Last lecture we discussed Global Investing. 
- Global Markets;
- Global Risk Factors;
- Assessing Global Risks;
- Quantifying Global Risks; and,
- Differing Levels of Development.

Today we will talk about foreign exchange.
Foreign Exchange

Chapter 18, A Quantitative Primer on Investments with R
This part discusses foreign exchange. In particular, we will discuss:

- Global Currencies;
- Currency Risk;
- Interest Rate Parity;
- Purchasing Power Parity and Other Models;
- Growth Implications; and,
- Current Issues.
Currency Codes

- Even more than countries, we need a shorthand for currencies.
  - ¥? JPY? CNY? Not TWD or HKD... except spoken.\(^2\)

- ISO code = country code + currency character... mostly:
  - EUR, CAD, AUD, NZD, HKD, MOP, CNY, JPY, INR, IDR.

\(^2\)中文与普通话或粤语不一样。
Global Currencies

- A few issues, conventions we need to know for FX.
- Most currencies *freely convertible*; some subject to *capital controls*.
- Some currencies are also *pegged* to others.
- Quoting convention of Base/Quoting: counterintuitive.
  - ABC/DEF = \( x \): 1 unit of ABC is \( x \) units of DEF; 1 : \( x \).
  - ABC/DEF \( \approx \frac{1}{\text{DEF/ABC}} \) (due to transaction costs)
- Preferred base: EUR, then GBP, AUD, NZD, USD, CAD, CHF.
  - Quote JPY as USD/JPY; GBP, EUR as GBP/USD, EUR/USD.
- “Long” = long base currency (and so short quoting currency).
Market Size

FX: biggest market in the world; never sleeps.

Q_{36}
How do we handle these risks? Ideally, we hedge:

- Find instruments matching those risks; trade to counter risk.
- Trade FX futures to (roughly) lock in exchange rates.
- Buy volatility, out-of-the-money puts in case of political issues.

Should also hire analysts who understand local language/culture.

Analysts can also help parse differences in financial reporting.

Diversify: don’t put too much of your portfolio in one country.
Handling Risks: Example

- Suppose I am going to invest USD 30 mn in the Euro Stoxx 50.
- To hedge my Euro exposure, I can lock in the reconversion to USD.
- When I sell stocks, will sell EUR and buy USD; so: short EUR.
- Sell USD 30 mn = EUR 25.5 mn $\Rightarrow 204$ CME 6E futures.
- If EUR ↑, less USD per EUR:
  - Unhedged: I might lose even though index is up.
  - Hedged: futures decline; short position accrues a profit.
- If I sell at a value $>$ $30$ mn, I am unhedged on the gains.
- Could also be over-hedged (equally bad) if we have losses.
- Thus we adjust the FX hedge day-by-day.
Investment opportunities in a country drive FX rates.
In particular, interest rates are a strong driver of FX rates.
Will see two such models: uncovered, covered interest rate parity.
Will also look at purchasing power parity.
And then consider some other drivers.
If we know interest, FX rates: should not be easy money.

This is the idea behind *uncovered interest rate parity*:
- Interest rate differences imply expected FX rate change.
- If $r_{\tau, \text{USD}}$ = USD risk-free rate over $t$ to $t + \tau$:

\[
1 + r_{\tau, \text{USD}} \text{ should } \frac{E(X_{t+\tau, \text{EUR}/\text{USD}})}{X_{t, \text{EUR}/\text{USD}}} (1 + r_{\tau, \text{EUR}}) \quad (1)
\]

\[
\implies \hat{X}_{t+\tau, \text{EUR}/\text{USD}} = \frac{1 + r_{\tau, \text{USD}}}{1 + r_{\tau, \text{EUR}}} X_{t, \text{EUR}/\text{USD}}, \text{ or } \quad (2)
\]

\[
\% \Delta \hat{X}_{t+\tau, \text{EUR}/\text{USD}} \approx r_{\tau, \text{USD}} - r_{\tau, \text{EUR}}. \quad (3)
\]

- If $r_{\tau, \text{USD}} = 4\%$, $r_{\tau, \text{EUR}} = 3\%$: expect EUR/USD ↑ 1\%.
Beautiful theory! There’s just one problem…

Yet again: it’s those ugly facts.

*Forward premium puzzle:*
  - Currencies of high-interest rate economies should depreciate.
  - However, they often appreciate. Why? Not clear.

This has led to *carry trades:*
  - Borrow in low-interest rate economies…
  - …invest in high-interest rate economies.

⚠️ *Aviso! Is this a Peso Problem? YES.*
Interest Rate Parity: Covered

- What if we could lock in future FX rates?
- There should not be easy money; else, we can arbitrage.
- This is the idea behind covered interest rate parity:
- If we know the later FX rate $X_{t+\tau}, USD/EUR$:

$$
X_{t,EUR/USD}(1 + r_{\tau,USD}) \overset{\text{should}}{=} (1 + r_{\tau,EUR})X_{t+\tau,EUR/USD}.
$$

- FX rates should compensate for different interest rates.
- If relationship doesn’t hold, carry trade: lock in profit.
  - If $r_{\tau,USD} = 4\%, \ r_{\tau,EUR} = 3\%$: $X_t = X_{t+\tau} = 1$.
  - Borrow EUR @ 3\%, EUR→USD, lock in USD→EUR at time $\tau$.
  - Invest USD @ 4\%. End: USD→EUR, repay loan.
  - PROFIT!
Suppose we can lock in future FX rates and see an arbitrage.
This should be easy money; fire up the money machine!
Makin’ cash! Amirite?!? U jelly bro? Well... hold on.
The truth is that even with hedging we could end up unhappy.
What if the bank we invest in fails?
What if the money is stolen through fraud?
What if the country limits conversions out of their currency?
Why would banks offer an arbitrage if they were healthy?
Consider people who put money in Icelandic banks:

- 2003 Iceland: 290k people, $9.7 bn GDP (≈$39k).
- Pre-2008: banks expanded with easy loans from Eurobonds.
- Meanwhile, rates in Europe in 4%–6% range, US in crisis.

Icelandic banks court investors through online banking.
Money flows into ISK; huge bank deposits.

Banks: more money than borrowers need... so lend foolishly.

- 2007 Iceland: 312k people, $21 bn GDP (= $69k).
- 2007–2008 Icelandic inflation of 14% ≫ target of 2.5%.

Sep 2008: Central bank raises rates to 15+ % to stem inflation.

Banks are unable to replace old debt w/new debt; begin failing.

Depositors lose money; Iceland limits conversions out of ISK.

Government fell; bank executives imprisoned.

Capital controls not removed until 2017!
Money is not useful *per se*; useful for what it can buy.

Often measure purchasing power with a *basket* of goods.

Adjusting for costs of goods: *purchasing power parity* (PPP).

In the US, we usually adjust based on CPI.

One of the more effective, unusual indices: *Big Mac Index*.

  - Reason: Big Mac is common, unchanging basket of goods + services.
Two ideas about FX rates and PPP: absolute and relative.

Absolute: Differences in PPP imply FX rate.\(^3\)

\[
\tilde{X}_{t,\text{EUR/USD}} \text{ should } \frac{\text{CPI}_{t,\text{USD}}}{\text{CPI}_{t,\text{EUR}}}.
\]

Relative: Change in PPP implies change in FX rate.

\[
\tilde{X}_{t+\tau,\text{EUR/USD}} \text{ should } \frac{\Delta \text{CPI}_{t\rightarrow t+\tau,\text{USD}}}{\Delta \text{CPI}_{t\rightarrow t+\tau,\text{EUR}}} X_{t,\text{EUR/USD}}.
\]

Problem: Prices usually higher in more productive economies.

- Could we adjust for productivity? Sure!\(^4\)
- Also consider anti-distortionary FX policies, trade.

\(^3\)N.B. Both CPIs must have same basket.

\(^4\)If you thought that, welcome to being an analyst.
Current Issues

- Big issues in the land of foreign currencies now?
- The Eurozone: can it stick together?
  - How to handle the next Greece?
  - What will Brexit do to EUR? European financing markets?
- Cryptocurrencies
  - What happens when govts with capital controls crack down?
  - Already happening. Results? Often hurts cryptocurrencies.
  - What about counterparty risk? Operational risk? KYC?
We covered Foreign Exchange; on to Risk Alleviation and Futures next!

- Risk Alleviation: Futures, Options, Credit, Structured Products; and,
- All Together Now: Active Portfolios, Investment Firms, Crises.