Currency Risk Premia

Carry trade/UIP deviations can be motivated as risk premia (Lustig & Verdelhan 2007)

- The Yen (JPY) \textit{appreciates} in global “bad times”
Currency Risk Premia

**Carry trade/UIP deviations can be motivated as risk premia**
(Lustig & Verdelhan 2007)

- The Yen (JPY) **appreciates** in global “bad times”
- The New Zealand Dollar (NZD) **depreciates** in global “bad times”
Motivation

Currency Risk Premia

*Carry trade/UIP deviations can be motivated as risk premia* (Lustig & Verdelhan 2007)

- The Yen (JPY) *appreciates* in global “bad times”
- The New Zealand Dollar (NZD) *depreciates* in global “bad times”
- For an investor in Hong Kong: Safe JPY Assets ≻ Safe NZD assets
- Yields on safe JPY assets < yields on safe NZD assets
Understanding this:

- Under log-normality of SDFs ($M^i$) and real exchange rates ($Q^j_i$):
  (Engel, 2014 Handbook Chapter)

$$\lambda^j_{i,t} \equiv r_{i,t} - r_{j,t} + \mathbb{E}[\Delta q^j_{i,t+1}] = -\text{Cov}_t \left( \frac{m^i_{t+1} + m^j_{t+1}}{2}, \Delta q^i_{i,t+1} \right).$$

- $\text{Cov}(SDF, \text{return}_i - \text{return}_j)$.
- Except pricing kernel is an **average** of each country’s SDF.

**Any macro/finance theory explaining carry trade needs to:**

- Model global bad states ($m^i + m^j$) ↑.
- Model which currencies appreciate and which depreciate in bad times $\Delta q^i$ ↑↓?.
- Key: global shocks (SDFs co-move) but asymmetric exposure ($\Delta q^i$ changes)!
Motivation

Previous work and our work:

\[ \lambda_{i,t}^j = -\text{Cov}_t \left( \frac{m_{i+1} + m_{j+1}}{2}, \Delta q_{i+1}^j \right) \]

Hassan (2013):

- Large countries bid up the prices of global tradable goods: \( m_{\text{large}} \uparrow \rightarrow m_i \uparrow \).
- Large countries most exposed to their own shocks: \( \Delta q_{\text{large}}^j \uparrow \).
- Large countries’ assets are the best hedge to “global” risk.


- Countries producing downstream/final goods have more global influence.
- Global Production Networks: Central countries have out-sized influence.

This paper:

- Currency composition of global trade (Goldberg & Tille, 2008...)
- Dominance of the USD and Euro in global trade amplify US & Euro Area shocks.
- Bad shock in US \( m_{\text{US}} \uparrow = \) bad shock globally \( m_i \uparrow \) and \( \Delta q_{\text{USD}}^j \uparrow \).
Invoicing Currency Concentration And Currency Risk Premia

Motivation

Previous work and our work:

\[ \lambda_{i,t} = -\text{Cov}_t \left( \frac{m_i^{t+1} + m_j^{t+1}}{2}, \Delta q_{i,t+1}^{j} \right) \]

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(Dominance of the USD and Euro in global trade amplify US & Euro Area shocks.
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- Bad shock in US \( m^{US} \uparrow = \) bad shock globally \( m^i \uparrow \) and \( \Delta q_{\text{USD}}^j \uparrow \).
What we do:

Model:

- Currency invoicing and bond pricing in a tractable multi-country model.
- No financial frictions: markets are complete.
- Trade frictions: prices are sticky bilaterally in an arbitrary currency.

Empirical: Link currency composition to

1. Bilateral consumption correlations.
2. Carry trade risk premia.
What we find:

**Currency Concentration of Consumption (CCC) → Carry trade risk premia**

- US/EU/Japan *consume* largely in their own currencies → low rates!
- US dominance in non-US trade – less relevant for risk free rates.

**Empirical Result #1**: Bilateral consumption correlations

- Covariances of common currencies explain consumption correlations.
  - Even controlling for correlation with world consumption.
  - Consistent with model mechanism

**Empirical Result 2**: Carry Trade Factors

- CCC can explain Forward/Spot spreads (measure of $r_i^{rf} - r_{US}^{rf}$).
  - Even when controlling for size and centrality.
- Portfolio sorts on CCC show that it explains much of (unconditional) carry trade.
Sketch of model

- **Open-economy New-Keynesian model with** $N$ **countries, 2 periods** $(t = 0, 1)$.

- **Households have log-linear utility:**

$$U^k = \log(C^k_0) - L^k_0 + \beta E_0 \left[ \log(C^k_1) - L^k_1 \right].$$

- **Armington structure:**
  - **Cobb-Douglas aggregator:** $C^k_t = \prod_{n=1}^{N} (C^k_{n,t})^{\omega^n_k}$.
  - **CRS production:** $Y^k_t = Z^k_t L^k_t$.

- **Price stickiness and invoicing currency:**
  - **Prices from origin** $n$ **to destination** $k$ **fully rigid in some currency** $j$: $p^k_n = \bar{p}^j_n \times \mathcal{E}^k_j$ ($\bar{p}^j_n$ normalized to 1, $\mathcal{E}^k_j \equiv$ nominal ER)
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- Armington structure:
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- Price stickiness and invoicing currency:
  - Prices from origin $n$ to destination $k$ fully rigid in some currency $j$: $p^k_n = \bar{p}^j_n \times \mathcal{E}^k_j$ 
    ($\bar{p}^j_n$ normalized to 1, $\mathcal{E}^k_j \equiv$ nominal ER)

- Nests popular benchmarks: 
  Producer Currency Pricing (PCP) — set $j = n \ \forall \ n$
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- Nests popular benchmarks:
  - Local Currency Pricing (LCP) — set $j = k \forall k$
Sketch of model

- Open-economy New-Keynesian model with \( N \) countries, 2 periods \((t = 0, 1)\).

- Households have log-linear utility:

\[
U^k = \log(C^k_0) - L_0^k + \beta E_0 \left[ \log(C^k_1) - L_1^k \right].
\]

- Armington structure:
  - Cobb-Douglas aggregator: \( C^k_t = \prod_{n=1}^{N} (C^k_{n,t})^{\omega^k_n} \).
  - CRS production: \( Y^k_t = Z^k_t L^k_t \).

- Price stickiness and invoicing currency:
  - Prices from origin \( n \) to destination \( k \) fully rigid in some currency \( j \): \( p^k_n = \bar{p}^j_n \times E^k_j \)
    \((\bar{p}^j_n \text{ normalized to 1, } E^k_j \equiv \text{nominal ER})\)
  - **Nests popular benchmarks:**
    - **Dominant Currency Pricing (DCP)** — set \( j = \begin{cases} 
    d & \text{if } n \neq k \\
    n & \text{if } n = k 
  \end{cases} \)
Sketch of model

- Open-economy New-Keynesian model with $N$ countries, 2 periods ($t = 0, 1$).

- Households have log-linear utility:

$$U^k = \log(C_0^k) - L_0^k + \beta E_0 \left[ \log(C_1^k) - L_1^k \right].$$

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  - Cobb-Douglas aggregator: $C_t^k = \prod_{n=1}^{N} (C_{n,t}^k)^{\omega_n^k}$.
  - CRS production: $Y_t^k = Z_t^k L_t^k$.

- Price stickiness and invoicing currency:
  - Prices from origin $n$ to destination $k$ fully rigid in some currency $j$: $p_n^k = \bar{p}_n^j \times E_j^k$ ($\bar{p}_n^j$ normalized to 1, $E_j^k \equiv$ nominal ER)
  - Let $\gamma_j^k$ denote (exogenous) aggregate share of country $k$'s consumption invoiced in currency $j$.
    $\gamma_j^k \equiv \sum_{n=1}^{N} \omega_n^k \mathbb{1}_{n,j}^k$ — ($\mathbb{1}_{n,j}^k = 1$ if trade from $n$ to $k$ is in currency $j$)
Sketch of model

- Open-economy New-Keynesian model with $N$ countries, 2 periods ($t = 0, 1$).

- Households have log-linear utility:
  
  $$U^k = \log(C^k_0) - L^k_0 + \beta E^0 \left[ \log(C^k_1) - L^k_1 \right].$$

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- Price stickiness and invoicing currency:
  
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  - Let $\gamma^j_k$ denote (exogenous) aggregate share of country $k$’s consumption invoiced in currency $j$.

- Financial markets are complete (payoffs in some nominal currency).

- Monetary policy stabilizes nominal marginal costs in each country.
Consumption growth between dates 0 and 1 given by

$$\Delta c^k_1 = \sum_{j=1}^{N} \gamma_j^k z_1^j.$$

Efficient allocation (or sticky prices with PCP), where $\Delta c^k_1 = \sum_{j=1}^{N} \omega_j^k z_1^j$. 

*Figure: Consumption risk for country $k$. 
Invoicing currencies & consumption risk

- Consumption growth between dates 0 and 1 given by

\[ \Delta c_1^k = \sum_{j=1}^{N} \gamma_j^k z_j^1. \]

- Efficient allocation (or sticky prices with PCP), where \( \Delta c_1^k = \sum_{j=1}^{N} \omega_j^k z_j^1. \)

Figure: Equilibrium allocation of consumption risk.
Consumption risk exposures under PCP vs DCP

Illustration with 3 countries of symmetric size, no home bias ($N = 3$, $\omega_j^k = \theta_k = 1/3 \forall j, k$)

PCP

Perfect risk-sharing + balanced exposures

$\forall k: c^k = \frac{1}{3}z^1 + \frac{1}{3}z^2 + \frac{1}{3}z^3$

DCP

Imperfect risk-sharing + imbalanced exposures

$c^1 = z^1; \quad c^k = \frac{2}{3}z^1 + \frac{1}{3}z^k$ for $k = 2, 3$
Log currency risk premium (UIP deviation) between countries $n$ and $k$:

\[
\lambda_{n,0}^k \equiv r^n_0 - r^k_0 + E_0[\Delta q^k_{n,1}]
\]

\[
= -Cov_0 \left( \frac{m^n_1 + m^k_1}{2}, \Delta q^k_{n,1} \right)
\]
Invoicing currencies & return differences

Log currency risk premium (UIP deviation) between countries \( n \) and \( k \):

\[
\lambda_{n,0}^k \equiv r_n^0 - r_k^0 + E_0[\Delta q_{n,1}^k]
\]

\[
= -Cov_0 \left( \frac{m_1^n + m_1^k}{2}, \Delta q_{n,1}^k \right)
\]

\[
= -\sum_{i=1}^{N} \sum_{j=1}^{N} \left( \gamma_i^k + \gamma_i^n \right) \times \left( \frac{\gamma_j^k - \gamma_j^n}{2} \right) \times \sigma_{z,i} \sigma_{z,j} \rho_{i,j}.
\]

To simplify: assume no correlation of shocks \( \rho_{i,j} = 1 \) if \( i = j \)
Invoicing currencies & return differences

Log currency risk premium (UIP deviation) between countries $n$ and $k$:

$$\lambda_{n,0}^k \equiv r_n^0 - r_k^0 + E_0[\Delta q_{n,1}^k]$$

$$= -Cov_0 \left( \frac{m_n^1 + m_1^k}{2}, \Delta q_{n,1}^k \right)$$

$$= -\sum_{i=1}^{N} \left( -\frac{\gamma_i^k + \gamma_i^n}{2} \right) \times \left( \frac{\gamma_i^k - \gamma_i^n}{\sigma_{z,i}} \right)$$

- Exposure of average SDF to country $i$ risk
- Exposure of real exchange rate to country $i$ risk
Invoicing currencies & return differences

Log currency risk premium (UIP deviation) between countries $n$ and $k$:

$$\lambda_{n,0}^k \equiv r_0^n - r_0^k + E_0[\Delta q_{n,1}^k]$$

$$= -Cov_0 \left( \frac{m_1^n + m_1^k}{2}, \Delta q_{n,1}^k \right)$$

$$= -\sum_{i=1}^{N} -\frac{\gamma_i^k + \gamma_i^n}{2} \times \left( \gamma_i^k - \gamma_i^n \right)$$

Exposure of average SDF to country $i$ risk

Exposure of real exchange rate to country $i$ risk

$\sigma_{z,i}$.

Figure: Determination of most relevant shock for a country pair.
Invoicing currencies & return differences

Log currency risk premium (UIP deviation) between countries $n$ and $k$:

$$\lambda_{n,0}^k \equiv r_0^n - r_0^k + E_0[\Delta q_{n,1}^k]$$

$$= -Cov_0 \left( \frac{m_1^n + m_1^k}{2}, \Delta q_{n,1}^k \right)$$

$$= -\sum_{i=1}^{N} -\gamma_i^k + \gamma_i^n \times \left( \gamma_i^k - \gamma_i^n \right) \sigma_{z,i}.$$ 

\[ \text{Exposure of average SDF to country } i \text{ risk} \]
\[ \text{Exposure of real exchange rate to country } i \text{ risk} \]

◇ Lowest return on currency that is best hedge against most relevant shocks.

Figure: Risk properties of (real) currencies.
Risk premia under PCP/DCP
Illustration with 3 countries of symmetric size, no home bias ($N = 3$, $\omega_j^k = \theta_k = 1/3 \forall j, k$)

**Symmetric PCP**
- Same $c^k$, $q_i^j = 1$, $\forall i, j$
- Same SDF, same risk-free rates

**Symmetric DCP**
- All $m^i$ loads highest on $z^1$
- $q_1^k \uparrow$ when $z^1 \downarrow$
- Country 1 has lowest risk free rates
Final Example – Euro/Japan

Same as DCP graph except 3 is 100% own currency
Final Example – Euro/Japan

Two effects:

1. Pricing kernel \( \frac{m^i + m^j}{2} \) exposure to \( z^2 \) and \( z^3 \) are low
Final Example – Euro/Japan

Two effects:
1. Pricing kernel \((m^2 + m^3)/2\) exposure to \(z^2\) and \(z^3\) are low
2. Bilateral ReR \(\Delta q_{23}\) very exposed to \(z^3\), some exposure to \(z^2\)
Two effects:

1. Pricing kernel \( \frac{m^2 + m^3}{2} \) exposure to \( z^2 \) and \( z^3 \) are low
2. Bilateral ReR \( \Delta q_{23} \) very exposed to \( z^3 \), some exposure to \( z^2 \)

End result:

\( r^3 < r^2 \) because country 3’s invoicing currency “concentration” is higher
Measuring currency concentration in the data

\[
\lambda_{n,0}^k = -\sum_{i=1}^{N}\sum_{j=1}^{N} \left( -\gamma_i^k + \gamma_i^n \right) \times \frac{\left( \gamma_j^k - \gamma_j^n \right)}{2} \times \sigma_z, i \sigma_z, j \rho_{i,j}.
\]

Exposure of average SDF to country \(i\) risk
Exposure of real exchange rate to country \(i\) risk
Correlation structure of shocks

Assuming i.i.d shocks across countries, currency risk premium simplifies to

\[
\lambda_{n,0}^k \equiv r_0^n - r_0^k = \frac{\sigma_z^2}{2} \sum_{i=1}^{N} \left[ \left( \gamma_i^k \right)^2 - \left( \gamma_i^n \right)^2 \right].
\]

⇒ Testable prediction: \textit{Invoicing currency concentration of consumption (CCC)} is a determinant of currency risk premia and return differences.

Define our empirical CCC measure:

\[
\xi_k \equiv \sum_{i=1}^{N} \left( \gamma_i^k \right)^2
\]

Constructing \(\xi_k\) assuming \textit{uncorrelated} \(\{z^i\}\) \textbf{works against us} in empirical tests.
Data

**Currency Invoice Shares**
- Data on share of imports in USD, Euros, Home Currency and “Other”
- Use Import/Consumption to convert to share of consumption

**UIP Deviations and interest rate gaps**
- Many countries don’t have risk-free assets (default risk)
- But if CIP holds $r_{i,t}^{rf} - r_{US,t}^{rf} \approx f_{i,t}^i - s_{US,t}^i$ and
  
  \[ rx_{i,t} = r_{i,t}^{rf} - r_{US,t}^{rf} + \Delta s_{US,t+1}^i \approx f_{i,t}^i - s_{US,t+1}^i \]
- Source: Barclays and Reuters

**Other data**
- Size: NGDP shares
- Centrality: follow Richmond (2019) including data sources
- Real consumption: Sourced from Haver (aggregated from national accounts)
Evidence of link between invoicing shares and consumption growth

- Model predicts $\Delta c_t^k = \sum_{j=1}^{N} \gamma_j^k \Delta c_t^j$, and thus $\text{Corr}(\Delta c_t^k, \Delta c_t^i) \equiv \xi_{k,i} = \sum_{j=1}^{N} \gamma_j^k \gamma_j^i$

- Construct empirical measure as $\xi_{k,i} = \gamma_{USD}^k \gamma_{USD}^i + \gamma_{EUR}^k \gamma_{EUR}^i$

Table: Consumption correlation regressions

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<td>Prod of size</td>
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<td>18.44***</td>
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<td></td>
<td>(4.60)</td>
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<td>(5.91)</td>
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<td>Prod of correlation</td>
<td>-0.48***</td>
<td>0.0431</td>
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<td>with world cons.</td>
<td>(0.11)</td>
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<td>Prod of cons.</td>
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<td>0.26***</td>
<td>0.28***</td>
<td>0.20*</td>
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<td>invoice shares $\xi_{k,i}$</td>
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<td>(0.03)</td>
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<td>Prod of output</td>
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Robust standard errors are in parenthesis. *, ** and *** denote statistical significance at the 10 percent, 5 percent and 1 percent level respectively.
Evidence of link between invoicing shares and return differential: regression

- Test main model prediction by running panel regression

\[
\log(F_{US,t}^k) - \log(S_{US,t}^k) = \delta_t + \beta \times \xi_{k,t} + \Gamma \text{controls}_{i,t} + \epsilon_{k,t}
\]

<table>
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<tr>
<th>Table: Forward spread regression</th>
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<td>Richmond (2019) centrality</td>
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<td>Consumption Invoice Concentration $\xi_{k,t}$</td>
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<td>Output Invoice Concentration</td>
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<td>Time Fixed Effects</td>
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<td>Country Fixed Effects</td>
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Evidence of link between invoicing shares and return differential: portfolios

- Sort currencies into portfolios (Lustig and Verdelhan, 2007) using our model-based invoicing currency concentration measure $\xi_{i,t}.$

<table>
<thead>
<tr>
<th>Table: Portfolios sorted on Currency Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Previous Concentration $\xi_{i,t-12}$</td>
</tr>
<tr>
<td>mean</td>
</tr>
<tr>
<td>Forward Spread $f_{US,t} - s_{US,t}$</td>
</tr>
<tr>
<td>mean</td>
</tr>
<tr>
<td>standard error</td>
</tr>
<tr>
<td>Excess Returns $r_{US,t}$</td>
</tr>
<tr>
<td>mean</td>
</tr>
<tr>
<td>standard deviation</td>
</tr>
<tr>
<td>standard error</td>
</tr>
<tr>
<td>Real Forward Spread</td>
</tr>
<tr>
<td>mean</td>
</tr>
<tr>
<td>standard error</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
</tr>
<tr>
<td>mean</td>
</tr>
<tr>
<td>standard error</td>
</tr>
</tbody>
</table>
Evidence of link between invoicing shares and return differential: risk factors

- Denote by $HML_t^{FX}$ and $UHML_t^{FX}$ risk factors constructed by sorting portfolios using current forward spreads and average 1988-2001 forward spreads.

- Run time-series regressions:

$$ (U)HML_t^{FX} = \alpha + \beta DMC_t^{FX} + \varepsilon_t. $$

**Table: Explanatory Regressions for Benchmark Risk Factors**

<table>
<thead>
<tr>
<th></th>
<th>HML$^{FX}$</th>
<th>UHML$^{FX}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>5.39***</td>
<td>1.74</td>
</tr>
<tr>
<td></td>
<td>(1.67)</td>
<td>(1.41)</td>
</tr>
<tr>
<td>$\beta$ on DMC</td>
<td>0.32***</td>
<td>0.51***</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>N</td>
<td>233</td>
<td>180</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.14</td>
<td>0.21</td>
</tr>
</tbody>
</table>
Conclusion

- Present multi-country sticky price model indicating that countries with more concentrated invoicing currency structures should face lower risk free rates.

- Provide empirical support for:
  - mechanism relying on influence of invoicing currencies onto consumption risk exposures,
  - effect of currency concentration on return differentials and carry trade.

Implications:

- USD Trade dominance $\rightarrow$ financial advantage of US *even with complete markets*.
  - Gopinath & Stein (2021) generated with with financial frictions.

What we’re working on:

- Currency Areas could be thought of as a mechanism to reduce risk-free rates.

- Same as Exchange rate pegs (Hassan, Mertens and Zhang, 2022).
Consumption risk exposures under PCP vs DCP with **home bias**

3 countries of symmetric size & **home bias** ($N = 3$, $\theta_k = 1/3$, $\omega^k = \bar{\omega}/(\bar{\omega} + 2)$, $\omega^j = 1/(\bar{\omega} + 2)$, $\forall j \neq k$, $\bar{\omega} > 1$)

### PCP

$$c^k = \frac{\bar{\omega}}{\bar{\omega} + 2} z^k + \sum_{n \neq k} \frac{1}{\bar{\omega} + 2} z^n$$

### DCP

$$c^1 = z^1; \quad c^k = \frac{2}{\bar{\omega} + 2} z^1 + \frac{2}{\bar{\omega} + 2} z^k \text{ for } k = 2, 3$$
Consumption risk exposures under PCP vs DCP with asymmetric size

3 countries of asymmetric size, no home bias $(N = 3, \omega_j^k = \theta_k \forall j, k)$

PCP

$$\forall k: c^k = \theta_1 z^1 + \theta_2 z^2 + \theta_3 z^3$$

DCP

$$c^1 = z^1; \quad c^k = (1 - \theta_k)z^1 + \theta_k z^k \text{ for } k = 2, 3$$
## Carry Trade Factor (HML)

### Table: Portfolios sorted on Current Forward Spread $f_{i,t-1} - s_{i,t-1}$

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>2</th>
<th>3</th>
<th>High</th>
<th>$HML^{FX}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Forward Spread</strong> $f_{US,t-1}^i - s_{US,t-1}^i$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>-1.56</td>
<td>0.31</td>
<td>2.00</td>
<td>6.52</td>
<td>8.08</td>
</tr>
<tr>
<td><strong>Forward Spread</strong> $f_{US,t}^i - s_{US,t}^i$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>-1.35</td>
<td>0.38</td>
<td>2.01</td>
<td>6.18</td>
<td>7.52</td>
</tr>
<tr>
<td>standard error</td>
<td>0.08</td>
<td>0.09</td>
<td>0.08</td>
<td>0.12</td>
<td>0.13</td>
</tr>
<tr>
<td><strong>Excess Returns</strong> $r_{US,t}^i$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>-2.06</td>
<td>-0.51</td>
<td>2.99</td>
<td>3.36</td>
<td>5.41</td>
</tr>
<tr>
<td>standard deviation</td>
<td>6.22</td>
<td>5.84</td>
<td>7.40</td>
<td>9.02</td>
<td>7.14</td>
</tr>
<tr>
<td>standard error</td>
<td>1.16</td>
<td>1.09</td>
<td>1.38</td>
<td>1.67</td>
<td>1.32</td>
</tr>
<tr>
<td><strong>Sharpe Ratio</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>-0.33</td>
<td>-0.09</td>
<td>0.040</td>
<td>0.37</td>
<td>0.76</td>
</tr>
<tr>
<td>standard error</td>
<td>0.19</td>
<td>0.19</td>
<td>0.19</td>
<td>0.19</td>
<td>0.20</td>
</tr>
</tbody>
</table>
## Unconditional Carry Trade Factor (UHML)

**Table:** Portfolios sorted on Average Forward Spread (1988-2001)

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>2</th>
<th>3</th>
<th>High</th>
<th>$UHML^{FX}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Forward Spread (1988-2001)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>-1.24</td>
<td>0.66</td>
<td>2.24</td>
<td>8.13</td>
<td>9.37</td>
</tr>
<tr>
<td><strong>Forward Spread</strong> $f^{i}<em>{US,t} - s^{i}</em>{US,t}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>-0.42</td>
<td>0.36</td>
<td>1.16</td>
<td>2.95</td>
<td>3.37</td>
</tr>
<tr>
<td>standard error</td>
<td>0.07</td>
<td>0.17</td>
<td>0.10</td>
<td>0.10</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>Excess Return</strong> $r^{i}_{US,t}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>0.48</td>
<td>1.11</td>
<td>2.07</td>
<td>2.79</td>
<td>2.31</td>
</tr>
<tr>
<td>standard deviation</td>
<td>5.58</td>
<td>2.65</td>
<td>9.79</td>
<td>9.84</td>
<td>6.55</td>
</tr>
<tr>
<td>standard error</td>
<td>1.46</td>
<td>0.69</td>
<td>2.55</td>
<td>2.54</td>
<td>1.69</td>
</tr>
<tr>
<td><strong>Sharpe Ratio</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>0.09</td>
<td>0.42</td>
<td>0.21</td>
<td>0.28</td>
<td>0.35</td>
</tr>
<tr>
<td>standard error</td>
<td>0.26</td>
<td>0.26</td>
<td>0.27</td>
<td>0.27</td>
<td>0.27</td>
</tr>
</tbody>
</table>