International Finance

Exchange Rate Predictability and Currency Risk Premia

Main issues

- Can we predict exchange rates?
- The Unbiased Expectations Hypothesis (UEH)
- Uncovered Interest Rate Parity (UIP)
- Empirical evidence: the Fama regression
- The exchange rate disconnect puzzle
- Cross-section of currency returns: carry, dollar, and momentum

What do we know so far?

- Nominal exchange rates are volatile.
- Price changes at home and abroad do not offset changes in the nominal exchange rate (PPP fails).
- Hence, there is **real exchange rate risk**.
- CIP holds: the forward rate is pinned by interest rate differentials.
- The forward rate is the **certainty equivalent** of the future spot rate.

But does the forward rate equal the *expected* future spot rate?

Are exchange rates predictable?

If exchange rates are predictable $\Rightarrow$ risk may be manageable.

If exchange rates are *not* predictable $\Rightarrow$ firms must hedge.

General forecasting regression:

$$\ln\left(\frac{S_{t+1}}{S_t}\right) = f(X_t) + u_{t+1}$$

where X_t is a vector of forecasting variables.

Random walk benchmark: $E_t[S_{t+1}] = S_t$

The random walk is the model to beat — both in-sample and out-of-sample.

Classification of tests

- **Weak form:** Use past exchange rates to forecast future rates
- **Semi-strong form:** Use all publicly available information (including past rates)
- **Strong form:** Use public *and* private information

We will work through each of these.

Can past exchange rates predict future exchange rates?

First-order autocorrelation model:

$$\ln\left(\frac{S_{t+1}}{S_t}\right) = a + b \cdot \ln\left(\frac{S_t}{S_{t-1}}\right) + u_{t+1}$$

Higher-order model:

$$\ln\left(\frac{S_{t+1}}{S_t}\right) = a + b_1 \ln\left(\frac{S_t}{S_{t-1}}\right) + \cdots + b_k \ln\left(\frac{S_{t-k+1}}{S_{t-k}}\right) + u_{t+1}$$

While there is some predictability in-sample, statistical models **do not consistently beat the random walk** out of sample.

UEH: definition

The **Unbiased Expectations Hypothesis (UEH)** conjectures that the forward rate equals the expected future spot rate:

$$E_t[\tilde{S}_{t+1}] = F_{t,t+1}$$

This would mean the forward rate is the best forecast of the future spot rate.

When does UEH hold?

The UEH would hold if:

- There is no uncertainty (trivially), or
- All investors are risk neutral, or
- All exchange rate risk is completely diversifiable

If investors are risk averse and FX risk is systematic, UEH fails because the forward rate embeds a **risk premium**.

Testing UEH: two problems

We want to test $E_t[\tilde{S}_{t+1}] = F_{t,t+1}$, but:

Problem 1: Expectations are unobservable.

- We can only observe the *realized* value S_{t+1}
- In an efficient market: $S_{t+1} = E_t[\tilde{S}_{t+1}] + \text{error}_{t+1}$
- So: $S_{t+1} = F_{t,t+1} + \text{error}_{t+1}$, where the error is unpredictable

Problem 2: Non-stationarity.

- Spot and forward rates do not have well-defined unconditional means
- Solution: work in *changes* rather than *levels*

The UEH test regression

In percentage changes:

$$\frac{S_{t+1} - S_t}{S_t} = a + b \cdot \frac{F_{t,t+1} - S_t}{S_t} + \text{error}_{t+1}$$

Or equivalently in logs:

$$\ln\left(\frac{S_{t+1}}{S_t}\right) = a + b \cdot \ln\left(\frac{F_{t,t+1}}{S_t}\right) + \text{error}_{t+1}$$

Under UEH: $a = 0$ and $b = 1$.

The forward premium should be an unbiased predictor of the future spot change.

Connection to interest rates

From CIP (Lecture 4):

$$\ln\left(\frac{F_{t,t+1}}{S_t}\right) \approx r_t - r_t^*$$

The forward premium equals the interest rate differential.

So the UEH regression is also a test of whether interest rate differentials predict exchange rate changes.

This leads directly to Uncovered Interest Rate Parity.

UIP = CIP + UEH

Combining CIP with UEH yields Uncovered Interest Rate Parity:

$$E_t\left[\frac{\tilde{S}_{t+1}}{S_t}\right] = \frac{1 + r_{t,t+1}}{1 + r^*_{t,t+1}}$$

What UIP says: High interest rate currencies should **depreciate** to offset the interest rate advantage.

If UK rates are 2% higher than US rates, UIP predicts GBP will depreciate by approximately 2% against USD — so that investing in either currency earns the same expected return.

The Fama regression

The standard test of UIP is the **Fama (1984) regression:**

$$\Delta s_{t \to t+k} = a + b \cdot (f_t - s_t) + \varepsilon_{t+k}$$

where $\Delta s = \ln(S_{t+k}/S_t)$ and $f_t - s_t = \ln(F_{t,t+k}/S_t) \approx r_t - r_t^*$.

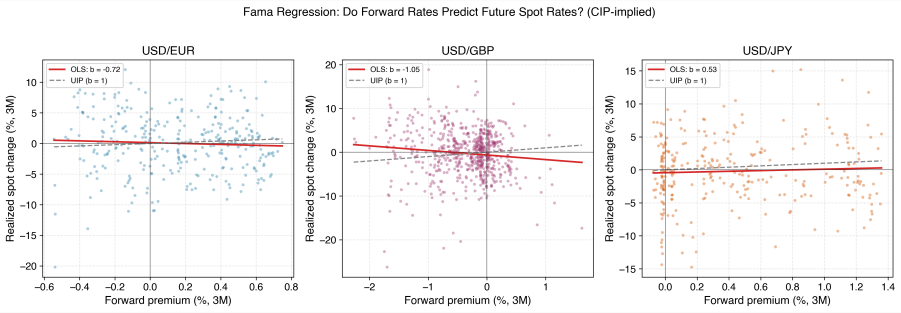
Under UIP: $a = 0, b = 1$.

This is the most important empirical test in international finance.

The evidence

	β_0	β_1	t-Statistic	R^2	Sample
Canada	0.000	−0.632	−3.331	0.004	76:01–08:01
	(0.001)	(0.490)			
France	0.000	0.091	−1.288	0.000	76:01–98:12
	(0.003)	(0.706)			
Germany	0.003	−0.657	−1.992	0.003	76:01–98:12
	(0.002)	(0.832)			
Italy	−0.001	0.196	−2.072	0.001	76:01–98:12
	(0.003)	(0.388)			
Japan	0.010	−2.400	−5.097	0.026	78:06–08:01
	(0.003)	(0.667)			
Switzerland	0.007	−1.408	−3.495	0.014	76:01–08:01
	(0.003)	(0.689)			
United Kingdom	−0.002	−1.533	−2.945	0.014	76:01–08:01
	(0.002)	(0.860)			
Europe	0.005	−4.334	−3.223	0.048	98:12–08:01
	(0.002)	(1.655)			

Fama regression: our data



Monthly data, 3M horizon. Source: FRED (OECD 3M interbank rates, daily spot rates).

Fama regression: results

Fama Regression: $\Delta s_{t \to t+3} = a + b \cdot (f_t - s_t) + \varepsilon_{t+3}$
Monthly data, 3M horizon, Newey-West HAC s.e. — (CIP-implied)

Currency Pair	$\hat{a}$	$t(\hat{a})$	$\hat{b}$	$t(\hat{b})$	R^2	N
USD/EUR	0.0014	(0.25)	-0.725	(-0.50)	0.0026	322
USD/GBP	-0.0064	(-1.73)	-1.048	(-1.33)	0.0121	658
USD/JPY	-0.0043	(-0.64)	0.535	(0.53)	0.0023	283
UIP prediction	0		1			

What does $b < 0$ mean?

UIP predicts $b = 1$: high interest rate currencies depreciate.

The data show $b < 0$: high interest rate currencies tend to **appreciate**.

The forward premium predicts the **wrong direction** of spot rate changes.

Implication: An investor who borrows in low-rate currencies and invests in high-rate currencies earns positive excess returns on average. This is the **carry trade** — and it works precisely because UIP fails.

Why is b negative?

Three leading explanations:

1. **Risk premium** — investors require compensation for bearing FX risk. The forward rate embeds a risk premium: $F_t = E_t[\tilde{S}_{t+1}] + \text{risk premium}$
2. **Errors in forming expectations** — market participants systematically misforecast future exchange rates (behavioral explanation)
3. **Peso problems** — rare but large events (currency crashes, regime changes) that are rationally anticipated but haven't occurred in the sample

Key insight for the course

UIP failure implies **FX risk premia exist**.

This has implications for all three firm decisions:

- **Risk management (Decision 1):** When a firm hedges with forwards, it pays or receives these risk premia. Hedging is not "free."
- **Financing (Decision 2):** Borrowing in a low-rate currency and swapping is not equivalent to borrowing in a high-rate currency — risk premia create a wedge.
- **Investment (Decision 3):** The cost of capital for international projects must account for currency risk premia.

Preview: Full treatment of risk premia in Lecture 7 (ICAPM and carry trade).

Forecasting with macroeconomic variables

Several theories relate exchange rates to macroeconomic fundamentals:

- Purchasing Power Parity (covered in Lecture 3)
- Balance of payments models
- Monetary models
- Real business cycle models
- Portfolio balance models

These are covered in international macroeconomics. For this course, the key question is: **do they forecast?**

The exchange rate disconnect puzzle

Empirical evidence:

- Correlations between exchange rate changes and fundamentals are **low**
- Regression coefficients are **insignificant**
- R^2 values are **near zero**

Exchange rates appear **disconnected** from observable macroeconomic variables in the short run.

This is one of the major puzzles in international finance (Meese and Rogoff, 1983): macroeconomic models cannot beat the random walk in out-of-sample forecasting.

Forecasting record of professionals

Technical forecasters:

- Have a somewhat better record than fundamental models
- But performance is not persistent: the best forecasters this year are not the best next year

Fundamental forecasters:

- May predict the *direction* ($S_{t+1} > F_t$ or $S_{t+1} < F_t$) slightly better than chance
- But no service consistently outperforms

Central banks:

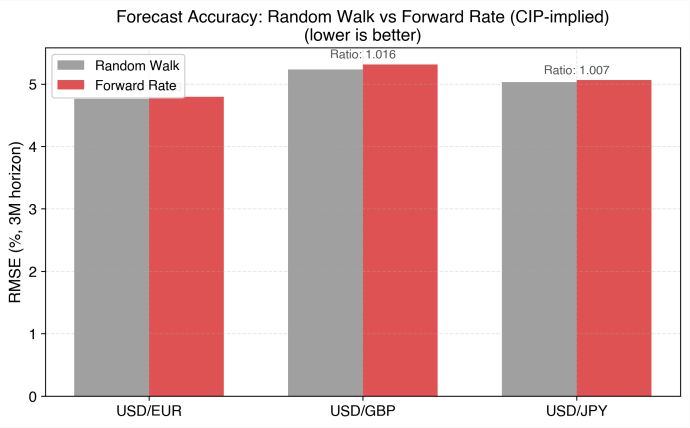
Private information: order flow

Order flow = net of buyer-initiated minus seller-initiated orders

- Dealers who observe order flow can predict **short-term** (daily) movements
- Order flow and exchange rates are strongly positively correlated: prices rise with buying pressure
- But order flow has **no predictive power** for medium and long-term horizons

Private information helps at very short horizons but does not resolve the broader predictability puzzle.

The random walk is hard to beat



3M forecast horizon. Ratio < 1 means the forward rate beats the random walk.

Summary of predictability

- **Weak form (past prices):** Some short-run autocorrelation, but does not beat random walk out of sample.
- **Semi-strong form (public information):** Macroeconomic models fail to beat random walk. Forward rates predict the wrong direction. Exchange rate disconnect puzzle.
- **Strong form (private information):** Order flow predicts daily movements only.

Bottom line: Exchange rates are essentially unpredictable at short and medium horizons. The random walk is very hard to beat.

This is why FX risk matters for firms.

Currency returns have structure

Even though *individual* exchange rates are hard to predict, **portfolios** of currencies sorted by observable characteristics earn systematic returns:

- **Carry factor:** Long high-interest-rate currencies, short low-interest-rate currencies. Positive average return but negative skewness (crash risk).
- **Dollar factor:** Average return of all currencies vs. USD. Captures global risk appetite — goes up when the dollar weakens.
- **Momentum factor:** Currencies that appreciated recently tend to continue appreciating.

Why the cross-section matters

These factors tell us that **UIP failure is not random** — it has structure:

- High-rate currencies earn positive excess returns (carry) because they expose investors to **crash risk**
- The dollar factor captures the price of **global risk**

Lustig, Roussanov, and Verdelhan (2011): high interest rate currencies load on a global risk factor. Carry returns are compensation for bearing systematic risk, not anomalies.

Preview: Full treatment of these factors and their implications for the cost of capital in Lecture 7.

Connection to firm decisions

FX risk premia are embedded in forward rates.

When a firm hedges:

- If it sells high-carry currencies forward, it earns the carry premium (gives up crash risk)
- If it buys high-carry currencies forward, it pays the carry premium

A firm with natural long exposure to high-carry currencies is effectively short crash risk — whether it realizes it or not.

Understanding the cross-section of currency returns is necessary for all three firm decisions: hedging, financing, and investment/discount rates.

Summary

- PPP fails $\Rightarrow$ real FX risk exists (Lecture 3)
- CIP holds $\Rightarrow$ forward rate = certainty equivalent (Lecture 4)
- **UEH/UIP fail** $\Rightarrow$ forward rate $\neq$ expected spot; **risk premia exist**
- Exchange rates are essentially **unpredictable** at short horizons
- The random walk is very hard to beat (exchange rate disconnect puzzle)
- Currency returns have **cross-sectional structure** (carry, dollar, momentum)

Investors and firms should worry about exchange rate risk.