DOMESTIC FINANCIAL FRICTIONS:
IMPLICATIONS FOR INTERNATIONAL RISK SHARING,
REAL EXCHANGE RATE VOLATILITY AND
INTERNATIONAL BUSINESS CYCLES

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Fact: Lack of international risk sharing

Under full risk sharing (complete international financial markets): Relative (Home vs. Foreign) consumption perfectly correlated with relative CPI:
relative C increases when real exchange rate depreciates
(Kollmann (1991, 1995), Backus & Smith (1993))

Empirically: \(\text{corr}(C/C^*, P/P^*)\) close to zero, or even positive

VERY HARD TO CONSTRUCT MODELS CONSISTENT WITH THIS FACT (ROBUSTLY):
‘CONSUMPTION - REAL EXCHANGE RATE ANOMALY’
Correlation between relative consumption and real exchange rate
(Annual data)

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>JA</th>
<th>FR</th>
<th>UK</th>
<th>IT</th>
<th>CA</th>
<th>mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>First differenced</td>
<td>0.03</td>
<td>-0.29</td>
<td>-0.10</td>
<td>0.29</td>
<td>-0.11</td>
<td>-0.00</td>
<td>-0.03</td>
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<td></td>
<td>(0.77)</td>
<td>(0.14)</td>
<td>(0.69)</td>
<td>(0.00)</td>
<td>(0.31)</td>
<td>(0.98)</td>
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</tr>
<tr>
<td>HP-filtered</td>
<td>-0.01</td>
<td>-0.29</td>
<td>-0.21</td>
<td>0.05</td>
<td>-0.21</td>
<td>-0.30</td>
<td>-0.16</td>
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<tr>
<td></td>
<td>(0.94)</td>
<td>(0.23)</td>
<td>(0.24)</td>
<td>(0.70)</td>
<td>(0.06)</td>
<td>(0.30)</td>
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<tr>
<td>Linearly detrended</td>
<td>0.09</td>
<td>-0.15</td>
<td>-0.17</td>
<td>-0.14</td>
<td>-0.24</td>
<td>-0.35</td>
<td>-0.16</td>
</tr>
<tr>
<td></td>
<td>(0.62)</td>
<td>(0.54)</td>
<td>(0.31)</td>
<td>(0.34)</td>
<td>(0.05)</td>
<td>(0.15)</td>
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</tr>
</tbody>
</table>

NB Predicted correlation under complete mkts: -1
This paper:
Shows that ‘consumption-RER puzzle’ can be explained by SIMPLE model in which:
● only fraction of households trade in complete markets
● remaining households are ‘hand-to-mouth’, HTM (consume labor income, do not trade in financial mkt.)

HTM assumption also helps capture other key facts better:
● Real exchange rate volatility
● Volatility of consumption, net exports
Motivation for HTM assumption:

- Large fraction of households holds zero assets
- Aggregate consumption tracks aggregate income 'too' closely; rejections of Euler equations (Campbell & Mankiw)
- Professional forecasters’ predictions of future aggregate consumption closely track predicted future income; interest rates or expected exchange rates do not matter for expected C growth

Smith & Yetman (2006)
Engel & Rogers (2007)
Devereux, Smith & Yetman (2009)
CLOSED economy macro literature argues that HTM assumption may explain:

- ‘excess sensitivity’ of $C$ to $Y$ (Campbell and Mankiw)
- macro effects of fiscal policy (Gali et al.)
- equity premium (Weil, Danthine, Lustig)
OPEN ECONOMY literature:

- HTM assumption has received little attention

- To try to explain lack of risk sharing, literature has focused on models with **limited set of internationally traded assets** (e.g. just bond); each country has representative household

  e.g. Kollmann; Baxter & Crucini; Corsetti, Dedola & Leduc etc.
Problems with this approach:

- Results often sensitive to changes in asset menu
e.g. when just have bond denominated in local/foreign good,
then introducing bond denominated in other good can
generate equilibrium similar to complete markets
e.g. G. Benigno & Kucuk-Tuger

- In reality large-scale trade in rich asset set (stocks, options)
- Risk sharing is limited within countries, unappealing
to assume one representative household in each country
MODEL HERE:

- complete markets exist, but only used by fraction of households; other households are HTM

- SIMPLE integration of within-country heterogeneity into model of world economy
Main result:
For plausible model calibration, presence of HTM households can generate:
● realistic C-RER correlation,
● more volatile RER
RELATED LITERATURE:

- Devereux, Yetman & Smith (2009), argue that HTM households can explain consumption & RER forecasts; do not discuss implications of HTM for broader macro facts
Kocherlakota & Pistaferri (2007): privately observed labor productivity

private information-Pareto optimal (PIPO) model implies that cross-sectional right-tail cross-sectional consumption inequality drives exchange rate
K & P claim that PIPO model explains US-UK RER. Can PIPO model explain other macro facts?

THE MODEL

- World with two countries, i=H,F
- Two goods, country i produced good i, output $Y_i$
- Country i has two households: HTM and RS (risk-sharer)

$$U(C_i^h) = \frac{1}{1-\sigma} ((C_i^h)^{\sigma-1} - 1),$$

$$C_i^h = \left[ \alpha^{1/\phi} (c_{i,h}^{i,h})^{(\phi-1)/\phi} + (1-\alpha)^{1/\phi} (c_{i,j,h}^{j,h})^{(\phi-1)/\phi} \right]^{\phi/(\phi-1)}, \ h=\text{HTM,RS}$$

$c_{i,j,h}^{j,h}$: good i consumption by household h in country j

**Home bias:** $0.5 < \alpha < 1$
• Real investment: CES aggregate of local & imported inputs (same parameters as C aggregator)

• HTM household receives stochastic share $\lambda_i$ of GDP: 

$$\lambda_i Y_i$$

HTM consumption: 

$$C_{i}^{HTM} = p_i \lambda_i Y_i / P_i$$

$p_i$ : price of good i;  $P_i$ : CPI in country i

• RS households of the two countries share risk:

$$\left( C_{H}^{RS} \right)^{-\sigma} / \left( C_{F}^{RS} \right)^{-\sigma} = P_H / P_F$$
Shocks to:

• Output

• Physical investment (produced using domestic and foreign inputs using same aggregator as aggregate consumption)

• Share of GDP received by HTM household
THE MAIN MECHANISM

- Presence of HTM households lowers price elasticity of relative demand for two goods
  
  E.g. when price of good H rises, this raises the relative income of HTM household in country H. Due to local spending bias, this dampens effect of price change on relative demand.

Lower price elasticity due to HTM agents means: supply and demand shocks have stronger effect on terms of trade $\Rightarrow$ RER more volatile
When trade share is low (local spending strong: $\alpha$ close to 1), the real exchange rate is:

$$\hat{RER} = -\sigma \frac{\bar{C}}{C^{RS}} (\hat{Y}_H - \hat{Y}_F) + \sigma \frac{\bar{I}}{C^{RS}} (\hat{I}_H - \hat{I}_F) + \sigma \frac{C^{HTM}}{C^{RS}} (\hat{\lambda}_H - \hat{\lambda}_F)$$

Thus, RER volatility greater, the greater risk aversion, the smaller share of Risk Sharer (RS) in total consumption.
Effect of investment shocks

A positive shock to Home investment appreciates Home tot & RER, and lowers Home relative C

But, presence of HTM households dampens drop in relative C (due to wealth effect of tot appreciation)

⇒ dampening of negative comovement between $C_H/C_F$ and $P_H/P_F$ induced by Y & I shocks.
• New shock
When share of Home GDP received by HTM household rises,
Home RER appreciates, and Home relative C rises.

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Without HTM households: \( \text{Corr}(C_H/C_F, P_H/P_F) = -1 \)

With HTM households \( \text{Corr}(C_H/C_F, P_H/P_F) \) greater, closer to zero (as in data)
QUANTITATIVE RESULTS

Model calibrated to US vs. aggregate of remaining G7 countries (‘G6’)

- mean trade share: 3.5% ($\alpha = 0.965$)
- mean investment/GDP ratio: 22%
- mean share of HTM households in total consumption: 50% (Campbell & Mankiw, 1989)

$$\Rightarrow C^{HTM}: 39\% \text{ of GDP, on average}$$

- substitution elasticity Home vs. Foreign goods: $\phi = 0.9$ (Hooper & Marquez, 1995)
- risk aversion: $\sigma = 2$
• Take fluctuations in labor share as proxy for fraction of GDP received by HTM households
\( \hat{Y} \equiv Y_H - Y_F; \hat{C}; \hat{I} \): relative output, consumption, investment
\( \hat{\lambda} \equiv \lambda_H - \lambda_F \): relative HTM GDP share

**Solution under full risk sharing (no HTM)**
\[
\hat{RER} = -2.20 \hat{Y} + 0.41 \hat{I} \quad \hat{C} = 1.01 \hat{Y} - 0.20 \hat{I}
\]

**Solution in HTM benchmark model**
\[
\hat{RER} = -2.23 \hat{Y} + 0.71 \hat{I} + 1.24 \hat{\lambda} \quad \hat{C} = 0.97 \hat{Y} - 0.15 \hat{I} + 0.23 \hat{\lambda}
\]

**NOTE:** stronger [weaker] responsiveness of RER [C]
2 approaches for generating model predicted moments:

1) STATIC APPROACH
   Estimate covariance matrix of US,G6 Output, relative investment, HTM share.

   Compute implied moments of consumption and real exchange rate
2) DYNAMIC APPROACH
Embed HTM households into dynamic International RBC model with exogenous shocks to: TFP, investment efficiency, share of GDP received by HTM households

Endogenously generate output and investment, and implied RER, C

NB If the dynamic model reproduces the observed moments of Y,I,λ, then dynamic approach gives same C,RER moments as static approach.
1) RESULTS FROM STATIC APPROACH

Empirical moments of growth rates of relative forcing variables:

\[\text{Std}(\hat{Y}) = 1.70\%, \text{ Std}(\hat{I}) = 7.69\%, \text{ Std}(\hat{\lambda}) = 1.41\%\]

\[\text{Corr}(\hat{I}, \hat{Y}) = 0.86\%, \text{ Corr}(\hat{Y}, \hat{\lambda}) = -0.26\%, \text{ Corr}(\hat{I}, \hat{\lambda}) = -0.26\%\]

Note: \(\hat{I}\) 4.68 times more volatile than \(\hat{Y}\)

\(\hat{I}\) & \(\hat{Y}\) strongly correlated
PREDICTIONS

In benchmark HTM model:

\[ \text{Corr}(\text{RER}, C_H/C_F) = -0.07, \quad \text{Std}(\text{RER}) = 2.69\% \]

Under full risk sharing:

\[ \text{Corr}(\text{RER}, C_H/C_F) = -1.00, \quad \text{Std}(\text{RER}) = 1.74\% \]

OTHER PREDICTIONS: SEE TABLES
2) RESULTS FROM IRBC MODEL WITH HTM HOUSEHOLDS

Generates realistic $\text{Corr}(C_H / C_F, RER)$

Consistent with other stylized facts
CONCLUSIONS:

PRESENCE OF HAND-TO-MOUTH CONSUMERS CAN CONTRIBUTE TO SOLVING ‘CONSUMPTION-REAL EXCHANGE RATE PUZZLE’

HTM assumption also helps capture other key facts better
### Static approach: predictions

<table>
<thead>
<tr>
<th></th>
<th>HTM model</th>
<th>Full risk sharing</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(a) Baseline calibration</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>$\text{Corr}(\text{RER}, C_H/C_F)$</td>
<td>-0.07</td>
<td>-1.00</td>
<td>0.03</td>
</tr>
<tr>
<td>$\text{Std}(\text{RER})$ in %</td>
<td>2.69</td>
<td>1.74</td>
<td>7.70</td>
</tr>
<tr>
<td>$\text{Std}(\hat{C}_i)$ in %</td>
<td>0.96</td>
<td>0.91</td>
<td>1.19</td>
</tr>
<tr>
<td>$\text{Std}(\frac{NX_i}{(p_i Y_i)})$ in %</td>
<td>0.13</td>
<td>0.06</td>
<td>0.29</td>
</tr>
<tr>
<td>$\text{Corr}(C_H, C_F)$</td>
<td>0.40</td>
<td>0.54</td>
<td>0.42</td>
</tr>
<tr>
<td><strong>(b) High risk aversion, $\sigma = 5$</strong></td>
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</tr>
<tr>
<td>$\text{Corr}(\text{RER}, C_H/C_F)$</td>
<td>0.20</td>
<td>-1.00</td>
<td>0.03</td>
</tr>
<tr>
<td>$\text{Std}(\text{RER})$ in %</td>
<td>4.35</td>
<td>3.12</td>
<td>7.70</td>
</tr>
<tr>
<td><strong>(c) High subst. elasticity dom. vs. foreign goods, $\phi = 2$</strong></td>
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<td></td>
</tr>
<tr>
<td>$\text{Corr}(\text{RER}, C_H/C_F)$</td>
<td>0.12</td>
<td>-1.00</td>
<td>0.03</td>
</tr>
<tr>
<td>$\text{Std}(\text{RER})$ in %</td>
<td>1.72</td>
<td>1.32</td>
<td>7.70</td>
</tr>
<tr>
<td><strong>(d) High trade share, $\alpha = 0.8$</strong></td>
<td></td>
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</tr>
<tr>
<td>$\text{Corr}(\text{RER}, C_H/C_F)$</td>
<td>-0.41</td>
<td>-1.00</td>
<td>0.03</td>
</tr>
<tr>
<td>$\text{Std}(\text{RER})$ in %</td>
<td>0.65</td>
<td>0.81</td>
<td>7.70</td>
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</table>
### Predictions based on IRBC model

#### Moments of HP filtered series

<table>
<thead>
<tr>
<th></th>
<th>HTM</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>(a) Baseline calibration</strong></td>
<td></td>
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<tr>
<td>Corr(RER, (C_H/C_F))</td>
<td>-0.30</td>
<td>-1.00</td>
<td>-0.01</td>
</tr>
<tr>
<td>Std(RER) in %</td>
<td>1.98</td>
<td>1.69</td>
<td>9.89</td>
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<tr>
<td>Std((\hat{Y}_t)) in %</td>
<td>1.10</td>
<td>1.10</td>
<td>1.85</td>
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<tr>
<td>Std((\hat{I}_t)) in %</td>
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<td>3.04</td>
<td>7.06</td>
</tr>
<tr>
<td>Corr((C_H,C_F))</td>
<td>0.24</td>
<td>0.18</td>
<td>0.38</td>
</tr>
</tbody>
</table>

|                |         |                   |       |
| **(b) High risk aversion, \(\sigma = 5\)** |         |                   |       |
| Corr(RER, \(C_H/C_F\)) | -0.03  | -1.00             | -0.01 |
| Std(RER) in %  | 2.23   | 2.07              | 9.89  |

|                |         |                   |       |
| **(c) High subst. elasticity dom. vs. foreign goods, \(\phi = 2\)** |         |                   |       |
| Corr(RER, \(C_H/C_F\)) | -0.25  | -1.00             | -0.01 |
| Std(RER) in %  | 1.76   | 1.55              | 9.89  |

|                |         |                   |       |
| **(d) High trade share, \(\alpha = 0.8\)** |         |                   |       |
| Corr(RER, \(C_H/C_F\)) | -0.04  | -1.00             | -0.01 |
| Std(RER) in %  | 1.35   | 1.24              | 9.89  |