: β_{re} measures irrationality component in the bias, β_{rp} measures risk premium component in the bias, and β is the total bias. *, **, and *** represent significance at 10 percent, 5 percent, and 1 percent levels respectively. Column 4 is the authors' calculation as $1-\beta_2$. β_1, β_2 are the slope coefficients from formal regressions as discussed in the methodology section.

In an earlier study, Cavaglia, Verschoor and Wolf (1990) investigate 18 exchange rates from January 1, 1986 – December 1, 1990 at the three, six and twelve month ahead forecast horizons. The results show that both irrational expectations and time varying risk premium are present in the data.

Currency pairs	β	$\beta_1=\beta_{re}$	β_2	β_{rp}
	Three months			
JY/US	-9.6632**	-12.1662**	2.5030**	-1.503
SF?US	-5.5380**	-6.7023**	1.1743	-0.1743
BP/US	-1.1201	-3.1161	1.9960**	-0.996
CD/US	0.9094	1.1592	-0.2497*	1.2497
FF/US	-3.4259*	-6.5709**	3.1450**	-2.145
DF/US	-7.0037**	-9.2252**	2.2215**	-1.2215
IL/US	-5.1734**	-9.3296*	4.1563**	-3.1563
BF/US	-4.2005*	-6.2524	2.0519	-1.0519
DM/US	-6.1755**	-7.4329**	1.2573	-0.2573
IP/US	1.1067	-0.0625	1.0441	-0.0441
JY/DM	-7.4455**	-8.3810**	0.9355	0.0645
SF/DM	-1.9285	2.8638	0.9353	0.0647
BP/DM	1.426	0.8281	0.5976	0.4024
CD/DM	-2.1132	-2.3138	0.2006	0.7994
FF/DM	1.9200*	1.1625*	0.7575	0.2425
DF/DM	-0.0184**	-1.6543	1.6358	-0.6358
IL/DM	0.1270**	-2.2123**	2.3393*	-1.3393
BF/DM	0.2625**	-0.0079	0.2704**	0.7296
	Six months			
JY/US	-8.4154**	-9.7537**	-1.3383	2.3383
SF?US	-3.3457**	-4.1794**	0.8337	0.1663
BP/US	-2.5787	-4.0545*	1.4758	-0.4758
CD/US	0.8576	0.4612	0.3953**	0.6047
FF/US	-2.7976**	-50207**	2.2231**	-1.2231
DF/US	-6.2353**	-7.8593**	1.6240	-0.624
IL/US	-4.8088**	-7.4155**	2.6067	-1.6067
BF/US	-6.0996**	-8.1168**	2.0172	-1.0172
DM/US	-5.6402**	-7.1149**	1.4747	-0.4747
IP/US	0.4938	-0.4151	0.9089	0.0911
JY/DM	-8.7270**	-9.9223**	1.1953	-0.1953
SF/DM	-1.0545**	-1.3154**	0.2609**	0.7391
BP/DM	2.5470	1.9817	0.5653	0.4347
CD/DM	-3.6461	-5.209	1.4748	-0.4748
FF/DM	1.5807	0.8080	0.7727**	0.2273
DF/DM	-0.0588**	-0.3628	0.3040**	0.696
IL/DM	0.1553	-0.7235**	0.8789	0.1211
BF/DM	0.9962	-0.0466	1.0429	-0.0429

	Twelve months			
JY/US	-9.5225**	-10.8515**	1.3090	-0.309
SF?US	-8.6610**	-9.6754**	1.0144	-0.0144
BP/US	-5.4541**	-6.0015**	0.5474	0.4526
CD/US	1.4574	0.9813	0.4761	0.5239
FF/US	-2.2339**	-4.0361**	1.8023**	-0.8023
DF/US	-3.1052*	-3.5131	0.4079	0.5921
IL/US	-4.0021**	-5.9186**	1.9165**	-0.9165
BF/US	-6.2999**	-8.3153**	2.0154**	-1.0154
DM/US	-7.2391**	-7.8569**	0.6179	0.3821
IP/US	-0.4750	-0.8260	0.3510*	0.649
JY/DM	-6.4139**	-6.8126*	0.3987**	0.6013
SF/DM	-2.7244**	-3.4652**	0.7408	0.2592
BP/DM	4.5390*	4.0824**	0.4566	0.5434
CD/DM	-7.4400**	-8.7447	1.3049	-0.3049
FF/DM	1.2864	0.8442**	0.4423**	0.5577
DF/DM	.0423**	-0.0526	0.0948**	0.9052
IL/DM	0.2167**	-0.0991	0.3158**	0.6842
BF/DM	0.8663	0.6007	0.2657**	0.7343

Note: β_{re} measures irrationality component in the bias, β_{rp} measures risk premium component in the bias, and β is the total bias. *, **, and *** represent significance at 10 percent, 5 percent, and 1 percent levels respectively. Column 4 is the authors' calculation as $1-\beta_2$. β_1, β_2 are the slope coefficients from formal regressions as discussed in the methodology section.

Frankel and Chinn (1993) investigate the amount of risk premium in the forward discount bias using 17 currencies from February 88 – February 1991. Regressions are run on a pooled

	β	$\beta_1 = \beta_{re}$	β_2	β_{rp}	
Constrained	-0.671***		0.815	0.185	3 months
Unconstrained	-2.881***		0.423***	0.577	
Constrained	-0.370***		0.549***	0.451	12 months
Unconstrained	-3.409***		1.055	-0.055	
			0.596***	0.404	SUR Estimates
Constrained intercept			0.253***	0.747	3 months
Constrained intercept			0.308***	0.692	
			0.234***	0.766	
			0.502***	0.498	SUR Estimates
Constrained intercept			0.401***	0.599	12 months
Constrained intercept			0.732***	0.268	
			0.321	0.679	

Note: β_{re} measures irrationality component in the bias, β_{rp} measures risk premium component in the bias, and β is the total bias. *, **, and *** represent significance at 10 percent, 5 percent, and 1 percent levels respectively. Column 5 is the authors' calculation as $1-\beta_2$. The study did not report β_1. β_1, β_2 are the slope coefficients from formal regressions as discussed in the methodology section.

time series / cross section using OLS and SUR methods. Unlike their earlier study on five major currencies (Froot and Frankel, 1989), they found that risk premium can explain more than half of the variation in the forward discount bias. They attribute this finding to the inclusion of many minor currencies as minor currencies are easier to predict, but riskier to hold. However, most of these currencies are now merged into Euro. Only Singapore and South Africa were included in the sample from the rest of the world. The results are reproduced in the table above.

Frankel and Poonawala (2010) is perhaps the only comprehensive study that investigate the forward discount bias for emerging market currencies. They find that the overall bias in forward discount is significantly less than those of developed countries currencies for the period 12/31/96–04/30/04. The forecast horizon was one month. As we notice in the table below,

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

14. Turkey	-0.0031 (0.0284)	-0.11	1241	1.54	0.9133

almost all of the individual and the joint null hypothesis cannot be rejected. The study do not try to understand the magnitude of the bias due to irrational expectations and / or the presence of risk premium although the authors assert that the bias is probably due to irrational expectations as the magnitude of the bias is smaller compared to major currencies, and minor currencies supposed to be more riskier than major currencies.

There are a few other studies that investigated the presence of risk premium and the rationality of exchange rate expectations using data from various sources as summarized in Jongen, *et al* (2008). A general conclusion of these studies show that risk premium is present although failure of rational expectations also contributes to the bias.

The issue needs more investigation for emerging market currencies. Many emerging market currencies are now traded in the forward market. However, there are no comprehensive study on the causes of forward discount bias for these currencies. This study attempts to fill the gap in the existing literature by investigating forward discount bias in seventeen emerging market currencies focusing on the recent global financial crisis time period.

METHODOLOGY:

As it is explained earlier, researchers in this area believe that forward discount contains two components in it: expected rate of depreciation and a premium for taking risk, which can be written as follows:

$$F_{t,t+k} - S_t = (E_t S_{t+k} - S_t) + RP_t^k \qquad (1)$$

Forward discount = Expected rate of depreciation + Risk premium

It is now possible to separate the components using survey data, because survey data does not contain any risk premium as it reflects expectations of experts about the future exchange rates, and no actual transaction is taking place. The most common test of forward market efficiency is a regression of the future change in the spot rate on the forward discount as follows:

$$S_{t+k} - S_t = \alpha + \beta(F_{t,t+k} - S_t) + \varepsilon_{t+k} \qquad (2)$$

Where, the dependent variable is actual change in the exchange rate and the independent variable is the forward discount. All series are in log format. A test of forward market unbiasedness

requires that α=0 and β=1 and the errors are randomly distributed with a mean zero, and they are uncorrelated with the independent variable. Majority of the study found that β is significantly less than one, which is described as an evidence of the presence of risk premium or irrational expectations or both by the researchers. In equation 2, β is:

$$\beta = cov(F_{t,t+k} - S_t, S_{t+k} - S_t)/var(F_{t,t+k} - S_t) \quad (3)$$

As mentioned earlier, survey data allow us to decompose the coefficient β into the following two components[2]: portions attributable to irrational expectations (β_{re}), and portions attributable to risk premium (β_{rp}). In notation, we can write it as follows:

$$\beta = 1 - \beta_{re} - \beta_{rp} \quad (4)$$

Where,

$$\beta_{re} = -cov(F_{t,t+k} - S_t, S_{t+k} - E_t S_{t+k})/var(F_{t,t+k} - S_t) \quad (5)$$

$$\beta_{rp} = 1 - cov(F_{t,t+k} - S_t, E_t S_{t+k} - S_t)/var(F_{t,t+k} - S_t) \quad (6)$$

β_{re} should be zero, because rational expectations assumes that forecast errors should be uncorrelated with any information available during the time of forecast. Thus, covariance of forward discount $(F_{t,t+k} - S_t)$ and forecast errors $(S_{t+k} - E_t S_{t+k})$ should be zero. On the other hand, the covariance of forward discount and expected depreciation $(E_t S_{t+k} - S_t)$ should be 1, which means that β_{rp} is zero in equation 6.

The decomposition of the coefficient β will show which component was responsible for the bias in the recent past. However, this decomposition does not allow us to make any statistical inference about the significance of the bias. We will formally perform regression analysis to achieve that objective. Thus, the following two regressions will be fitted:

1. Test of Rational Expectations:

$$S_{t+k} - E_t S_{t+k} = \alpha_1 + \beta_1 (F_{t,t+k} - S_t) + \varepsilon_{t+k} \quad (7)$$

The dependent variable is errors in expectation and the independent variable is forward discount. The null hypothesis in the above regression is that α_1 = 0, β_1 =0 and ε_{t+k} are purely random. A rejection of the null hypothesis will signify that expectations are not rational. By inspection β_1 is the same as β_{re} in equation 5 above without the negative sign.

[2] See Engel (1996) and Froot and Frankel (1989) for the derivation of this decomposition.

2. Test of Perfect Substitutability:

$$E_t S_{t+k} - S_t = \alpha_2 + \beta_2 (F_{t,t+k} - S_t) + \varepsilon_{t+k} \quad (8)$$

The dependent variable is expected depreciation and the independent variable is forward discount. The null hypothesis in the above regression is that $\alpha_2 = 0$, $\beta_2 = 1$ and ε_{t+k} are purely random. A rejection of the null hypothesis will signify presence of risk premium in forward discount. By inspection, it is $1 - \beta_{rp}$ in equation 6.

Following time series methods, each series will be tested for stationarity. Serial correlation problem, which is common in time series data will be taken care of by using serial correlation consistent regression methods. Since forecasts are available for shorter as well as longer horizons, all the tests described above can be repeated for all the forecast horizons. It is expected that different results will emerge for the short and the long horizons as it is shown in earlier studies.

EMPIRICAL RESULTS AND DISCUSSIONS:

Table 1 reproduces the standard regression results of the forward discount bias for all the exchange rates individually. Estimated β is less than one in seven cases and in the rest ten currencies it is negative, which implies that forecasters even miss the direction of the change. We also note that β is close to one for three currencies (Mexican peso, Indonesian Rupiah and Russian Ruble). However, none of the hypothesis tests are statistically significant for these currencies. Froot and Frankel (1990) reports average β is -0.88 from 75 earlier studies, only a few are greater than zero and none is greater than 1. Our average is 0.0976, which is positive and much smaller compared to the reported average in Froot and Frankel. Please note that earlier studies only focused on major currencies. Thus, it appears that the bias in forward discount in our study is less pronounced for emerging currencies than those of major currencies, but far from one. This finding corroborates with the findings of Frankel and Poonawala (2010). They also found that forward rates in 14 emerging market currencies are less biased than major currencies as the average β in their study is 0.00335. Thus, we do observe a rise in the bias in our study. What might be the reasons of this rise in the bias? One might attribute it to the uncertainties in the financial markets as our study focuses on the financial crisis time period. In other words, the risk premium component in the bias might have increased during our study period. The null of β

= 1 is rejected in twelve out of seventeen currencies. In majority of the cases, the joint null hypothesis is also rejected. Rejection of the individual and joint null hypothesis in our study is much stronger than Frankel and Poonawala (2010). However, one has to be cautious as the differences in the results might be due to the differences in the forecast horizon as our forecast horizon is longer (three months) than their forecast horizon (one month).

Table 1: Test of Forward Discount Unbiasedness (k = 3)
$S_{t+k} - S_t = \alpha + \beta(F_{t+k} - S_t) + \varepsilon_{t+k}$, From January 1, 2006, through May 1, 2012

	Country	$\hat{\beta}$	$t: \hat{\beta} = 0$	$t: \hat{\beta} = 1$	χ^2test $\hat{\alpha} = 0, \hat{\beta} = 1$	χ^2 Probability
1	Czech Republic	-.317	-0.475	-1.973**	4.596	0.100
2	Hungary	-1.333	-1.469	-2.571***	6.935**	0.031
3	Poland	-.438	-0.575	-1.889*	3.661	0.160
4	Russia	.931	3.148***	-0.233	2.379	0.304
5	Turkey	-.015	-0.030	-2.007**	5.684*	0.058
6	Hong Kong	.373	2.630***	-4.427***	34.257***	0.000
7	India	.273	0.624	-1.661*	2.758	0.252
8	Indonesia	.918	1.920*	-0.171	1.442	0.486
9	Philippine	-.338	-0.575	-2.278**	16.213***	0.000
10	Singapore	-.317	-1.596	-6.626***	53.381***	0.000
11	South Korean	-.200	-0.262	-1.568	3.150	0.207
12	Taiwan	-.406	-0.927	-3.211***	10.912***	0.004
13	Thai	.559	2.058**	-1.622*	15.000***	0.001
14	Argentine	.226	3.831***	-13.12***	218.610***	0.000
15	Brazil	.745	1.802*	-0.616	4.113	0.128
16	Mexico	.901	0.978	-0.108	0.016	0.992
17	South African	-.141	-0.525	-4.239***	17.969***	0.000
	Panel Regression					
	All Countries	0.234	2.906***	-9.495***	104.870***	0.000

Notes: *, **, and * represent significance at 10 percent, 5 percent, and 1 percent levels respectively.**

The results of the panel regression is also reported in Table 1. The results are in line with the individual regressions in Table 1. It shows that β is greater than zero but significantly less than one (0.234) as opposed to major currencies, and the bias is statistically significant. The null hypothesis of slope coefficient is one is strongly rejected in majority of the cases, and the joint

null hypothesis of intercept is zero and slope coefficient is one, is also strongly rejected. Thus, the panel result supports the earlier studies although the magnitude of the bias is still small.

In Table 2, we report the results of the test of rational expectations. Rationality requires that slope coefficients be zero and the forecast errors are purely random. We observe that β_1 is positive in almost half of the currencies, and negative for the remaining half of the currencies. We fail to reject the null of $\beta=0$ in 11 out of 17 currencies. We also fail to reject the joint null in 12 out of 17 currencies. Thus, we do not have a strong rejection of the rational expectations hypothesis for the three month ahead forward rate. This result is similar to Cavaglia, *et al* (1993) for some Asian currencies. However, Froot and Frankel (1989) found strong rejection of rationality for major currencies. The result should not be surprising as emerging markets are still developing and currencies are easier to predict than major currencies. In general, emerging markets' currencies depreciate against major currencies for various reasons. Especially, we are considering a time period when all major interest rates were expected to go down continuously for a long time period based on the information provided by the Central Banks of advanced countries. However, the negative values of some of the estimates are surprising. It means that an expectation of a currency depreciation or appreciation by the forecasters did not occur as expected. A further investigation of monetary policy circumstances in each of these countries is needed to understand the country specific results, which is beyond the scope of the current study.

The panel regression of test of rational expectations clearly shows that slope coefficient is very small and statistically indistinguishable from zero. The joint null hypothesis of intercept and slope coefficient together is zero, cannot be rejected at the usual level of significance. Thus, we conclude that failure of rational expectations play a minor rule in the bias for the three month forward rate.

Table 2: Test of Rational Expectations (k = 3)
$S_{t+k} - E_t S_{t+k} = \alpha_1 + \beta_1 (F_{t+k} - S_t) + \varepsilon_{t+k}$, From January 1, 2006, through May 1, 2012

	Country	$\hat{\beta}_1$	$t: \hat{\beta}_1 = 0$	$t: \hat{\beta}_1 = 1$	χ^2test $\hat{\alpha}_1 = 0, \hat{\beta}_1 = 0$	χ^2 Probability
1	Czech Republic	-.983	-1.448	-2.922***	3.149	0.207
2	Hungary	-1.797	-2.005**	-3.120***	4.023	0.134
3	Poland	-.913	-1.200	-2.514***	1.474	0.479
4	Russia	.758	2.485***	-0.793	6.366**	0.042

5	Turkey	-.464	-0.883	-2.784***	1.077	0.584
6	Hong Kong	.362	2.497***	-4.404***	7.794**	0.020
7	India	.230	0.523	-1.756*	4.285	0.117
8	Indonesia	1.017	2.070**	0.035	5.044*	0.080
9	Philippine	-.622	-1.091	-2.845***	1.459	0.482
10	Singapore	-.320	-1.482	-6.115***	3.877	0.144
11	South Korean	-.443	-0.580	-1.888*	3.041	0.219
12	Taiwan	-.593	-1.269	-3.409***	1.821	0.402
13	Thai	.596	1.971**	-1.335	9.474***	0.009
14	Argentine	.231	3.717***	-12.387***	20.441***	0.000
15	Brazil	.631	1.485	-0.868	2.269	0.322
16	Mexico	.972	1.008	-0.029	2.665	0.264
17	South African	-.292	-1.070	-4.734***	1.291	0.525
	Panel Regression					
	All Countries	0.091	1.097	-11.024***	2.428	0.297

Notes: *, **, and * represent significance at 10 percent, 5 percent, and 1 percent levels respectively.**

Table 3 provides the results for the test of perfect substitutability. The original idea of perfect substitutability comes from the literature on substitutability of domestic and foreign bonds in investors' portfolio. Here it means that if we fail to reject the null hypothesis of $\beta_2=1$ would imply that assets denominated in different currencies are substitutes to one another. In other words, an acceptance of the hypothesis would mean that there is no risk premium in holding different currencies and thus, assets denominated in difference currencies should be substitutable in investors' portfolio. Interestingly, we notice that all point estimates of β_2 in Table 3 are greater than β in Table 1. Unlike Froot and Frankel (1989), we do find a strong rejection of $\beta_2=1$ (no time varying risk premium since $\beta_{rp} = 1 - \beta_2 = 0$ if β_2 is 1) across all currencies. The joint null is also strongly rejected across all currencies. It seems that the rejection of the null in this study is stronger than any other earlier study.

Table 3: Test of Perfect Substitutability ($k = 3$)
$E_t S_{t+k} - S_t = \alpha_2 + \beta_2(F_{t+k} - S_t) + \varepsilon_{t+k}$, From January 1, 2006, through May 1, 2012

	Country	$\widehat{\beta}_2$	$t: \widehat{\beta}_2 = 0$	$t: \widehat{\beta}_2 = 1$	χ^2**test** $\widehat{\alpha}_2 = 0, \widehat{\beta}_2 = 1$	χ^2 **Probability**
1	Czech Republic	.661	4.944***	-2.537***	7.394***	0.025

2	Hungary	.455	2.838***	-3.398***	24.651***	0.000
3	Poland	.470	3.802***	-4.290***	27.077***	0.000
4	Russia	.174	3.541***	-16.857***	424.625***	0.000
5	Turkey	.454	4.460***	-5.366***	110.742***	0.000
6	Hong Kong	.028	0.492	-16.909***	426.602***	0.000
7	India	.042	0.463	-10.644***	211.110***	0.000
8	Indonesia	-.077	-0.927	-12.898***	309.295***	0.000
9	Philippine	.281	2.266**	-5.811***	216.095***	0.000
10	Singapore	-.009	-0.175	-18.862***	395.156***	0.000
11	South Korean	.260	2.060**	-5.860***	57.562***	0.000
12	Taiwan	.205	1.965**	-7.621***	59.620***	0.000
13	Thai	-.041	-0.508	-12.947***	176.568***	0.000
14	Argentine	-.004	-0.166	-46.898***	2904.990***	0.000
15	Brazil	.113	1.309	-10.267***	170.237***	0.000
16	Mexico	-.078	-0.389	-5.364***	68.785***	0.000
17	South African	.148	2.165**	-12.463***	158.024***	0.000
	Panel Regression					
	All Countries	0.143	8.313***	-49.628***	3003.286***	0.000

Notes: *, **, and * represent significance at 10 percent, 5 percent, and 1 percent levels respectively.**

Panel regression also shows that the slope coefficient is positive and highly significant meaning risk premium is present in the data. The null of $\beta_2=1$ is strongly rejected. The joint null hypothesis is also highly significant. Together, the results show a strong rejection of no risk premium hypothesis. Thus, we conclude that presence of risk premium is the primary reason of the bias in forward discount in our sample period for the three month forward rate. This finding is completely different than the finding of Froot and Frankel (1989). Our understanding is that the difference in the results are due to the time period under investigation. However, there might be another reason for this result. It is possible that the forward markets in the emerging currencies have become more competitive. A further study with normal economic environment is necessary to investigate this hypothesis.

In Table 4, we calculate β_{rp}. It is always positive, compared to $\beta_{re,}$ where nine of them are negative. The magnitude of β_{rp} is larger than one in five cases. In another five cases, it is greater than 0.8. The lowest value is 0.339. On the other hand, absolute value of β_{re} is greater than one in two cases, greater than .8 in another 2 cases. The lowest absolute value is 0.23. When we

look at the average values of β_{re} and β_{rp}, the difference is striking. β_{rp} is positive and greater than 0.8 compared to $\beta_{re,}$ where the average is -0.09588 (absolute value of the average is 0.620035). Thus, we conclude that presence of risk premium is the primary cause for the bias in forward discount in our sample period for the three month forward rate.

Table 4: Magnitude of the bias (k= 3months)

	Country	β	$\beta_1 = \beta_{re}$	β_2	$\beta_{rp} = 1 - \beta_2$
1	Czech Republic	-0.317	-0.983	0.661	0.339
2	Hungary	-1.333	-1.797	0.455	0.545
3	Poland	-0.438	-0.913	0.47	0.53
4	Russia	0.931	0.758	0.174	0.826
5	Turkey	-0.015	-0.464	0.454	0.546
6	Hong Kong	0.373	0.362	0.028	0.972
7	India	0.273	0.23	0.042	0.958
8	Indonesia	0.918	1.017	-0.077	1.077
9	Philippine	-0.338	-0.622	0.281	0.719
10	Singapore	-0.317	-0.32	-0.009	1.009
11	South Korean	-0.2	-0.443	0.26	0.74
12	Taiwan	-0.406	-0.593	0.205	0.795
13	Thai	0.559	0.596	-0.041	1.041
14	Argentine	0.226	0.231	-0.004	1.004
15	Brazil	0.745	0.631	0.113	0.887
16	Mexico	0.901	0.972	-0.078	1.078
17	South African	-0.141	-0.292	0.148	0.852
	Average	0.0835	-0.0958	0.1812	0.8187
	All countries	0.234	0.091	0.143	0.857

Now, we focus on the twelve month forward rate. Table 5 produces the results of the unbiasedness test. The estimated β is positive in 12 cases and larger than one in six cases. Unlike three month forward rate, β is close to zero in three currencies. The average β is 1.035625 for the twelve month forward rate compared to 0.083588 for the three month forward rate. The null of $\beta=1$ is strongly rejected in almost half of the cases, and the joint null hypothesis is rejected in all cases except for two currencies. However, the panel regression shows that β is positive, larger than β of three month forward rate, and all hypothesis tests are highly significant. Thus,

we conclude that the unbiasedness hypothesis is rejected for the twelve month forward rate. However, the bias is still smaller than the earlier studies with major currencies.

Table 5: Test of Forward Discount Unbiasedness (k = 12)
$S_{t+k} - S_t = \alpha + \beta(F_{t+k} - S_t) + \varepsilon_{t+k}$, From January 1, 2006, through May 1, 2012

	Country	$\hat{\beta}$	$t: \hat{\beta} = 0$	$t: \hat{\beta} = 1$	χ^2test $\hat{\alpha} = 0, \hat{\beta} = 1$	χ^2 Probability
1	Czech Republic	3.930	4.444***	3.313***	15.530***	0.000
2	Hungary	4.871	4.814***	3.826***	18.099***	0.000
3	Poland	5.041	4.836***	3.877***	15.312***	0.001
4	Russia	-.135	-.488	-4.102***	19.763***	0.000
5	Turkey	-.183	-.382	-2.469***	15.664***	0.000
6	India	1.541	2.134**	.749	1.035	0.596
7	Indonesia	-.847	-2.053**	-4.475***	33.484***	0.000
8	Philippine	.528	.959	-.859	28.759***	0.000
9	Singapore	.013	.034	-2.624***	31.877***	0.000
10	South Korean	1.075	.794	.055	2.748	0.253
11	Taiwan	-1.329	-2.526***	-4.427***	20.812***	0.000
12	Thai	.564	1.029	-.794	17.928***	0.000
13	Argentine	.159	2.601***	-13.80***	253.419***	0.000
14	Brazil	1.286	2.188**	.487	29.218***	0.000
15	Mexico	.006	.007	-1.128	1.487	0.475
16	South African	.050	.075	-1.426	5.289*	0.071
	Panel Regression					
	All	0.387	5.217***	-8.273***	135.456***	0.000

Notes: *, **, and *** represent significance at 10 percent, 5 percent, and 1 percent levels respectively. Hong Kong is not included in this regression because of missing observations.

Now, we investigate the sources of the bias. In Table 6, we produce the results of the test for rational expectations. The estimated average β_1 is 0.7576875 compared to -0.09588 for the three month ahead forecast in Table 2. This should not be surprising. It is expected that longer horizon forecasts will be more difficult, and thus, will carry bigger errors. The null of β_1=0 is rejected in six cases, which is similar to the test of rational expectations for the three month ahead forecast in Table 2. However, the joint null hypothesis is rejected in majority of the cases unlike the three month ahead forward rate. In panel regression, we do notice a rejection of the

null of $\beta_1=0$ (although weak, stronger than three month forward rate) for the test of rational expectations hypothesis, but the joint null hypothesis is highly significant. Thus, we have a stronger evidence of failure of rational expectations for the twelve month forward rate compared to the three month forward rate.

Table 6: Test of Rational Expectation ($k = 12$)
$S_{t+k} - E_t S_{t+k} = \alpha_1 + \beta_1 (F_{t+k} - S_t) + \varepsilon_{t+k}$, From January 1, 2006, through May 1, 2012

	Country	$\hat{\beta}_1$	$t: \hat{\beta}_1 = 0$	$t: \hat{\beta}_1 = 1$	χ^2test $\hat{\alpha}_1 = 0, \hat{\beta}_1 = 0$	χ^2 Probability
1	Czech Republic	2.927	3.268***	2.151**	24.134***	0.000
2	Hungary	3.937	4.092***	3.053***	18.226***	0.000
3	Poland	4.114	4.006***	3.032***	16.729***	0.000
4	Russia	-.395	-1.480	-5.232***	2.293	0.318
5	Turkey	-.684	-1.437	-3.537***	2.117	0.347
6	India	1.532	2.077**	.722	14.276***	0.001
7	Indonesia	-.832	-1.963**	-4.321***	4.734*	0.094
8	Philippine	.311	.537	-1.189	0.854	0.653
9	Singapore	-.037	-.093	-2.587***	6.990**	0.030
10	South Korean	1.501	1.083	.361	9.836***	0.007
11	Taiwan	-1.813	-3.291***	-5.107***	11.797***	0.003
12	Thai	.430	.834	-1.107	16.126***	0.000
13	Argentine	.096	1.336	-12.583***	14.306***	0.001
14	Brazil	1.029	1.603	.045	5.188*	0.075
15	Mexico	.383	.445	-.718	4.246	0.120
16	South African	-.376	-.579	-2.119***	0.962	0.618
	Panel Regression					
	All	0.125	1.684*	-11.742***	3.087***	0.000

Notes: *, **, and * represent significance at 10 percent, 5 percent, and 1 percent levels respectively.**

Table 7 produces the results of the test of perfect substitutability. The estimated β_2 is positive in most cases. The average is 0.277938 compared to 0.181294118 for the three month forward rate. Thus, it seems that risk premium will be slightly smaller for the twelve month ahead forecast than those of three month ahead forecast. The null of estimated beta is one, is rejected in all cases except for three currencies, and the joint null is strongly rejected in all

currencies except for one currency. Taken together, the test shows a strong evidence of presence of risk premium in the forward discount at the twelve month horizon.

Table 7: Test of Perfect Substitutability (k = 12)
$E_t S_{t+k} - S_t = \alpha_2 + \beta_2(F_{t+k} - S_t) + \varepsilon_{t+k}$, From January 1, 2006, through May 1, 2012

	Country	$\hat{\beta}_2$	$t: \hat{\beta}_2 = 0$	$t: \hat{\beta}_2 = 1$	χ^2test $\hat{\alpha}_2 = 0, \hat{\beta}_2 = 1$	χ^2 Probability
1	Czech Republic	1.003	5.230***	.013	53.23***	0.00
2	Hungary	.934	4.418***	-.313	11.40***	0.00
3	Poland	.926	5.369***	-.428	3.08	0.21
4	Russia	.260	5.383***	-15.340***	369.24***	0.00
5	Turkey	.501	6.126***	-6.102***	319.64***	0.00
6	India	.008	.076	-9.178***	767.81***	0.00
7	Indonesia	-.015	-.260	-17.665***	1420.16***	0.00
8	Philippine	.216	1.768*	-6.400***	449.61***	0.00
9	Singapore	.050	.494	-9.407***	154.70***	0.00
10	South Korean	-.426	-2.469***	-8.269***	181.76***	0.00
11	Taiwan	.484	3.627***	-3.866***	15.03***	0.00
12	Thai	.135	1.036	-6.653***	48.18***	0.00
13	Argentine	.063	2.215**	-33.155***	1780.49***	0.00
14	Brazil	.258	1.820*	-5.249***	253.59***	0.00
15	Mexico	-.376	-2.113**	-7.726***	203.77***	0.00
16	South African	.426	4.627***	-6.243***	94.80***	0.00
	Panel Regression					
	All	0.261	14.252***	-40.297***	2589.134***	0.000

Notes: *, **, and * represent significance at 10 percent, 5 percent, and 1 percent levels respectively.**

We decompose the bias in the forward discount for the twelve month horizon in Table 8. They are positive in all cases except one, and some of them are greater than one. As we have discussed earlier, failure of rational expectations component is bigger for the twelve month ahead forward rate compared to three month ahead forward rate. In three month ahead forward rate, failure of rational expectations plays a very minor rule in the bias. However, the risk premium component is slightly smaller for the twelve month forward rate compared to three month forward rate. But in both the horizons, risk premium component is significantly bigger than rational expectations component, and the results are statistically significant.

Table 8: Magnitude of the Bias (K=12 months)

	β	$\beta 1 = \beta_{re}$	β_2	β_{rp}
Czech Republic	3.93	2.927	1.003	-0.003
Hungary	4.871	3.937	0.934	0.066
Poland	5.041	4.114	0.926	0.074
Russia	-0.135	-0.395	0.26	0.74
Turkey	-0.183	-0.684	0.501	0.499
India	1.541	1.532	0.008	0.992
Indonesia	-0.847	-0.832	-0.015	1.015
Philippine	0.528	0.311	0.216	0.784
Singapore	0.013	-0.037	0.05	0.95
South Korean	1.075	1.501	-0.426	1.426
Taiwan	-1.329	-1.813	0.484	0.516
Thai	0.564	0.43	0.135	0.865
Argentine	0.159	0.096	0.063	0.937
Brazil	1.286	1.029	0.258	0.742
Mexico	0.006	0.383	-0.376	1.376
South African	0.05	-0.376	0.426	0.574
Average	1.0356	0.7576	0.2779	0.7220
All Countries	0.387	0.125	0.261	0.739

CONCLUSION:

Three clear conclusions emerge from this study. First, forward discount bias is positive, and smaller for the emerging market currencies compared to those of major currencies from earlier studies. Second, existence of risk premium plays a major rule in the bias both at the short and at the long horizons during the financial crisis time period. Third, irrationality of expectations plays an insignificant rule in the bias for the three month forward rate, but accounts for almost half of the bias for the twelve month forward rate. The results of this study should be interpreted cautiously as it might have been influenced by the time period under investigation. The study contributes to the existing literature as there is no comprehensive study on the subject for emerging market currencies. A further study on the subject utilizing data from normal economic environment may produce different results.

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