The safe-haven effect in forward premia: what makes a currency trustworthy? *

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Abstract

The forward puzzle has traditionally been explained as the reflection of a covariance-risk premium, market friction or limits to arbitrage. Recently, the role of safe-haven effects has become increasingly clear. Following danger signals from the market, portfolio managers shun the riskier assets and flee for quality, thus generating a risk premium for these beleaguered currencies. The currency that serves as a safe haven also acts as the benchmark for performance measurement. In this paper we explore what contributes to a safe-haven or benchmark image of currency in turbulence. By comparing floating rates to band-regime ones, strong base currencies to weak ones, and the base currencies with different market shares, we find that the benchmarking role primarily comes from currency' strength measured by interest rate differential. However a low interest rate is not sufficient. A trustworthy currency also has large share in FX markets as well, and in this sense our safe-haven effect is not a pure carry-trade-cycle effect. The exchange-rate regime seems to matter the least. Besides, we find that consistent with the idea that reputation comes from a slow-moving effect, the safe-haven evidence is especially present in the long-run-trend component of the forward premium.

Keywords: forward puzzle, exchange rate regime, base-currency strength, nonstationarity, career-risk premium.
JEL-codes: G15, G32.

Introduction

Outside academia it seems to be self-evident that some currencies are somehow less risky than others. *The Economist*, for instance, notes “the relative security of the Japanese yen and the Swiss franc”, against which “riskier currencies have [recently] lost ground”.[1] The DEM in pre-EUR days would have been also on the list of safe currencies, and the fact that many currencies have pegged their money to the USD signals a belief in large parts of the world that also the dollar is an emblem of safety. This paper explores the characteristics of a safe image and studies what notion of risk may be behind such an image. Orthodox theory holds that asset risk should correspond to covariance with marginal utility. In the currency markets empirical support for this notion has been divided at best,[2] but the recent carry-trade literature[3] has re-opened this avenue. We return to this line of thinking later. Other avenues would adopt less arcane notions of risk. One of these might be purchasing power risk: a history of low inflation is surely one common characteristic of the JPY, CHF, DEM and, relative to its peggers, the USD. But low inflation is directly relevant only to locals: to Canadians, for instance, Swiss inflation is relevant only if and to the extent that it affects the nominal exchange rate (and hence, the return on investment) via some PPP effect. Empirical support for PPP effects in exchange rates are weak in the short run. More importantly, even though low-inflation currencies do appreciate in the long run, to a Canadian this is a boon only if interest rate differentials do not wipe out the gain, on average.

This brings us to the second obvious characteristic of the above ‘safe’ currencies: they have low interest rates. In addition, we know that in the long run the total return on low-yield currencies is below that on high-yield currencies, consistent with the long-run success of the carry trade but also implying that a higher interest rate is associated with an increased risk premium. Obviously, if the level of interest rates matters, it should be indirectly, via some proxying mechanism: after all, interest rates are part of the expected return rather than direct measures of risk. One example of interest differentials proxying for risk is provided by Bansal (1997), who shows that the orthodox covariance risk premium is correlated with the square of

[1] January 26, 2008, p 68

[2] Frankel and Engel (1984), Domowitz and Hakkio (1985), Hodrick and Srivastava (1986); Hodrick (1987, 1989), Cumby (1988), Mark (1988), Engel (1996), Hollifield and Uppal (1997), Mark and Wu (1997), Backus, Foresi, and Telmer (2001), and Chinn and Frankel (2002) all fail to explain the forward puzzle well; however, see Bansal (1997), and the recent carry-trade literature for a dissident view.

[3] Ranaldo and Soderlind (2010); Clarida, Davis and Pedersen, (2009).

the interest differential. Liu and Sercu (2009a, b, henceforth LS) explain such a risk premium as a trader's career risk. As they point out, the most influential players nowadays work with money of their customers or employers rather than their own. These professional portfolio managers are concerned about track record, which is not the same as the best return. The big, strong currencies do look safe and respectable, from that perspective. Paraphrasing the old saying about IBM's computers, one could state that "Nobody ever got fired for buying CHF". Getting fired for buying Turkish Lira is much easier to imagine. In the stock market there is a similar aversion to very small-capitalization stocks or to shares that have done badly in the recent past ('fallen angels'): investors don't like them, so they're priced with big returns.

In this paper we generalize the career-risk argument of LS into a safe-haven effect and extend the test to currencies outside of pre-EUR ones, the sample they studied. In LS, the risk premium relative to a safe base is non-linearly related to the interest differential: a small forward discount[4] hardly matters, but a large one itself is an excellent summary measure of perceived danger. They find the pattern in the intra-ERM[5] rates relative to the DEM; what this paper is about, then, is whether there are other currencies that play a similar role, and why. We explore three characteristics that may contribute to build a safe image or a benchmark status. First, common sense suggests that a benchmark currency should get excellent ratings on one of the following two scales, and a good score on the other: (*i*) a history of reassuringly low interest rates; (*ii*) having a large market share in FX markets, *i.e.* a good liquidity. Thus, if we found the LS pattern for weaker or less widely traded base currencies, this would invalidate their hypothesis. Our second common-sense expectation is that benchmark status is neither coming overnight nor disappearing fast. If big interest-rate differentials proxy for an image of danger, we should look at long-term trends in these differentials rather than short-lived deviations from the trend. A third idea is that benchmark status might be clearest in admissible-band rates: the position relative to the central parity and to the bounds is a very visible measure of danger, and there is a clear anchor currency, notably the DEM in the ERM, or the USD in the case of unilateral pegs. For floating-rate currencies, the notions of anchor, strength and danger may be much fuzzier, so the benchmark effect may be harder to detect or even absent.

To test the external validity of LS's safe-haven effect, we set up the experiment for various sets of exchange rates that differ in terms of base currency strength, currency regime, and FX

[4] Here, the interest rate differential is used interchangeably with the forward premium (discount).

[5] European Exchange Rate Mechanism

market share. We find that a fixed-rate regime is not necessary: safe-haven effects are present also in the floating rates. Nor is a fixed regime sufficient: the effect is patently absent in the pre-EUR sample when the currencies are quoted against the ITL rather than the DEM, and in the sample of HKD pegged to USD. Relative to regime, currency strength in terms of interest rate differential and market share of currency are much more important to identify a benchmark. Primarily, the LS pattern show up for base currencies that have both low interest rates and large market shares, like DEM, CHF and JPY, while the safe-haven pattern is insignificant or absent in the sets where the base currencies have both high interest rates and low shares in the FX markets, like ITL and ESP. Nor can a benchmark currency be weak in just one of the yield and size criteria. For example, NLG was the strong currency member in pre-EUR group, but it had a small proportion of the FX market; and the safe haven effect is empirically absent when the ERM currencies are quoted in NLG. On the contrary, the benchmark pattern is observed when the floating-rate currencies are quoted in USD, which has a dominant share in the market but whose strength is middle-of-road relative to DEM or CHF. Lastly, a currency's reputation seems to be formed over a long time. Our finding is that the non-linear risk premium is exclusively related to its (Hodrick-Presscott) trend component while the filtered component (the deviation from trend) seems to be too fast-moving to contribute to such an effect.

In short, the safe haven is not necessarily a currency with a currently low interest yield, but one with a tradition of low yields and one that investors can return to when the situation gets rough. The size requirement makes one difference between the benchmark or safe-haven effect and the carry trade cycle, the behavior of buying low-yield currencies and shorting high-yield ones. In addition, the safe-haven premium has a long-run perspective. Our safe-haven view also differs from the safe-harbour effect in the carry trade, which focuses on time-varying financial risk rather than on the nature of the link between risk premium and forward premium. In that sense our results are complementary to the recent work on carry trade.

1 Models and Hypotheses

LS use cubic polynomials to model the relation between exchange-rate changes and forward premiums. These cubics can capture at least three very different theories about the risk premium, which are reviewed in the first subsection. Then we turn to the testable hypotheses.

1.1 The Competing Hypotheses

We review, in turn, the market-friction/limits-to-arbitrage hypothesis, the Bansal risk premium and the safe-haven views (including the career-risk/fallen-angel hypotheses).

The Market-friction/Limits-to-arbitrage Hypothesis

Huisman *et al.* (1998) explain the forward puzzle as the result of market frictions, like transaction costs, which obscure the theoretical parity between expected exchange rate changes and forward premiums. This is especially likely when the expected exchange-rate change is small and diffuse. Therefore, the subset of observations where the forward premiums are larger may provide a much more favorable signal-to-noise ratio than the small-sized observations. Huisman *et al.* (1998) accordingly generalize the Fama regression by letting the coefficient change with the forward premium, and they use panel techniques with a cross-currency constraint that ensures numeraire-invariance of the estimates. Their major finding is that extreme-premium observations generate Fama regression coefficients close to unity, and even substantially above unity if the definition of "large variance" is very strict.

The Limits-to-arbitrage literature model, which has its origin in behavioral finance (see e.g. De Long *et al.*, 1990a, b, or Schleifer and Vishny, 1997), is similar in spirit, pointing out that so-called UIP arbitrage is not cost- and risk-free, in reality. More recent tests would typically model the varying beta in a smoother and more flexible way rather than the abrupt switch between the large- and small-sized forward premiums of Huisman *et al.* But both the market-friction and the limits-to-arbitrage theories believe that the slope (beta) increases in the absolute size of the forward premium, that is, the betas should exhibit a U-shaped pattern. Table 1 sums up the competing theories and their beta patterns.

Bansal's Risk Premium Hypothesis

Bansal (1997) takes a very different perspective, focusing on the risk premium instead of friction. He starts from a CCAPM equilibrium asset pricing model and establishes that its currency risk premium is approximately quadratic in the forward premium. Thus, the entire relation between expected change and forward premium becomes quadratic. In his tests, Bansal approximates this by a piecewise linear relation, implying that the Fama β changes discretely around $f = 0$, from positive to negative or vice versa. With the original quadratic function for $\mathrm{E}(\tilde{s})$, the beta is negatively or positively linear in the forward premium.

Table 1: **Overview of beta patterns in competing theories**

Beta pattern	Hypothesis	Description of the relation between β and f
U-shaped	–Market friction –Limits to arbitrage	high (low) β for large (small) $\|f\|$s U-shaped pattern
Linear	Bansal's Risk premium	β linear in f, or stepwise changing sign
Inverse U-shape	Safe-haven stories: –Fallen-angel effect –Career-risk effect	inverse U or inverse V, possibly asymmetric

Key: "β" is the Fama (1983) beta and "f" is the forward premium.

The Benchmark/Safe-haven Hypothesis

Like the limits-to-arbitrage view, the benchmark/safe-haven hypothesis has its roots in behavioral finance. It encompasses the career-risk effect in the currency markets as tested by Liu and Sercu (2009) and the fallen-angel effect in the equity market documented by Ikenberry, Lakonishok and Vermaelen (1995). In this view, whenever uncertainty rises or danger signals are observed, safety concerns become more important to professional money managers, and money tends to flow from currencies with a riskier image towards the ones regarded as safe havens. This affects both the forward premium and the risk premium. For example, when bad news about a peripheral currency hits the market, many investors head for the exit, sending the risky currency's spot value down and its interest rate up relative to the safe-haven currency. Note that a falling spot value and a rising interest rate mean that the forward rate falls even more than the spot rate, which in the unbiased-expectations view would imply that still worse is to come. In the fallen-angel or career-risk view, portfolio managers require a risk premium for hanging on to such a weakened currency: even if gains and losses would actuarially balance out *ex ante*, the potential loss from staying in the weakening currency would still weigh more heavily than the potential gain from a recovery (or the potential opportunity loss from getting out, if you wish). One reason is that the loss from hanging on would be a cash loss, and this looks worse than the opportunity loss of missing a recovery. Second, a loss is even worse if it comes from a contrarian decision—holding on after a clear and publicly observable bad signal. In sum, the risk premium is needed to counterbalance a dark matter, a pay-off not observed when one studies only the traditional returns on the investment, notably the damage to the manager's track record from possibly making a cash loss that she 'should have seen coming'. This view fits well with the strong culture of loss-stopping among currency traders.

The above fallen-angel effect can easily be broadened into a more general safe-haven story. Consider, for instance, retail investors' reactions to a general danger signal, whether it's a recent depreciation or not. Also for them the choice is between, on the one hand, following the herd and not looking worse than the average when things go wrong, and on the other hand, being contrarian, which is a painful option if the bet does not pay off. In this case, the dark matter missed by standard tests is not a track-record effect but a psychological cost of deviating from the crowd. The safe-haven view almost automatically implies a benchmarking role too: investors measure performance against the safe-haven, whether this is the home currency or not.

LS translate this into the following predictions about the relation between expected changes and the forward premium against a benchmark currency. An unusually high interest rate as compared to the benchmark's rate is regarded as a public danger signal in itself, possibly reflecting other underlying risk signals, and a strong risk premium is needed to contain the flight for quality and convince at least some investors to hold the high-yield currency. The size of this risk premium is expected to become small and not very interest-sensitive when the forward premium versus the safe-haven currency is small. If, lastly, the currency's interest rate would be below the benchmark one, there is a public signal of reassurance, and the risk premium might become negative. Note that the relation between the forward premium and the safe-haven risk premium does not need to be symmetric between negative and positive forward premia. While it takes a large bribe to go against a public warning signal and risk a cash loss, the effect of a similar-sized 'positive' signal is likely to be weaker because the currency under consideration is, by assumption, still not a benchmark one.

In sum, the private risk premium can be modeled as a nonlinear function of the forward premium f—a cotangent-like shape, more precisely. The risk premium is low and not very interest-sensitive when f is around zero; it rises rapidly when the forward discount (in terms of a benchmark currency) rises; and it may fall fast if f turns to be positive, although examples of that may be rare because the benchmark currency itself has low interest rates. Candidate models for the risk premium would accordingly be a possibly asymmetric power function $\eta_{-}|\mathrm{Min}(f,0)|^n - \eta_{+}\mathrm{Max}(f,0)^n$ with positive ηs and with n equal to 2 or 3, implying that the expected return equals $f[1+\eta_{-}|\mathrm{Min}(f,0)|^{n-1} - \eta_{+}\mathrm{Max}(f,0)^{n-1}]$. Thus beta, the expression in square brackets, is predicted to be an inverse U- or V-function of the forward premium.

2 Research Design

In this section we first describe how we test the three competing hypotheses in any given sample. We then discuss how we can validate the diagnosis of benchmarking effects by looking at different samples and checking whether the conclusions make sense.

2.1 Testable Hypotheses in terms of the Fama Regression Slope

In this subsection, we identify the beta patterns we expect under each of the competing models. From the review of Table 1, both the market-friction and limits-to-arbitrage theories suggest a U-shaped pattern in beta. Bansal's risk premium hypothesis argues that the beta is monotonely rising or falling to the forward premium. The fallen-angel hypothesis, lastly, proposes an inverse U-shaped pattern for the career-risk effect. All these theories regard the missing variable as a non-linear function of the forward premium. U or inverse-U shapes for betas suggest quadratics, implying a cubic model for the expectations:

$$\begin{aligned} \mathrm{E}_t(\tilde{s}_{t,\Delta}) &= \alpha + \beta_1 f_{t,\Delta} + \beta_2 f_{t,\Delta}^2 + \beta_3 f_{t,\Delta}^3, \\ &= \alpha + \beta(f) f_{t,\Delta} \\ \text{where } \beta(f) &= \beta_1 + \beta_2 f_{t,\Delta} + \beta_3 f_{t,\Delta}^2. \end{aligned} \tag{2.1}$$

The possible shapes of β can be diagnosed as in Table 2.[6] From this overview, the crucial parameter to be watched is β_3, which makes the difference between the career-risk, limit-to-arbitrage and Bansal hypotheses. All our significance tests are based on Monte Carlo simulations as described in the Appendix, so as to simultaneously take into account the overlapping observations and the long memory in f.

Following LS, we test the models not only on the forward premia, but also, after a Hodrick-Prescott decomposition, on the two components of the forward premium. The motivation for the Hodrick-Prescott (HP) decomposition was as follows. The image of a currency as safe or unsafe is probably changing slowly; so, if this is to be picked up by the forward premium, then our chances might be best if we filter out the short-term fluctuations. In addition, the

[6] For completeness, we discuss the sensitivity of the patterns to the way of quoting. If $\mathrm{E}(\tilde{s}) = \alpha + \beta_1 f + \beta_2 f^2 + \beta_3 f^3$ and $s' := -s$ and $f' := -f$, then $\mathrm{E}(\tilde{s}') = -\alpha + \beta_1 f' - \beta_2 f'^2 + \beta_3 f'^3$. That is, in a linear regression only the intercept flips sign; in a quadratic, a U for the expected return gets inverted and *vice versa*; and the cubic coefficient does not change. In terms of beta we have $\beta' = \beta_1 - \beta_2 f' + \beta_3 f'^2$: a falling Bansal beta flips to a raising one, but a U- (or inverse-U-)shaped beta retains its shape, and only the vertex shifts from the positive to the negative domain of the forward premium or vice versa.

Table 2: Beta pattern: depending on higher-order coefficients

$$\mathrm{E}_t(\tilde{s}_{t,\Delta}) = \alpha + \beta_1 f_{t,\Delta} + \beta_2 f_{t,\Delta}^2 + \beta_3 f_{t,\Delta}^3,$$
$$\beta(f) = \beta_1 + \beta_2 f_{t,\Delta} + \beta_3 f_{t,\Delta}^2.$$

$\beta_3 = 0$		$\beta_3 \neq 0$	
$\beta_2 = 0$ Constant beta	$\beta_2 \neq 0$ linear in f	$\beta_3 > 0$ U-shape in f	$\beta_3 < 0$ inverse U in f
Standard Fama regression	Bansal's risk premium theory	Market friction or limits to arbitrage	Fallen-angel or career-risk effect etc

LS long-term component of the forward premium has, empirically, a unit root or is at least close to it, while the short-term part is definitely mean-reverting. Since, in a band regime, the expected exchange rate change cannot be a unit-root process, any expectation component in the forward premium would be more present in the short-term fluctuation, and the risk-premium component in the long-run part.[7] In each case LS estimate the models series per series, while we use panels.

2.2 Possible characteristics of a safe-haven or benchmark currency

We now discuss how we can validate a diagnosis of safe haven effect by checking whether in different samples benchmark characteristics are plausible. Before to do so, we need to agree on what characteristics a safe-haven or benchmark currency should have. We discuss how currency regime, base currency strength and currency market share could affect the relationship between exchange-rate changes and premiums.

The potential relevance of the band regime is easiest to argue. In the ERM, the admissible range for exchange rates is well-defined, and positions can be very clearly classified from excellent all the way down to highly risky.[8] In contrast, there is no such clear 'good'/'bad' standard for floating rate, nor does a falling rate associate with a peso-type risk of a discrete,

[7] If risks are orthodox covariances with consumption growth or market returns, they would be unlikely to be unit-root too; but in this paper we allow for very different concepts of risk.

[8] There even was an official summary measure that provided a synthetic view of the currency's position vis-a-vis each of the other member currencies: the divergence indicator. The divergence indicator was published every day in all major newspapers and was calculated as the divergence between the actual value and central parity of the ECU in units of home currency, as a percentage of the allowed maximum divergence,

$$D := \frac{[\text{actual value} - \text{central parity}]/\text{central parity}}{\text{maximum divergence}}. \tag{2.2}$$

A positive divergence indicator means a strong ECU, *i.e.*, a weak home currency.

big re-alignment. In the presence of a band, in fact, the notion of a danger zone is quite clear. In addition, intervention could lead to a build-up of pressure and to a drastic devaluation later on. The combination of clear danger signals and possibly disastrous consequences from ignoring these signals may be vital for the validity of the career-risk idea and related behavioral phenomena. Thus, to test whether a fixed-band regime is necessary, we apply the LS tests to mainstream floating rates against the three heavyweights, USD, JPY, and CHF. To test whether a band is sufficient, we also present additional results for band regimes, notably the USD/HKD rate and the intra-ERM rates for the ITL, NLG and ESP.

As noted already, a safe-haven effect means the world is not symmetric. Currency strength (as measured by yield) and currency market share, our next two plausible characteristics of a safe haven, are features that could induce asymmetry. Take the BEF and DEM for example. Both currencies were in the same band regime, the ERM, but the BEF was weaker than the DEM. In the career-risk hypothesis, an individual trader's attitudes are asymmetric as far as danger signs are concerned: they especially fear to be caught by a devaluation, because such a 'mistake' hurts their reputation more than profits from a revaluation would help it. But one currency's devaluation is another's revaluation, it could be argued; so an asymmetry in an individual's career risks is not enough to create an asymmetry in the risk premiums, unless there are other relevant asymmetries. Germany has more traders and more money to manage than Belgium, so the German point of view is likely to dominate in the market as a whole. This asymmetry in weight holds for all ERM members except possibly France. In addition, the DEM is more liquid than BEF, and the DEM was the reference point for the ERM system. In the language of ERM alignment, neither Germans nor Belgians would think of a devaluation of the BEF as a revaluation of the DEM, nor would a rise in the USD/HKD rate be called a revaluation of the USD.

The market share of currency could matter for other reasons than the number and wealth of its investors and analysts. The big market share associates with good liquidity and makes the currency familiar to all players. Recent psychological research has shown how mere familiarity can have a surprisingly large impact on valuation. *The Economist*,[9] describes an experiment, by Alter and Oppenheimer (2008), who exploit the co-existence of different versions of one currency, like familiar and unfamiliar USD bank notes. They conclude that "[p]eople, it seems, literally value familiarity. [...] With money, it seems, it is not familiarity, but unfamiliarity that

[9] April 3, 2008

breeds contempt." Size of the economy is also correlated with liquidity and currency-market share, two desirable features for a benchmark currency.

We address the asymmetry issue by running the regressions for various reference currencies chosen on the basis of currency strength and market share. The selected samples are introduced in the next section.

3 Empirical results

3.1 Sample Selection

We run the tests in seven samples. Three sets consist of the mainstream non-ERM currencies quoting different base currencies. The currencies are the Australian Dollar (AUD), Canadian Dollar (CAD), Swiss Franc (CHF), Pound Sterling (GBP), Hong Kong Dollar (HKD), Japanese Yen (JPY), New Zealand Dollar (NZD), Singapore Dollar (SGD) and U.S. Dollar (USD). The first floating-rate set are the rates for a half-strong base currency,[10] the USD, excluding the HKD, which is pegged to the USD. In the second and third sets, all the floating currencies are quoting a strong base, namely the JPY and CHF, respectively. The difference between the two samples obviously is that the Japanese economy is larger than the Swiss, so the JPY has more weight than the CHF in output and in world trade. Japan also has more wealth to manage, and the Yen's share in worldwide currency trading consistently dwarfs the Franc's share. In terms of familiarity, things are less clear. Japan's world brands are omnipresent and known to be Japanese. However, in international banking Switzerland has been very much more present than Japan, at least since the 1990s, and its reputation for financial safety is (or was) unparalleled.

The other four samples represent the fixed-rate regime. In the first such sample, the ERM rates in LS's work are re-expressed into quotes for the ITL. This sample has the twin characteristics of a weak base currency and a relatively small market share. In fact, the Lira was arguably the weakest currency within the European Monetary System and Italian traders do not dominate markets, whether in terms of numbers or amounts under management. Also, for the ITL, negative forward premiums were the rule rather than the exception. If the choice of the base currency matters because of the weight and strength of the currency, then in ITL terms there should be little or no safe haven patterns and little or no asymmetry even though

[10] A currency's relative strength vis-a-vis a base is assessed by the frequency of positive fs, see Appendix C.

this currency was part of a band regime.

The other two samples are the ERM rates quoted for the ESP and NLG. Both ESP and NLG have even smaller turnover shares than ITL. The ESP was almost as weak as the ITL, so this sample can provide a robustness test of the ITL sample. The NLG is the closest to being a clone of the DEM among the ERM members, apart from liquidity. Thus, the comparison between the ITL-ESP and DEM-NLG sets can help to disentangle the effect of currency strength from that of financial weight.

Lastly, we study the USD, quoted indirectly in HKD. The HKD is stronger than the USD in the sense that its interest rate was typically below the American one even though the strength is not as pronounced as for the DEM and the JPY. Another characteristic is that Hong Kong has a much smaller-scale economy than the U.S. Note that the study on USD/HKD provides us with a welcome additional case: even though the base currency (HKD) is doing better in terms of strength (*i.e.* forward premium), it is not a plausible candidate for the benchmark. Statistically, however, the HKD sample probably is the weakest in terms of power: being a one-series set rather than a panel, it has fewer observations and less variability on the right-hand side. We need to bear this in mind when interpreting the evidence.

All observations are weekly, and the forward quotes are for one-month contracts. We want comparable sample sizes (about 20 years), but the data from the ERM tautologically end in 1998, so they have to start earlier. Therefore, the sample period is from Apr. 2nd, 1979 to Dec. 31st, 1998 (1030 weeks) for the ERM currencies, and from Jan. 2nd, 1985 to Dec. 31st, 2006 (1148 weeks) for the floaters and the HKD.

3.2 Descriptive statistics on forward premia

Panel A of Table 3 presents some summary statistics on the exchange-rate changes and the forward premium for three illustrative sets of sample, those for the USD, the DEM, and the ITL. The first line shows the percentage of observations with positive forward premiums for the base currency or quoted currency (USD or DEM or ITL). From the perspective of the Unbiased Expectation Hypothesis (UEH), a positive forward premium f corresponds to an expected appreciation of the base currency or a depreciation of the quoting currency. Among the floating currencies, the AUD, CAD, GBP and NZD have far more than 50% positive fs for the USD, meaning that these quoting currencies were usually weak relative to the USD. In contrast, the CHF, JPY and SGD have much fewer positive fs for the USD, indicating that

Table 3: Descriptive statistics: currency strength, means, and standard deviations

Statistic Summary on $s_{t,\Delta}$ and $f_{t,\Delta}$

	Panel A: Floating Rates, quotes for USD							Peg Regime
	AUD	CAD	CHF	GBP	JPY	NZD	SGD	HKD
$\%_{f>0}$	83.9	68.6	20.7	87.7	13.9	89.6	10.8	40.0
$\frac{m(s_{t,\Delta})}{m(f_{t,\Delta})}$	0.00	-0.55	1.94	-0.11	1.32	-0.46	1.15	0.02
$\frac{\sigma(s_{t,\Delta})}{\sigma(f_{t,\Delta})}$	10.93	10.25	14.95	1.82	14.54	6.72	8.77	1.25
	Panel B: Semi-pegged Rates I, quotes for DEM							
	ATS	BEF	DKK	FRF	NLG	ITL	ESP	IEP
$\%_{f>0}$	68.5	81.2	98.3	89.9	57.2	99.8	93.2	99.6
$\frac{m(s_{t,\Delta})}{m(f_{t,\Delta})}$	-0.73	0.38	0.36	0.52	0.76	0.58	0.57	0.45
$\frac{\sigma(s_{t,\Delta})}{\sigma(f_{t,\Delta})}$	3.95	2.71	2.64	2.64	4.16	5.01	4.05	3.20
	Panel C: Semi-pegged Rates II, quotes for ITL							
	ATS	BEF	DKK	FRF	NLG	DEM	ESP	IEP
$\%_{f>0}$	0.4	3.7	11.8	4.0	0.3	0.2	52.4	18.0
$\frac{m(s_{t,\Delta})}{m(f_{t,\Delta})}$	0.66	0.72	0.88	0.66	0.58	0.58	0.41	0.79
$\frac{\sigma(s_{t,\Delta})}{\sigma(f_{t,\Delta})}$	5.30	6.85	5.92	7.76	5.18	5.01	5.22	4.31

Key: "$\%_{f>0}$" is the percentage of observations which have positive forward premiums for the base currency (USD or DEM or ITL); "$\frac{m(s_{t,\Delta})}{m(f_{t,\Delta})}$" denotes the ratio of averages of $s_{t,\Delta}$ and $f_{t,\Delta}$; and "$\frac{\sigma(s_{t,\Delta})}{\sigma(f_{t,\Delta})}$" is the ratio of the standard deviations of $s_{t,\Delta}$ and $f_{t,\Delta}$.

these quoting currencies were strong relative the USD. In the admissible-band regime group, intra-ERM currencies are all weaker against the DEM (where positive fs for the DEM are in the majority); but relative to the ITL the quoting currencies become the stronger group: only the ESP is close to the ITL in terms of strength, with a percentage of positive premiums for the ITL slightly exceeding 50. The HKD, lastly, is pegged to the USD, whose strength is neither as high as the DEM nor as low as the ITL. On the basis of f we would classify the HKD as mildly strong because the USD trades at a premium only 40% of the weeks.

In the rest of Table 3, some summary statistics on s and f are reported as ratios, providing a direct view on the relation between regressee and regressor. We first show $\frac{m(s_{t,\Delta})}{m(f_{t,\Delta})}$, the ratio of the means of s and f. This provides a first rough test of the unbiased-expectations view, which predicts that these ratios should be about unity. A glance at the table shows they are not. Interestingly, the usual carry-trade logic (with weak currencies falling less, and strong currencies similarly rising less, than their fs predict and *vice versa*) seems to have worked within the ERM but not so clearly for rates against the USD. Against the strong floating currencies (CHF, JPY and SGD), the dollar depreciated by more than its premium predicted, as shown by their ratios exceeding unity. Still, for weak floating currencies, the ratio was below unity or even negative, exactly as the carry-trade logic would predict. For the ERM, that logic would have worked too. All ratios are, in effect, below unity, meaning that the Deutsche Mark appreciated by less than its f predicted, and the Lira depreciated by less. Lastly, the ratio of the standard deviations of s and f is always above unity and turns out especially big under the floating regime.

We start our empirical work with the question whether our candidate benchmark currencies are 'merely' low-yield currencies, picking up the effects of the carry-trade cycle.

3.3 Main Tests: A Benchmark Risk Premium

LS (2009b) extend the original LS (2009a) to international samples using the same currency-by-currency methodology, but they find no patterns outside the ERM quotes for the DEM. In an attempt to gain power and obtain a clearer overall picture, we abandon currency-by-currency estimation and present aggregate estimates instead, which can be thought of as average estimates.[11] We present data estimated from one pooled equation per sample, via a panel with fixed country effects and common slopes.

Pooled estimation does provide more significant patterns than the equation-by-equation method. In fact, we often ran into the opposite problem, in the sense that, statistically, some nonlinearities are often quite convincing, while visual inspection shows they seem downright puny. Our procedure will be to filter by statistical significance in the first place; among the significant effects we will retain only the conclusions that do look important in practice on the basis of the visual evidence.

As there are many samples and regressors we first provide a roadmap to our findings. The general picture will be that LS's pattern, the inverse-U shaped beta for forward premium, are unusual to some extent: typically we need to drill down to the level of long- versus short-term decomposition of forward premium before we observe some similar patterns across sample sets. Specifically, for the long-term part of the forward premium we see inverse-U (*i.e.* safe-haven)

[11] One question that arises in this connection is the heterogeneity among the estimates of the individual series: pooled regressions are consistent with equation-by-equation estimates only if the coefficients are identical across equations. Our purpose, however, is to get some average pattern. According to Pesaran and Smith (1995), there are four procedures that can be used to estimate an average effect: the mean group estimator (estimating separate regressions for each group and averaging the coefficients across groups, as in LS), pooled regression, aggregate time-series regressions, and cross-section regressions on group means. In the static case, where the regressors are strictly exogenous and the coefficients differ randomly and are distributed independently of the regressors across groups, all four procedures provide a consistent and unbiased estimate of the coefficient means (Zellner, 1969).

patterns for the USD, representing a moderately strong currency from the ultimately dominant economy, and for all strong currencies from at least midsize economies, regardless of currency regime (CHF, JPY and DEM). Among the fixed-rate data, the reverse-U pattern of a benchmark currency is not observed if the base currency is weak (ITL and ESP), or has a small market share even though the currency is strong (NLG). This is quite plausible, so it tends to support the original LS approach.

Recall that the above is for the long-run trends in forward premiums. For the short-run components we observe no safe-haven effect, unlike LS (2009a). Instead, the dominant pattern is linear as suggested by Bansal (1997). For the sum of two components, *i.e.* the forward premium, we find that the disagreeing short- and long-term patterns provide a muddled overall picture: no clear net pattern is in the case of floating currencies; while for fixed-rate currencies the Bansal pattern from the short-run component dominates the total.

3.3.1 The link between expected return and the long-run forward-premium level

Table 4 presents the estimates for the long-run component in the forward premium. Panels A, B, and C are based on the results of the floating-currency groups quoting the USD, JPY and CHF, respectively; Panels D to G contains the results for the band-regime ERM rates re-expressed as quotes for the DEM, NLG, ITL and ESP, respectively; Panel H, lastly, also refers to a fixed-rate regime, the HKD/USD rate.

Figure 1 plots the betas of the samples under the floating regime, in terms of various regressors. The plots offer a more convenient way to judge the strength of the non-linearity, apart from its statistical significance, also give an impression about the level of the betas—for instance, whether $\beta(f)$ is typically positive. From top to bottom we show the betas of the floating-rate quotes for the USD, JPY and CHF, respectively. From left to right, the regressors are the long-run component $\widehat{f}$, the short-term or filtered component ff, and the total forward premium f, respectively. The shaded graphs refer to samples where the nonlinearity is insignificant. In the same manner, Figure 2 displays the beta patterns under the fixed regime: the ERM quotes for the DEM, NLG, ITL, ESP and the USD/HKD rate. In this section we focus on the leftmost graphs, depicting the link with the trend component in the forward premium.

For all the floating currency sets (in Panels A, B and C), β_2 for the long-term component $\hat{f}$ is positive and β_3 negative, and all of them are significant, indicating an inverse U-shape

Table 4: Estimates from the pooled regressions in terms of the trend components

$$\tilde{s}_{t+\Delta,i} = \alpha_i + \beta_1 \widehat{f}_{t,i} + \beta_2 \widehat{f}^2_{t,i} + \beta_3 \widehat{f}^3_{t,i}, \quad \beta(\widehat{f}_{t,i}) = \beta_1 + \beta_2 \widehat{f}_{t,i} + \beta_3 \widehat{f}^2_{t,i}.$$

Panel A: floating regime: weak base-currency and big economy(base: USD)

x		Common slopes			Fixed-effect intercepts						
	E[$\beta(x)$]	β_1	β_2	β_3	AUD	CAD	CHF	GBP	JPY	NZD	SGD
$\widehat{f}$	-1.217	***-1.346	***72.850	***-971.841	0.004	0.002	-0.004	0.003	-0.006	0.003	-0.002

Panel B: floating regime: strong base-currency and big economy (base: JPY)

x		Common slopes			Fixed-effect intercepts							
	E[$\beta(x)$]	β_1	β_2	β_3	AUD	CAD	CHF	GBP	HKD	NZD	SGD	USD
$\widehat{f}$	-2.079	***-2.771	***173.527	***-2431.238	0.005	0.002	-0.005	-0.003	0.000	0.003	-0.003	0.001

Panel C: floating regime: strong base-currency and small economy (base: CHF)

x		Common slopes			Fixed-effect intercepts							
	E[$\beta(x)$]	β_1	β_2	β_3	AUD	CAD	GBP	HKD	JPY	NZD	SGD	USD
$\widehat{f}$	-0.112	-0.232	**42.550	**-713.567	0.002	0.002	-0.006	0.002	-0.002	-0.000	0.000	0.002

Panel D: ERM rates: strong reference currency from a big economy (base: DEM)

x		Common slopes			Fixed-effect intercepts							
	E[$\beta(x)$]	β_1	β_2	β_3	ATS	BEF	DKK	FRF	NLG	ITL	ESP	IEP
$\widehat{f}$	0.012	-0.037	***136.353	*-6643.663	-0.000	0.000	-0.000	0.001	0.000	0.000	-0.000	-0.000

Panel E: ERM rates: strong reference currency from a small economy (base: NLG)

x		Common slopes			Fixed-effect intercepts							
	E[$\beta(x)$]	β_1	β_2	β_3	ATS	BEF	DKK	FRF	DEM	ITL	ESP	IEP
$\widehat{f}$	0.563	***0.553	26.238	559.812	-0.000	0.000	-0.000	0.000	0.001	-0.000	-0.001	-0.000

Panel F: fixed regime: weak reference currency and small economy (base: ITL)

x		Common slopes			Fixed-effect intercepts						
	E[$\beta(x)$]	β_1	β_2	β_3	ATS	BEF	DKK	FRF	NLG	ESP	IEP
$\widehat{f}$	-0.446	0.199	***399.168	***36098.95	-0.003	-0.001	0.000	0.001	-0.002	0.004	0.001

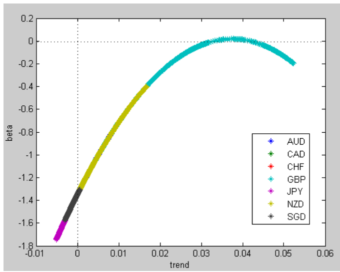
Panel G: ERM rates: weak reference currency from a small economy (base: ESP)

x		Common slopes			Fixed-effect intercepts							
	E[$\beta(x)$]	β_1	β_2	β_3	ATS	BEF	DKK	FRF	DEM	ITL	NLG	IEP
$\widehat{f}$	0.777	***1.279	**126.006	***5610.171	-0.000	-0.001	-0.000	0.000	0.000	-0.000	0.000	-0.000

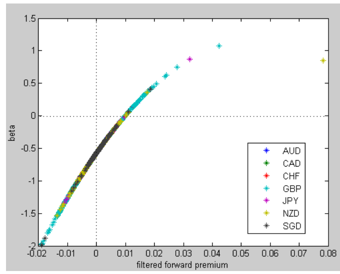
Panel H: fixed regime: strong reference currency from a small economy (base: HKD)

x		Slope		
	E[$\beta(x)$]	β_1	β_2	β_3
$\widehat{f}$	0.002	0.022	-63.956	-8590.054

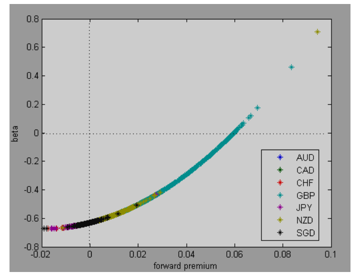
Figure 1: **Floating Regime: betas as a function of $\widehat{f}$, ff and f**



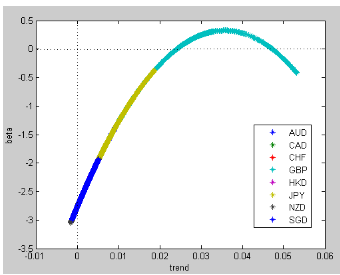
(a) regressor: $\widehat{f}$ (base: USD)



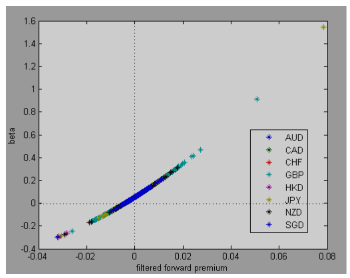
(b) regressor: ff (base: USD)



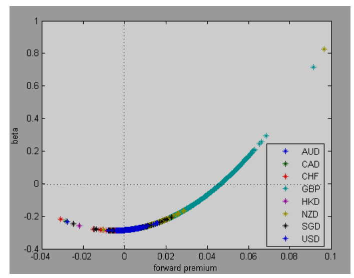
(c) regressor: f (base: USD)



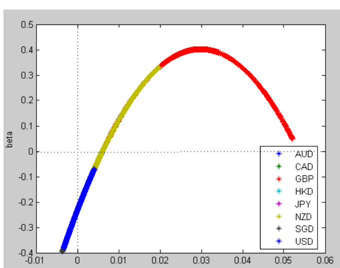
(d) regressor: $\widehat{f}$ (base: JPY)



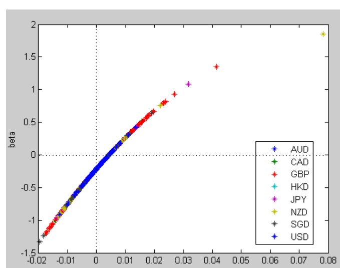
(e) regressor: ff (base: JPY)



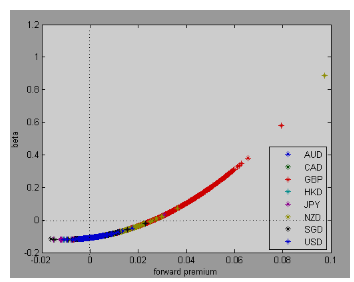
(f) regressor: f (base: JPY)



(g) regressor: $\widehat{f}$ (base: CHF)



(h) regressor: ff (base: CHF)

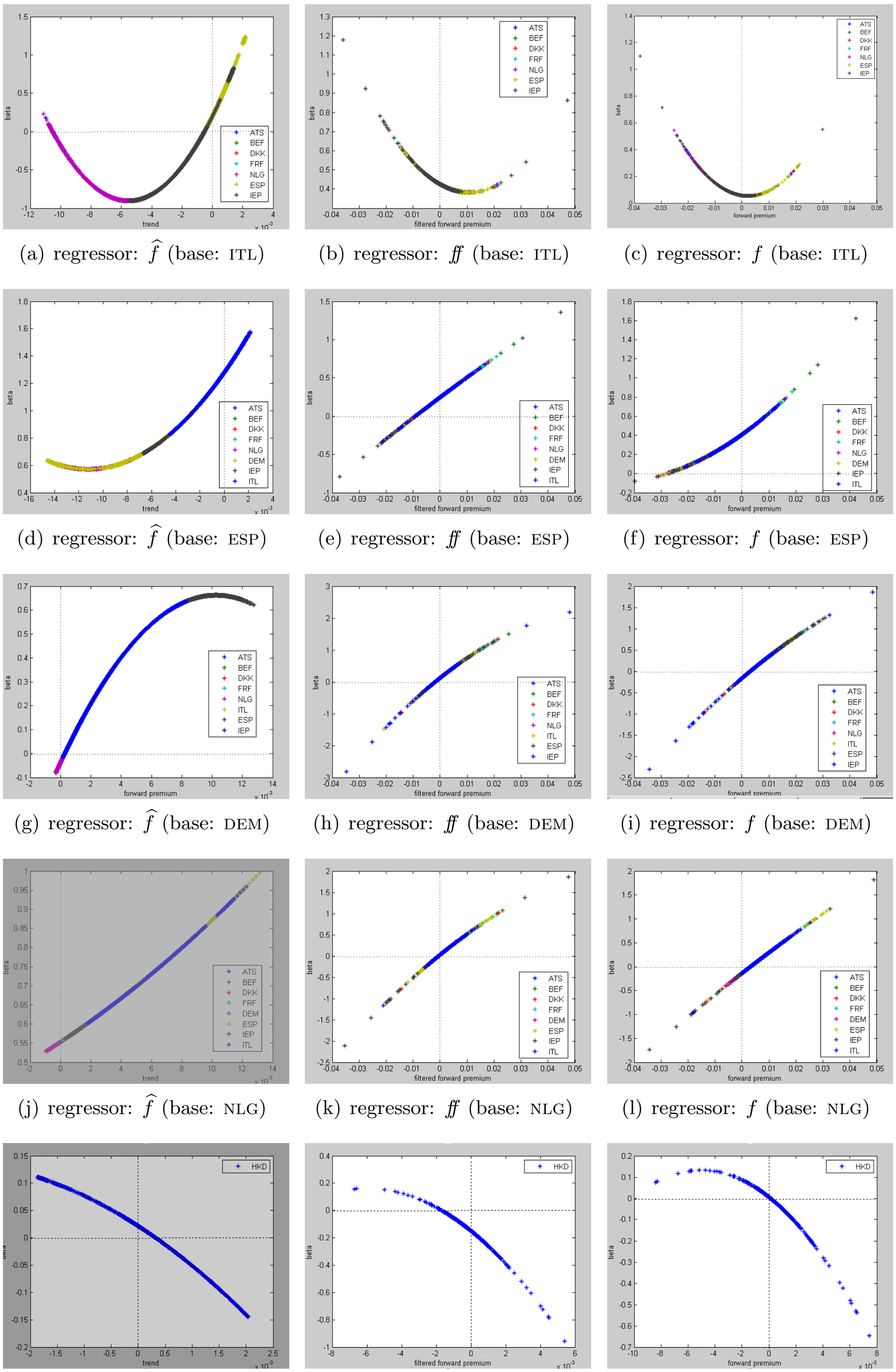


(i) regressor: f (base: CHF)

in the betas. This pattern is consistent with the work of LS, where the ERM rates for the DEM also show an inverse U. One conclusion definitely is that we do not need a band regime to see a safe haven pattern: an inverse-U pattern also shows when JPY and CHF, clearly very strong and also world-wide traded, work as the base currencies. Japan's economic weigtht and the traditionally safe reputation of Switzerland's financial institutions, combined with a good liquidity, make sense in the benchmark context. The USD, different from two currencies above, is of average strength only, but its dominant share in the FX markets seems to make up for its average performance in terms of forward premia. So it does seem to have benchmark status, all in all.

In the fixed-regime samples, the LS evidence of benchmarking, which is very much present in the DEM sample, disappears totally when the ITL is considered. Instead of exhibiting an inverse-U-pattern, the long-run trend of the ITL-set picks up a U-shaped pattern (*i.e.* $\beta_2 < 0$

Figure 2: **Fixed Regimes: betas as a function of $\widehat{f}$, ff and f**



(a) regressor: $\widehat{f}$ (base: ITL) (b) regressor: ff (base: ITL) (c) regressor: f (base: ITL)

(d) regressor: $\widehat{f}$ (base: ESP) (e) regressor: ff (base: ESP) (f) regressor: f (base: ESP)

(g) regressor: $\widehat{f}$ (base: DEM) (h) regressor: ff (base: DEM) (i) regressor: f (base: DEM)

(j) regressor: $\widehat{f}$ (base: NLG) (k) regressor: ff (base: NLG) (l) regressor: f (base: NLG)

(m) regressor: $\widehat{f}$ (base: HKD) (n) regressor: ff (base: HKD) (o) regressor: f (base: HKD) and $\beta_3 > 0$). This is in line with the equation-by-equation evidence and fits in with the transaction cost or limit-to-arbitrage theory. The same pattern emerges for the ESP, even though the U is more lopsided. The remaining cases, lastly, are the HKD- and NLG-sets, where in terms of the long-run component $\hat{f}$ no significant slope coefficients are found. NLG and HKD are strong or at least fairly strong currencies but they have no world-class financial visibility.

Generally speaking, then, the long-run forward premia tell us that for a currency to acquire benchmark status it needs to be from a huge economy and have at least moderate strength (the USD), or have good monetary strength and have at least midsize market shares (DEM, JPY, CHF). For a strong currency with small market share (NLG) we do not see the pattern, and similarly for a tiny share with only a moderately strong currency (HKD). Also in the cases of a mid-sized economy and a weak currency, as we see in the ITL and ESP cases, agents do not seem to pick the currency as a benchmark.

3.3.2 Results for the short-term component.

Table 5 presents the estimates for the short-run component in the forward premium. Panels A, B, and C are again based on the results of the floating-currency groups quoting the USD, JPY and CHF, respectively; Panels D to G refers to the band-regime ERM rates, the quotes for the DEM, NLG, ITL and ESP, respectively; Panel H, lastly, refers to the USD quote for the HKD. The relevant graphs are now the middle ones, row by row.

In terms of the filtered or short-term component there often is a discrepancy between the statistical and graphical evidence. In three cases (USD, DEM and NLG) the t-statistics show a significantly negative coefficient for the quadratic component in beta, indicating an inverse U. The graphical picture however tells us the effect is minimal. We prefer to err on the safe side and ignore the curvature of these betas. Only for the ITL we see a curvature in the beta that is both moderately significant and visually non-trivial. Interestingly, it follows the same limits-to-arbitrage pattern as its long-run counterpart. Again, there is no empirical trace of the notion that traders may regard exchange-rate changes against the Lira as potentially career-threatening. Rather, the agents seem to think of transaction costs.

The overall picture, then, is one where betas fall or rise linearly in the short-term component of the forward premium, in line with mainstream financial theory (Bansal). In terms of the safe haven argument, the conclusion is that short-term fluctuations of the forward premium around the long-run trend do not seem to affect the benchmark status (or lack thereof) of a

Table 5: Estimates from the pooled regressions in terms of the filtered components

$$\tilde{s}_{t+\Delta,i} = \alpha_i + \beta_1 ff_{t,i} + \beta_2 ff^2_{t,i} + \beta_3 ff^3_{t,i}, \quad \beta(ff) = \beta_1 + \beta_2 ff + \beta_3 ff^2.$$

Panel A: floating regime: weak base-currency and big economy (base: USD)

x		Common slopes			Fixed-effect intercepts							
	E[$\beta(x)$]	β_1	β_2	β_3	AUD	CAD	CHF	GBP	JPY	NZD	SGD	
ff	-0.574	***-0.570	***63.377	***-577.527	0.002	0.002	-0.001	-0.002	-0.001	0.000	0.001	

Panel B: floating regime: strong base-currency and big economy (base: JPY)

x		Common slopes			Fixed-effect intercepts							
	E[$\beta(x)$]	β_1	β_2	β_3	AUD	CAD	CHF	GBP	HKD	NZD	SGD	USD
ff	0.054	0.053	13.289	72.165	0.001	0.001	-0.002	-0.001	0.001	-0.001	-0.000	0.001

Panel C: floating regime: strong base-currency and small economy (base: CHF)

x		Common slopes			Fixed-effect intercepts							
	E[$\beta(x)$]	β_1	β_2	β_3	AUD	CAD	GBP	HKD	JPY	NZD	SGD	USD
ff	-0.215	-0.213	***50.859	-313.591	0.001	0.001	-0.002	0.001	-0.002	-0.001	-0.000	0.001

Panel D: ERM rates: strong reference currency from a big economy (base: DEM)

x		Common slopes			Fixed-effect intercepts							
	E[$\beta(x)$]	β_1	β_2	β_3	ATS	BEF	DKK	FRF	NLG	ITL	ESP	IEP
ff	-0.032	-0.049	***65.353	***-469.625	-0.001	-0.001	-0.000	-0.000	-0.001	0.002	0.002	-0.000

Panel E: ERM rates: strong reference currency from a small economy (base: NLG)

x		Common slopes			Fixed-effect intercepts							
	E[$\beta(x)$]	β_1	β_2	β_3	ATS	BEF	DKK	FRF	DEM	ITL	ESP	IEP
ff	0.030	0.031	***51.247	***-266.614	-0.001	-0.001	-0.000	0.000	-0.001	0.002	0.002	-0.000

Panel F: fixed regime: weak reference currency and small economy (base: ITL)

x		Common slopes			Fixed-effect intercepts							
	E[$\beta(x)$]	β_1	β_2	β_3	ATS	BEF	DKK	FRF	NLG	ESP	IEP	
ff	0.428	***0.425	-7.921	*364.648	-0.001	-0.000	-0.000	0.000	-0.001	0.002	0.000	

Panel G: ERM rates: weak reference currency from a small economy (base: ESP)

x		Common slopes			Fixed-effect intercepts							
	E[$\beta(x)$]	β_1	β_2	β_3	ATS	BEF	DKK	FRF	DEM	ITL	NLG	IEP
ff	0.246	***0.246	***26.465	-37.273	-0.001	-0.000	0.000	0.000	-0.001	0.002	-0.001	0.000

Panel H: fixed regime: strong reference currency from a small economy (base: HKD)

x		Slope			Fixed-effect intercepts
	E[$\beta(x)$]	β_1	β_2	β_3	
ff	-0.154	-0.148	***-102.884	-8532.932	

currency.

Lastly, we note that a second LS conclusion, regarding the short-term components as being better at picking up expectations, is not validated anywhere. Actually the mean betas $\mathrm{E}[\beta(\mathit{ff})]$ are more often smaller than $\mathrm{E}[\beta(\widehat{f})]$.

3.3.3 Test results for the total forward premium

Table 6 presents the estimates for the total forward premium. Panels A-C again refer to floating-currency groups; Panels D-G to the band-regime ERM rates, and Panel H to the USD quote for the HKD. The corresponding graphs in Figures 1 and 2 are those on the right.

From the betas in the left columns of the table, we find that the currency regime seems to act as a watershed to determine the presence or absence of nonlinearity: none of the three floater samples have significant β_2s or β_3s, but each fixed-regime set has at least one significantly higher-order slope, suggesting the presence of a nonlinearity. Thus, for floating currencies the clear safe haven effect that was present in the long-run part of f seems to have been largely blotted out by the different pattern in the short run, resulting in a muddled overall picture.

This seems to have been less of a problem in the band-regime series: in all samples the constant-beta model is clearly rejected even for the total forward premium. Statistically, there is an unambiguous curvature in the betas for the DEM and the ESP, but visually the effect is unimpressive. There is a decent U-shape for the ITL, perfectly in line with the results in both the short and the long run. Only for the HKD it is not obvious whether the statistically clear inverse-U-pattern means something in practice or not. This is also the only currency where there is more significance in the results for the total f than in those for the components.

A second observation is that the graphs for the total-f betas of the band-regime rates are very similar to those of the short-term components. Apart from the ITL, we see orthodox Bansal premiums. What exactly the economic link is between this phenomenon and the band regime is less clear.

4 Conclusion

The forward puzzle is traditionally explained as the reflection of a covariance-risk premium, market friction or limits to arbitrage. Recently, Liu and Sercu (2009a), working on intra-ERM rates for the DEM, presented evidence consistent with career-risk considerations (portfolio

Table 6: Estimates from the pooled regressions in terms of total forward premiums

$$\tilde{s}_{t+\Delta,i} = \alpha_i + \beta_1 f_{t,i} + \beta_2 f_{t,i}^2 + \beta_3 f_{t,i}^3, \quad \beta(f) = \beta_1 + \beta_2 f_t + \beta_3 f_t^2.$$

Panel A: floating regime: weak reference currency from a big economy

	Common slopes			Fixed-effect intercepts							
Base	β_1	β_2	β_3	AUD	CAD	CHF	GBP	JPY	NZD	SGD	
USD	***-0.631	4.244	105.600	0.002	0.001	-0.003	0.005	-0.004	0.001	-0.002	

Panel B: floating regime: strong reference currency from a big economy

	Common slopes			Fixed-effect intercepts							
Base	β_1	β_2	β_3	AUD	CAD	CHF	GBP	HKD	NZD	SGD	USD
JPY	-0.286	1.060	108.137	0.002	0.001	-0.003	0.000	0.001	-0.000	-0.001	0.001

Panel C: floating regime: strong base-currency and small economy

	Common slopes			Fixed-effect intercepts							
Base	β_1	β_2	β_3	AUD	CAD	GBP	HKD	JPY	NZD	SGD	USD
CHF	-0.109	1.895	85.373	0.002	0.001	-0.003	0.001	-0.002	-0.000	-0.000	0.001

Panel D: ERM rates: strong reference currency from a big economy

	Common slopes			Fixed-effect intercepts							
Base	β_1	β_2	β_3	ATS	BEF	DKK	FRF	NLG	ITL	ESP	IEP
DEM	***-0.163	***53.948	**-253.522	-0.001	-0.000	-0.000	0.000	-0.001	0.001	0.001	-0.000

Panel E: ERM rates: strong reference currency from a small economy

	Common slopes			Fixed-effect intercepts							
Base	β_1	β_2	β_3	ATS	BEF	DKK	FRF	DEM	ITL	ESP	IEP
NLG	***-0.137	***44.012	-82.952	-0.001	-0.000	-0.000	0.000	-0.001	0.001	0.001	-0.000

Panel F: ERM rates: weak reference currency from a small economy

	Common slopes			Fixed-effect intercepts							
Base	β_1	β_2	β_3	ATS	BEF	DKK	FRF	NLG	ESP	IEP	
ITL	0.056	-2.868	***651.991	-0.001	-0.001	-0.000	0.000	-0.001	0.002	0.000	

Panel G: ERM rates: weak reference currency from a small economy

	Common slopes			Fixed-effect intercepts							
Base	β_1	β_2	β_3	ATS	BEF	DKK	FRF	DEM	ITL	NLG	IEP
ESP	***0.408	***20.258	**201.246	-0.001	-0.000	-0.000	0.000	-0.001	0.001	-0.000	-0.000

Panel H: fixed regime: strong reference currency and small economy

	Slope		
Base	β_1	β_2	β_3
HKD	0.000	***-50.405	**-5032.786

Key: We run the pooled regression, and "Base" indicates the reference currency of the panel.

managers shun assets with danger signals, including negative forward premia), or with investors who assign fallen-angel status to such assets. In this paper, we test the external validity of this finding. If in the ERM the DEM acts as the safe haven when traders flee for safety, the LS patterns should be present also in other currencies that are regarded as icons of security, and absent in currencies that miss all a priori requirements for benchmark status. Therefore, we compare floating rates to band regimes, strong base currencies to weak ones, and large market shares to small ones. We find that the exchange-rate regime seems to matter the least. Instead, a benchmark role can come from either a huge market share (the U.S.), a strong currency with a financial-sector reputation exceeding the size of its market share (Switzerland), or good ratings on both counts (Japan and Germany). Consistent with the idea that these are slow-moving reputational effects, the evidence is especially present in the long-run-trend component of the forward premium. In the short-run, filtered part, other factors seem to be at work, mostly Bansal risk premiums. In the case of floating rates, these Bansal effects seem to blot out the long-run effects, resulting in unclear overall effects; but for floating rates the net effect is dominated by the short-term component. The general conclusions are that the LS findings for the intra-ERM rates against the DEM do seem to reflect benchmark status, or, stated differently, that benchmark-related patterns in the forward puzzle seem to be present in many more rates than those studied in LS.

The regularity we document is different from the safe-harbor effect in the carry-trade literature. First, ours is more behavioral or microstructural in nature, not covariance-risk based. Second, ours is a much more long-term phenomenon: it is related to the slow-moving component of the forward premium (itself already long-memory variable) and is documented in monthly data rather than the higher-frequency figures studied in much of the carry-trade literature. Third, safe havens are different from the funding currencies in the carry trade, in that a low interest rate is not sufficient to make a benchmark, and the market share is also a considerable condition. In fact, the statistical behavior of the low-yield and the safe-haven group is quite different.

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Appendix: Monte-Carlo Standard Deviations

The remaining issue is the reliability (SE) of the estimations. There are two complications. First, the forward premium is non-stationary or nearly so. Second, following Hansen and Hodrick (1980) we do not want to waste information by considering only non-overlapping forward contracts, so we use weekly observations on one-month forward contracts. For either reason, the conventional standard deviation is underestimated. The standard deviations can be calculated following the OLS, the Monte Carlo Simulation (MCS) and Hansen-Hodrick (HH) methods. Obviously, the OLS is not appropriate for the overlapping data, while both OLS and HH are also questionable when the forward premiums are non-stationary. So Monte Carlo Simulation (MCS) is employed to calculate the standard deviations of this paper.

We proceed as follows. Firstly, the variables on both sides of the Fama regression are expressed in their Autoregressive (AR) form,

$$s_{j,t} = \alpha_1 + \beta_1 s_{j,t-1} + \beta_2 s_{j,t-2} + ... + \beta_6 s_{j,t-my} + \nu_{j,t}, \tag{0.3}$$

$$f_{j,t} = \alpha_2 + \theta_1 f_{j,t-1} + \theta_2 f_{j,t-2} + ... + \theta_6 f_{j,t-mx} + \xi_{j,t}. \tag{0.4}$$

where the my and mx are the optimal orders of the AR(p) for the exchange rate change $s_{j,t}$ and the forward premium $f_{j,t}$. Secondly, we randomly generate the residuals ν and ξ and add them to the fitted values of the AR(my) or AR(mx) to construct new $\delta s_{j,t}$ and $f_{j,t}$, Thirdly, the cubic models are run on the new data and after 1000 times iterations there are distributions for the t-statistics of the coefficients. Lastly, we can tell the significant levels of the coefficients by checking in which intervals the t-statistics of the actual data fall, relative to the experimental distribution.

However, the residuals ν and ξ turned out non-normally distributed. Edward and John (1979) provide a technique for a non-normal distribution number generator. This technique accommodates a broad class of distributions because it transforms a uniform random number into distribution with any desired set of values for the first four statistical moments (mean, variance, skewness and kurtosis). These four moments, denoted below as μ_1, μ_2, μ_3 and μ_4, are functions of four parameters $\lambda_1, \lambda_2, \lambda_3$ and λ_4, as described in the following equations:

$$\mu_1 = \lambda_1 + \frac{A}{\lambda_2}, \tag{0.5}$$

$$\mu_2 = \frac{B - A^2}{\lambda_2^2}, \tag{0.6}$$

$$\mu_3 = \frac{C - 3AB + 2A^3}{\lambda_2^3}, \tag{0.7}$$

$$\mu_4 = \frac{D - 4AC + 6A^2B - 3A^4}{\lambda_2^4}. \tag{0.8}$$

In these equations, the terms A, B, C and D are also functions of $\lambda_1, \lambda_2, \lambda_3$ and λ_4:

$$A = \frac{1}{1+\lambda_3} - \frac{1}{1+\lambda_4}, \tag{0.9}$$

$$B = \frac{1}{1+2\lambda_3} + \frac{1}{1+2\lambda_4} - 2\,\mathcal{B}(1+\lambda_3, 1+\lambda_4), \tag{0.10}$$

$$C = \frac{1}{1+3\lambda_3} - \frac{1}{1+3\lambda_4} - 3\,\mathcal{B}(1+2\lambda_3, 1+\lambda_4) + 3\,\mathcal{B}(1+\lambda_3, 1+2\lambda_4), \tag{0.11}$$

$$D = \frac{1}{1+4\lambda_3} + \frac{1}{1+4\lambda_4} - 4\,\mathcal{B}(1+3\lambda_3, 1+\lambda_4) + 6\,\mathcal{B}(1+2\lambda_3, 1+2\lambda_4) - 4\,\mathcal{B}(1+\lambda_3, 1+3\lambda_4), \tag{0.12}$$

where $\mathcal{B}(u, v)$ is the beta function. To generate the residuals we estimate their first four moments and we numerically solve for the corresponding values of the λ's. The desired non-normal random number $\tilde{R}$ is the following transformation of a unit uniform random number $\tilde{p}$:

$$R(\tilde{p}; \lambda) = \lambda_1 + \frac{\tilde{p}^{\lambda_3} - (1-\tilde{p})^{\lambda_4}}{\lambda_2}. \tag{0.13}$$

A Data on exchange-rate strength

Table 7: Currency Strength, Measured by Frequency of Positive Forward Premiums

Floating Regimes: $\%_{f>0}$

Base								
	AUD	CAD	CHF	GBP	USD	NZD	SGD	HKD
JPY	98.3	97.6	80.7	95.5	85.7	98.9	74.2	81.2
	AUD	CAD	JPY	GBP	USD	NZD	SGD	HKD
CHF	91.2	89.7	19.3	93.9	78.7	92.8	58.8	73.2
	AUD	CAD	CHF	GBP	JPY	NZD	SGD	
USD	83.9	68.6	20.7	87.7	13.9	89.6	10.8	

Band Regimes: $\%_{f>0}$

	ATS	BEF	DKK	FRF	NLG	ITL	ESP	IEP
DEM	68.5	81.2	98.3	89.9	57.2	99.8	93.2	99.6
	USD							
HKD	40.0							
	ATS	BEF	DKK	FRF	NLG	DEM	ESP	IEP
ITL	0.4	3.7	11.8	4.0	0.3	0.2	52.4	18.0
	ATS	BEF	DKK	FRF	DEM	ESP	IEP	ITL
NLG	53.7	88.1	97.8	95.8	38.3	99.7	96.0	99.7
	ATS	BEF	DKK	FRF	DEM	NLG	IEP	ITL
ESP	0.6	5.0	9.3	6.6	0.3	0.2	21.3	47.6

Key: "$\%_{f>0}$" is the percentage of observations which have positive forward premiums for the base currency (USD or DEM or ITL).