Equity and Currency markets review: Section 8

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Pset 5 review

1. Fisher Eq. (FE) $\quad r^{¥} = i^{¥} - E[\pi^{¥}] = 0.08 - 0.03 = 0.05 \quad (5\%)$

UIP + PPP $\Rightarrow$ RIP $\quad (r^{¥} = r^{€})$

FE $\Rightarrow \quad i^{€} = r^{€} + E[\pi^{€}] = 0.05 + 0.12 = 0.17 \quad (17\%)$

We want forward $\frac{F-S}{S}$ in £ per €.

CIP $\Rightarrow \quad \frac{F_t^{£/€} - S_t^{£/€}}{S_t^{£/€}} = \frac{i_t^{£} - i_t^{€}}{1 + i_t^{€}} = \frac{0.14 - 0.17}{1 + 0.17} = \frac{-0.03}{1.17} \approx -0.0256$ (-2.56%)

CIP (approx) $\Rightarrow \quad \approx i^{£} - i^{€} = 0.14 - 0.17 = -0.03 \quad (-3\%)$

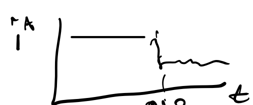
2.

a. $P_{new} = P_5 - P_1$. P_5 currencies with $\uparrow$ interest rates (largest forward discounts). P_1 currencies with low interest rates.

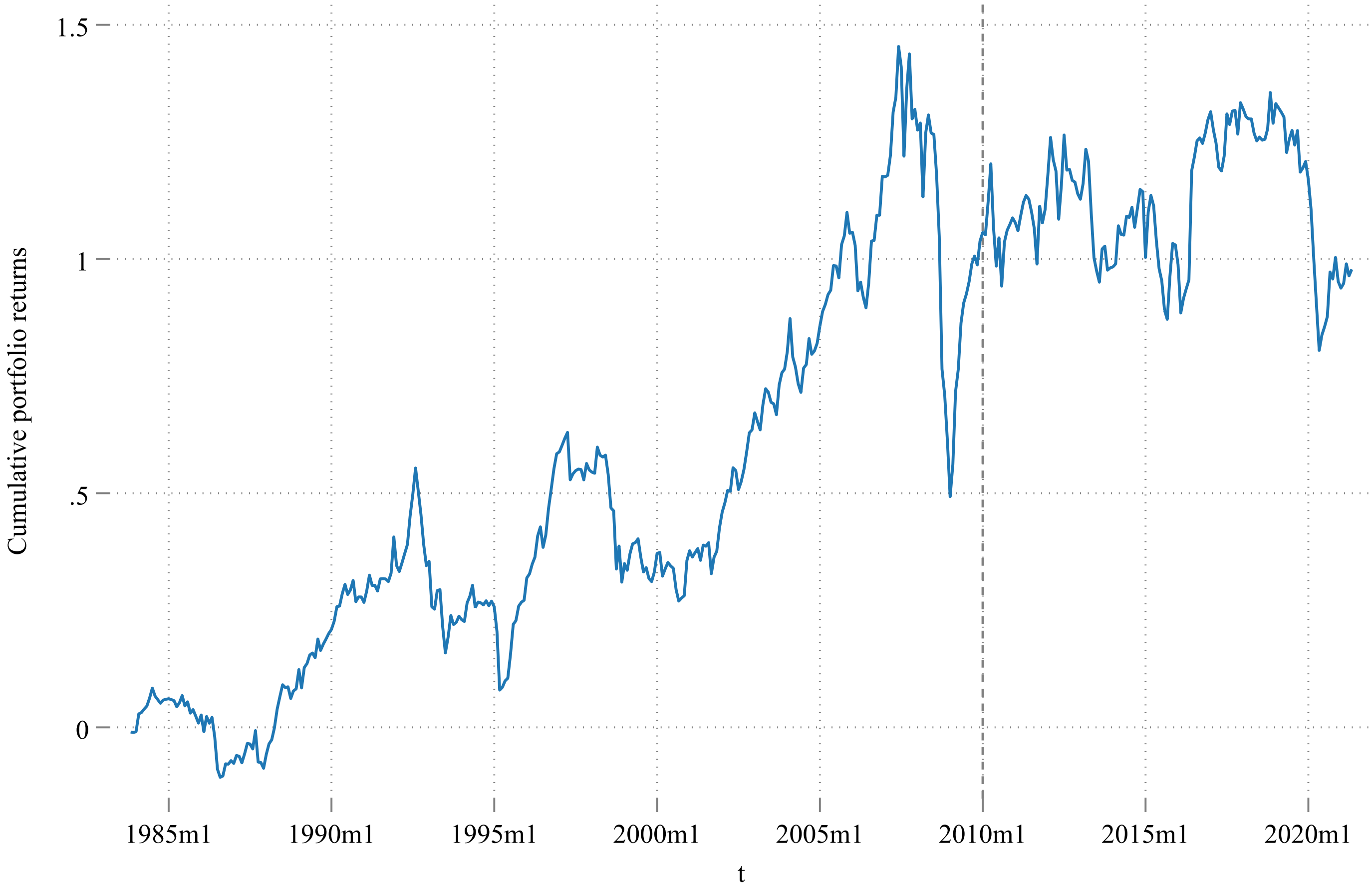
b. Negative relationship between carry trade returns and equity volatility.

c. Recall P_{new} is a portfolio of 15 developed countries: Australia, Belgium, Canada, Denmark, euro area, France, Germany, Italy, Japan, Netherlands, New Zealand, Norway, Sweden, Switzerland, and the United Kingdom.
This particular P_{new} strategy has not performed well 2010 even though average equity volatility about the same pre vs. post-2010. Interest rates in developed countries fell since pre-Great Recession (e.g. Australia `https://tradingeconomics.com/australia/interest-rate`).

AUD vs. JPY



Pset 5 review



Pset 5 review

3.

1. PPP spot rate

$$S_t^{PPP} = \frac{cpi_t^{c1}}{cpi_t^{c2}}$$

2. Real exchange rate

$$q_t = \frac{\frac{1+\pi^{c1}}{1+\pi^{c2}}}{1+e_t} = \frac{\frac{1+\frac{cpi_{t+1}^{c1}-cpi_t^{c1}}{cpi_t^{c1}}}{1+\frac{cpi_{t+1}^{c2}-cpi_t^{c2}}{cpi_t^{c2}}}}{1+\frac{S_{t+1}-S_t}{S_t}}$$

3. Did you observe mean reversion to 1?

AR(1)

Exam

- 24 hour take-home exam.
- Start: Wednesday, October 6 at 7am PT.
- End: Thursday, October 7 at 7am PT.
- THIS IS A HARD DEADLINE.
- Submit your exam early. Email exam to me if you have submission issues.
- Submission issues are not a valid excuse for late exam submission.
- Exam should take around 5 hours.
- Equity and currency: review materials and homework – make sure you understand the assignments.

Equity review

Macro fundamentals

~~other~~

Alternative data

Mean variance

1 period

dynamic portfolios

>1 periods

raw information → forecast → optimally & efficiently build portfolio, balancing risk & return forecasts

α

risk

Equity review

Mean-variance preferences

- We want to maximize active returns while minimizing risk.
- $U_P = \alpha_P - \lambda \cdot \omega_P^2 = h'_{PA} \cdot \alpha - \lambda \cdot h'_{PA} \cdot V \cdot h_{PA}$
  - Recall that we pretend we are institutional *equity* managers and ignore $\beta \neq 1$.
    Framework slides or
  - $(\beta_P - 1) \cdot E[r_B] - \lambda' \cdot (\beta_P - 1)^2 \cdot \sigma_B^2$ cancels out. Basic Math
- Solving the maximization problem yields the optimal holdings:
  $\frac{\partial U}{\partial h'_{PA}} = \alpha - 2\lambda V h_{PA} = 0$
  $\Rightarrow h^*_{PA} = \frac{\alpha}{2\lambda V}$
- We can also add other constraints such as requiring fully-invested portfolios (see Pset 1.6).
  l $\begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix}$
- Fully-invested minimum variance portfolio: $h_C = \frac{V^{-1}e}{e^\top V^{-1}e}$.

Equity review

Covariance matrices

- $V = Cov(r,r)$, $\hat{\sigma}_{ij} = \frac{1}{T-1}\sum_{t=1}^{T}\left[r_i(t) - \bar{r}_i\right]\cdot\left[r_j(t) - \bar{r}_j\right]$

$$V = \begin{pmatrix} \sigma_1^2 & \sigma_{12} & \cdots & \sigma_{1N} \\ \sigma_{21} & \sigma_2^2 & \cdots & \sigma_{2N} \\ \vdots & & \ddots & \vdots \\ \sigma_{N1} & & & \sigma_N^2 \end{pmatrix}$$

Risk modeling slides

- Estimating V with exponential smoothing

$$V_{ij} = \frac{\sum_{t=1}^{T}\left[r_i(t) - \bar{r}_i\right]\cdot\left[r_j(t) - \bar{r}_j\right]\cdot e^{-\gamma(T-t)}}{\sum_{t=1}^{T} e^{-\gamma(T-t)}}$$

- $\sigma_P^2 = h_P^\top \cdot V \cdot h_P$

Equity review

The Fundamental Law of Active Management

- FLoAM – IR depends on "skill" and breadth (independent bets per period).
  Annual ratio
  upper bound of performance
- Ex ante: $IR = IC\sqrt{BR}$.
- With transfer costs: $IR = IC\sqrt{BR}{\cdot}TC$.
- Multiple ICs: $IR_P^2 = \sum_{i \in P} BR_i \cdot IC_i^2$.

This is the one thing you should remember from our equity class if you can only remember one thing!

Equity review

In general, a factor model represents excess returns as

- $r = Xb + u$
  - $X_{N\times K}$ – stock exposures to the factors.
  - $b_{K\times 1}$ – vector of factor returns.
  - $u_{K\times 1}$ – specific return vector.

With asset covariance matrix

- $V = Cov(r, r) = XFX^{\top} + \Delta$
  - $F_{K\times K}$ – The covariance of factors
  - $\Delta_{N\times N}$ – Diagonal covariance matrix of "specific risk".

Equity review

More on factor models

1 2

- Fundamental models – “Calculate X, estimate b”
- $b = \underbrace{(X^\top X)^{-1} X^\top}_{H^\top} r$

factor returns

- H is the factor-mimicking portfolio.
- The columns of H correspond to portfolio weights for each factor.
- What if we had b and were interested X?

$$r_n(t) = \sum_{k=1}^{K} b_k(t) \cdot X_{nk} + \varepsilon_n(t)$$

Macro fundamental / slid

then we calculate b, and then estimate X

in Risk Modeling

Equity review

let's say

- We estimate covariance matrix using observed historical data.
- But we can use the estimated $\underbrace{\text{covariance matrix}}_{V}$ for (hopefully) good beta forecasts.
- Barr's better betas:

End of Risk Modeling

$$\beta_P = \frac{h_P^\top \cdot V \cdot h_B}{\sigma_B^2} = h_P^\top \cdot \beta$$

$$\beta = \frac{V \cdot h_B}{\sigma_B^2}$$

$$\sigma_B^2 = h_B^\top \cdot V \cdot h_B$$

Equity review

Valuation

- Dividend discount model – there is uncertainty

$$p(0) = \sum_t \frac{E\left[d(t)\right]}{(1+y)^t} \tag{1}$$

- Constant-growth dividend discount model – assume a constant growth rate

$$d(t) = d(1) \cdot (1+g)^{t-1} \tag{2}$$

- Eq. (1) + Eq. (2) $\Rightarrow$

$$p(0) = \frac{d(1)}{y-g}$$

- Constant dividends and discount rate imply total return is

$$y = \frac{p(1) - p(0) + d(1)}{p(0)}$$

Equity review

More valuation equations

- $e(t) = d(t) + I(t)$
- $d(t) = \kappa \cdot e(t)$
  - $\Rightarrow I(t) = (1 - \kappa) \cdot e(t)$
- $e(t+1) = e(t) + ROE \cdot I(t) = (1 + ROE \cdot (1 - \kappa)) \cdot e(t)$
  - $\Rightarrow g = ROE \cdot (1 - \kappa)$
- $y = i_f + \beta f_B + \alpha$
  - $+CGDDM \Rightarrow g = \alpha + \beta f_B + i_f - \frac{d}{P}$
- Observe p_{mkt} and estimate: $p_{model}(t) = \frac{\kappa \cdot e(t+1)}{y-g}$
  - Multiples: $m_{mkt} = \frac{p_{mkt}}{e}$, $m_{model} = \frac{\kappa}{y-g}$
  - Relative mispricing: $rmp = \frac{p_{model}}{p_{mkt}} - 1 = \frac{m_{model}}{m_{mkt}} - 1$

Valuation slides
week

Equity review

Market impact model

- Price impact proportional to volatility & $\sqrt{\text{volume}}$
- $\frac{\Delta p}{p} = c \cdot \sigma \cdot \sqrt{\frac{V}{\bar{V}_{daily}}}$
- Overall cost:
  - $\text{Cost} = \text{commission} + \frac{\text{spread}}{p} + c \cdot \sigma \cdot \sqrt{\frac{V_{trade}}{\bar{V}_{daily}}}$
- Cost-aware portfolio construction:

$$U = h_{PA}^{\top} \cdot \alpha - \lambda h_{PA}^{\top} \cdot V \cdot h_{PA} - \frac{Cost\{h_i, h\}}{\tau_h}$$

- where τ_h is the **transactions cost amortization horizon**

Equity review

α dynamics

- Information decay at equilibrium

new arriving info.

$$\alpha(t) = \underbrace{e^{-\gamma\cdot\Delta t}\cdot\alpha(t-\Delta t)}_{\text{decaying old info.}} + \tilde{s}(t)\cdot\sqrt{\Delta t}$$

- γ guides turnover or decay rate of old information.
- γ is closely related to half life of alpha information.

Half-life

Key formula

PDF

$$e^{-\gamma\cdot\Delta t} \equiv \frac{1}{2}^{\Delta t/HL}$$

- In equilibrium, $BR = \gamma \cdot N$.

Currency review

Covered Interest Parity

$$(1 + i_{\$}) = \frac{F}{S}(1 + i_*)$$

- Interest rate difference should equal the difference between forward and spot exchange rates.
- $F_{0,1}$ = Today's 1-period forward rate in \$/*.
- Approximate version: $i_{\$} - i_* = \frac{F_{0,1} - S_0}{S_0}(1 + i_*) \approx \frac{F_{0,1} - S_0}{S_0}$.
- % forward discount on the \$ is approximately $\frac{F_{0,1} - S_0}{S_0}$.
    - If $> 0 \Rightarrow$ \$ at forward discount.
    - If $< 0 \Rightarrow$ \$ at forward premium.
- This is an arbitrage condition.

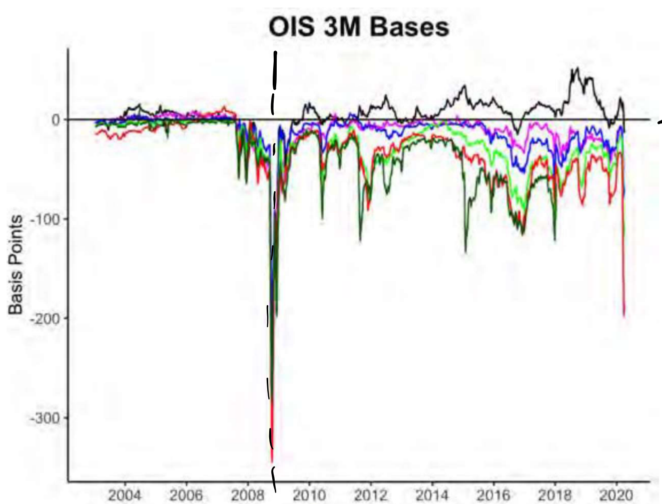
Currency review

- When CIP holds (ignoring any adjustments),

$$B_t = \overbrace{i_t^{\$}}^{\substack{\text{cash}\\ \text{rate}}} - \underbrace{\left[\frac{F_t}{S_t}(1 + i_t^*) - 1\right]}_{\substack{\text{synthetic}\\ \text{cash rate}}} = 0$$

- B_t is the cross-currency basis.

I think from Currency Lecture 2



$B_t \neq 0$

Currency review

- Gordon Liao (2020) " Credit migration and covered interest rate parity"
  - Credit spread is lower in Europe $\Rightarrow \uparrow$ demand to borrow in €
  - $\uparrow$ € borrowing $\Rightarrow \uparrow$ demand for currency hedge
  - $\Rightarrow \uparrow$ balance sheet of forward contract issuers
  - $\Rightarrow$ more costly to swap to \$.
- Other potential candidates that affect cross-currency basis:
  - Demand for credit borrowing (corporate demand for currencies).
  - Demand for swaps.

Currency review

Purchasing Power Parity

- $P_\$$ = US prices in USD.
- P_* = Country * prices in * currency.
- Absolute version of PPP

$$S = \frac{P_\$}{P_*}$$

- $S_{t+1} - S_t > 0$
  - $\Rightarrow$ \$ depreciation (because you need more \$ to pay for a unit of *)
- Condition relies on Law of One Price.
  - Applied internationally to a standard consumption basket.

Currency review

Relative PPP and the real exchange rate

$ in spot rate

$$e = \underbrace{\frac{\pi_\$ - \pi_*}{1+\pi_*}}_{\text{If true, relative ppp holds}} \approx \pi_\$ - \pi_*$$

- $e > 0$
  - $\Rightarrow$ \$ depreciation (because you need more \$ to pay for a unit of *)
  - $\Rightarrow$ positive inflation difference ($\pi_\$ - \pi*$) to keep exchange rate constant on PPP.
- In expectation,

$$E\left[\pi_\$ - \pi_*\right] \approx \frac{E_t\left[S_{t+1}\right] - S_t}{S_t}. = E[e]$$

- We define the real exchange rate as

relative PPP holds $\Rightarrow q = 1$

$$q = \frac{1+\pi_\$}{(1+e)(1+\pi_*)} = \frac{\frac{1+\pi_\$}{1+\pi_*}}{1+e}.$$

Currency review

Uncovered Interest Parity

- If there exists an interest rate difference in an efficient market, the currency that has a higher interest rate is expected to give it back.
- Approximately,

$$i_{\$} - i_{*} \approx \frac{E_t\left[S_{t+1}\right] - S_t}{S_t} = E[e].$$

- If the interest rate difference is negative, S_{t+1} is expected to decrease meaning that it takes fewer \$ to buy $*$ or the \$ is expected to appreciate.
- This is an equilibrium condition.
  - Relies on the assumption that capital markets are efficient.
  - If not true, interest rates may be set inefficiently.

Currency review

Reasons to peg to a currency?

- It becomes a nominal anchor.
- If country has high inflation, pegging currency slows down inflation.
  - As long as you can keep the peg! Examples in Amir's slides

Impossible trinity

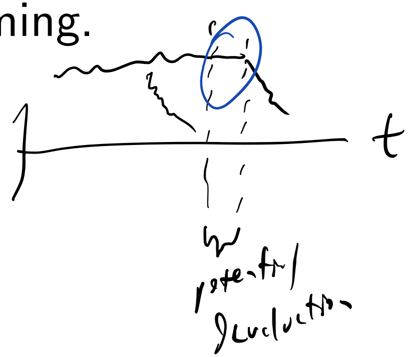
- Fixed exchange rate
- Free/flexible monetary policy
- Free capital flow (no controls)

You can't have all 3

Currency review

Signals of a currency crisis.

- Deviations in real exchange rate.
- Long, consistent trade deficits signal a looming currency crisis.
    - Current account and capital account have to balance.
- Borrowing from foreign entities with short maturities.
- Borrowing to finance public budget deficits.
- Difficult to predict the timing.



Currency review

Triffen dilemma

- Triffen paradox: countries with reserve currencies run a balance of payments deficit
  $\Rightarrow$ long-term balance of payments deficit lowers confidence in reserve currency
  $\Rightarrow$ downfall of reserve currency
- Modern Triffin dilemma: Demand for US dollar assets will outstrip US fiscal capacity.
  - Farhi, Gourinchas, Rey (2011); Obstfeld (2013); Farhi and Maggiori (2018).

Currency review

Order flow matters

- Transactions are buys or sells.
- Aggregating player transactions gives big picture view of the market.
  - Implicit information.
- Learning through order flow is important.
- Aggregate order flows are highly correlated with changes in exchange rates.
  - They also explain a lot of these changes (something macro fundamentals tend to fail to do) – Evans-Lyons model .

The end