Who Carries?

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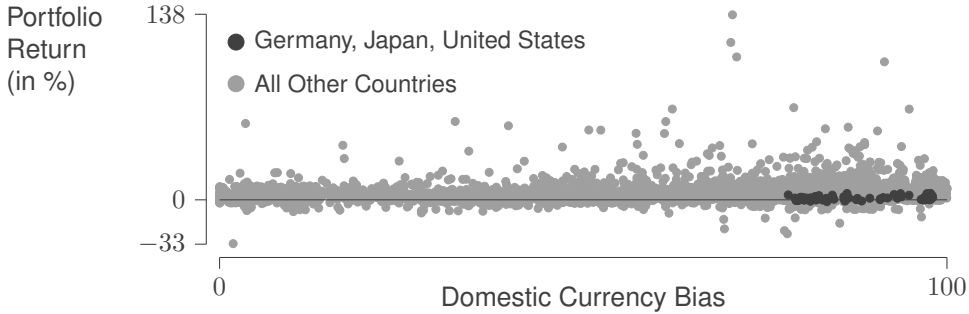
Who Carries?

The economic question: who carries? (1/4)



Remarks:

- DE, JP, and US hold aggregate debt portfolios with strong domestic currency bias
- At the same time, domestic interest rates in these countries have been very low
- If the aggregate position looks nothing like the carry trade, then who carry trades?

The economic question: who carries? (2/4)

Definition

Carry Trade	A long position in a high-interest currency, funded by a short position in a low-interest currency.

Remarks:

- Example: an investor takes a short position in JPY-denominated Japanese bonds
- . . . converts JPY sale proceeds into AUD, buys AUD-denominated Australian bonds

- After a holding period, the investor reverses these transactions
- Investor realizes a currency return plus the interest differential
- Low interest currency should appreciate under UIP; hence, CT violates UIP

The economic question: who carries? (3/4)

Definition

Domestic Portfolio Bias	Investor tendency to hold a disproportionate share of wealth in domestic (or domestic-currency) assets.

Remarks:

- Standard financial theory: investors should hold internationally diversified portfolios
- Evidence: around 80% of bond holdings are home bonds issued in home currency

- If carry trade is prevalent, home bias shouldn't appear in low-interest countries
- Instead, we should see negative JPY bond holdings and positive AUD bond holdings

The economic question: who carries? (4/4)

How can we reconcile the carry trade with domestic currency bias in aggregate portfolios?

- Carry trade receives considerable attention in international macro/finance literature…
- …but most papers focus on returns, leaving positions un-examined

- Intl macro literature suggests that most positions display domestic bias…
- …but in low-interest countries this implies the opposite of carry trade

- Can we endogenize carry traders in countries without aggregate carry trades?
- For whom is carry trade optimal? How do carry traders differ from other agents?

What we do in this paper

Empirics

- We estimate aggregate debt portfolios at the country level
- Demonstrate absence of aggregate carry trades in debt markets
- Document heterogeneity in gross short and long positions in debt

Theory

- Develop two-country model with heterogeneity in risk aversion
- Analyze effects of heterogeneity on portfolio holdings and asset returns
- Endogenize carry traders in economies without aggregate carry trades
- Develop solution for aggregate and individual portfolios in open economies

Key finding

Relevance of carry trade for macro economy

- Existence of carry traders requires assumption of heterogeneity
- Heterogeneity drives an aggregation wedge between CRR and IES
- The wedge can have large effects on asset prices and macro dynamics

Relevance of macro economy for carry trade

- Aggregate economies exhibit domestic bias in aggregate portfolio holdings
- Domestic bias in aggregate portfolios amplifies cross-country return differential
- Hence, aggregate domestic bias increases volatility of carry trade returns

Who Carries?

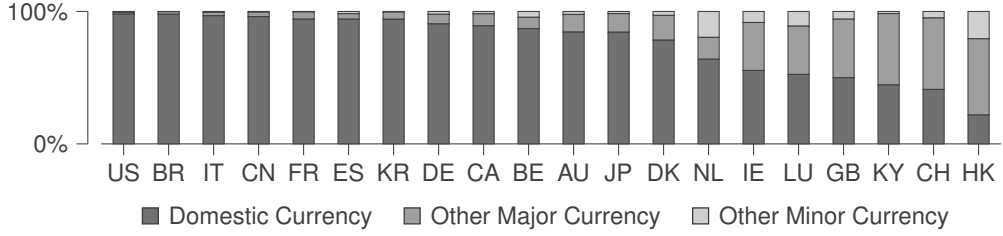
Three empirical findings

1. Most countries have domestic bias in debt holdings
2. Short ratios suggest heterogeneity in debt holdings
3. Negative aggregate net positions in debt are rare

Remarks:

- We look at debt (ignoring derivatives markets)
- We estimate aggregate debt portfolios using IMF CPIS and BIS Issuances
- We use a gravity model to estimate foreign debt holdings when missing from CPIS
- We use issuance minus rest-of-world holdings to estimate domestic debt holdings
- Our estimates surely have large errors, but picture is clear even with large errors

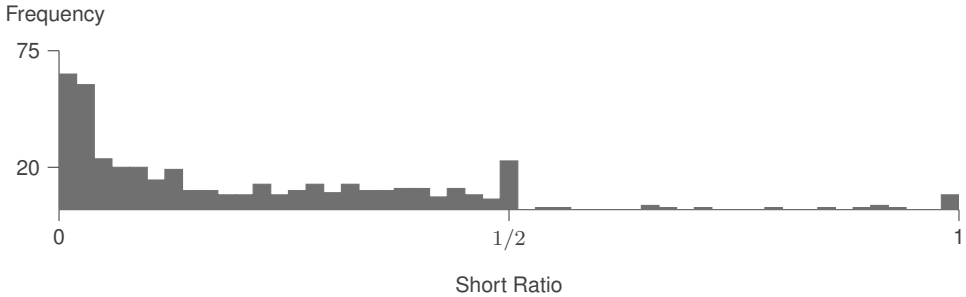
Most countries have domestic-currency bias in debt holdings



Remarks:

- The figure shows the currency composition of debt portfolios for the 20 largest holders
- Other major currencies are CHF, EUR, GBP, JPY, and USD if not the domestic currency
- Strong domestic currency bias in most developed countries; less so in GB, KY, CH, HK
- Similar to Coeurdacier and Rey (2013), **Burger:2018uv<empty citation>**, **Maggiori:2020aa<empty citation>**

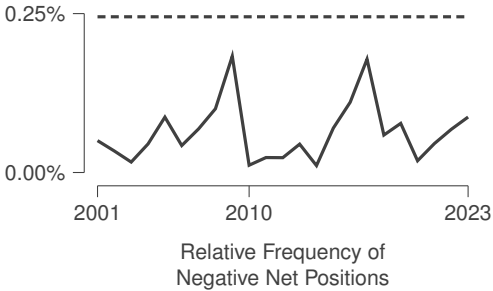
Short ratios suggest heterogeneity in debt holdings

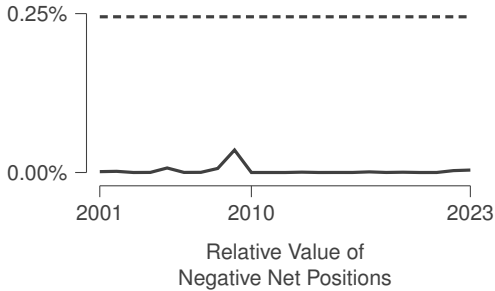


Remarks:

- Short ratios measure relative size of aggregate gross short positions
- Short ratio equals aggregate gross short over aggregate gross short and gross long
- Short ratio of one-half implies gross long and gross short equal in absolute value
- Data for Aruba, Belgium, Bulgaria, the Cayman Islands, Cyprus, and Germany

But negative aggregate net positions in debt are rare





Remarks:

- What would widespread carry look like in aggregate debt markets?
- It should produce negative aggregate net positions in low-interest currencies
- We almost never see negative aggregate net positions, so gross long $>$ gross short

Who Carries?

Theoretical model: key ingredients (1/2)

- Two-country model with incomplete debt markets
- Innovations to endowments and money supplies drive uncertainty
- Home bias in consumption drives home bias in portfolio holdings
- Household heterogeneity in risk aversion delivers portfolio heterogeneity
- Wealth in the utility function delivers stationarity and low risk-free rate

Theoretical model: key ingredients (2/2)

- Determinate non-stochastic steady state
- Stationary dynamics around SS for *both* individual and aggregate variables
- Exact aggregation in SS and approximate aggregation around SS
- Closed-form approximations for Q, R, and individual and aggregate C, W, B
- Meaningful distinction between individual and aggregate portfolio holdings

Model primitives: individual maximization problem

$$U_{it}(\rho) = \mathrm{E}_t\left[\sum_{s=t}^{\infty} \beta^{s-t}\Big(U_{Cis}(\rho) + U_{Wis}(\rho)\Big)\right]$$

$$\text{s.t.} \quad C_{it}(\rho) + B^i_{iit}(\rho) + B^i_{ijt}(\rho) = \frac{P^i_{Cit}}{P^i_{it}} Y_{it}(\rho) + R^i_{it} B^i_{iit-1}(\rho) + R^i_{jt} B^i_{ijt-1}(\rho)\,, \quad i \neq j\,,$$

Notation:

$C_{it}(\rho)$	consumption basket for agent with coefficient of relative risk aversion ρ
$B^i_{ijt}(\rho)$	real holdings of bond j for agent ρ in country i in numeraire currency i
$Y_{it}(\rho)$	endowment of the domestic good for agent ρ in country i, $Y_{it}(\rho) = Y_{it}$
R^i_{jt}	gross real return on bond j in numeraire currency i from period $t-1$ to t
i, j	country indices (subscripts) or currency index (superscript), $i, j \in \{H, F\}$
ρ	heterogeneous coefficient of relative risk aversion and agent index

Aggregation wedge

Individual: $\rho = 1/\sigma(\rho)$

Aggregate: $\bar{\rho} = \omega/\bar{\sigma}\,,$ where $\omega \in (0,1)$

Notation:

- ρ Individual coefficient of relative risk aversion
- $\bar{\rho}$ Aggregate coefficient of relative risk aversion
- $\sigma(\rho)$ Individual intertemporal elasticity of substitution
- $\bar{\sigma}$ Aggregate intertemporal elasticity of substitution
- ω Aggregation wedge, taking values between zero and one for $1/\rho \sim$ Pareto

Aggregate system of equations

$$\mathrm{E}_t\left[\hat{\boldsymbol{Z}}_{i-jt+1}\right] = \mathcal{E}^{(-)}_{ZZ}\hat{\boldsymbol{Z}}_{i-jt} + \mathcal{E}^{(-)}_{ZY}\hat{Y}_{i-jt} + \mathcal{E}^{(-)}_{ZV}\hat{V}^{i}_{i-jt} + O(\epsilon^2)\,,$$

Notation and remarks:

$\hat{\boldsymbol{Z}}_{i-jt}$	$\hat{\boldsymbol{Z}}_{i-jt} = [\hat{W}^{i}_{i-jt},\ \hat{C}_{i-jt}]'$, aggregate cross-country differenced deviations from SS
$\hat{Y}_{i-jt}$	Aggregate endowment, cross-country differenced deviations from SS
$\hat{V}^{i}_{i-jt}$	Aggregate portfolio valuation effect, cross-country differenced deviations from SS
$\mathcal{E}^{(-)}$	Matrix of partial elasticities, written in terms of model parameters

- Linearized aggregate system of equation derived from individual problem
- Strategy: solve aggregate system first, then return to individual problem

Individual system of equations

$$\mathrm{E}_t\left[\hat{\boldsymbol{Z}}_{i-jt+1}(\rho)\right] = \mathcal{E}^{(-)}_{Z(\rho)Z(\rho)}\hat{\boldsymbol{Z}}_{i-jt}(\rho) + \mathcal{E}^{(-)}_{Z(\rho)Y}\hat{Y}_{i-jt} + \mathcal{E}^{(-)}_{Z(\rho)V(\rho)}\hat{V}^{i}_{i-jt}(\rho) + \mathcal{E}^{(-)}_{Z(\rho)V}\hat{V}^{i}_{i-jt} + O(\epsilon^2)\,,$$

Notation and remarks:

- $\hat{\boldsymbol{Z}}_{i-jt}(\rho)$ — $\hat{\boldsymbol{Z}}_{i-jt}(\rho) = [\hat{W}^{i}_{i-jt}(\rho),\ \hat{C}_{i-jt}(\rho),\ \hat{W}^{i}_{i-jt}]'$, individual cross-country differenced SS deviations
- $\hat{Y}_{i-jt}$ — Individual endowment, cross-country differenced deviations from SS
- $\hat{V}^{i}_{i-jt}(\rho)$ — Individual portfolio valuation effect, cross-country differenced deviations from SS
- $\mathcal{E}^{(-)}$ — Matrix of partial elasticities, written in terms of model parameters
  - Individual system depends on household and aggregate real wealth
  - Aggregate real wealth derived from solution to aggregate problem
  - Hence, first solve aggregate problem, then return to individual problem

Portfolio valuation multiplier

$$\hat{R}^i_{i-jt} = \gamma^{(-)}_{RY} \hat{Y}_{i-jt} + \gamma^{(-)}_{RM} \hat{M}^{i-j}_{i-jt} + O(\epsilon^2)$$

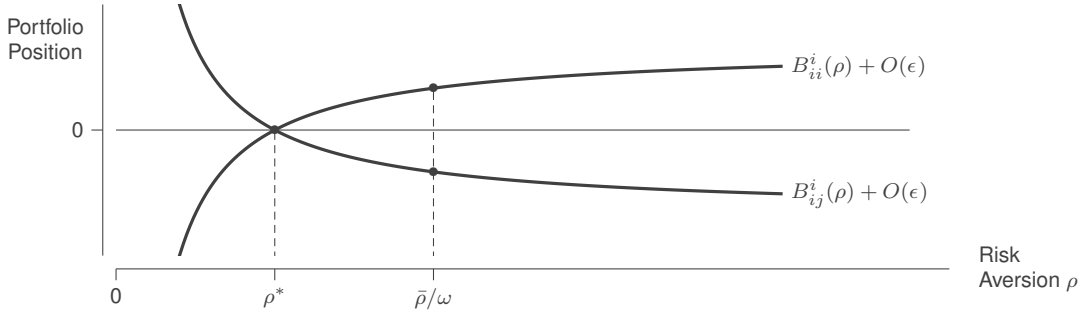
where

$$\gamma^{(-)}_{RY} = \mu^{(-)}_{ii-ji} \eta^{(-)}_{RY} \quad \text{and} \quad \gamma^{(-)}_{RM} = \mu^{(-)}_{ii-ji} \eta^{(-)}_{RM}\,, \quad \text{with} \quad \mu^{(-)}_{ii-ji} = \frac{1}{1 - \eta^{(-)}_{RV} B^i_{ii-ji}}$$

Notation and remarks:

- $\mu^{(-)}_{ii-ji}$ Portfolio valuation multiplier
- $\gamma^{(-)}$ General elasticity, depends only on model parameters
- $\eta^{(-)}$ Semi-partial elasticity, depends only on model parameters
  - Solve for cross-country differenced real returns using aggregate solutions
  - Multiplier amplifies money and endowment shocks when portfolios home-biased

Portfolio holdings in cross-section of agents



Remarks:

- Figure assumes that domestic real return lies below international real return
- Agents with $\rho < \rho^*$ are carry traders, while those with $\rho > \rho^*$ are hedgers

Who Carries?

Summary of Main Results

Empirical Findings

- Carry trade positions are rare in aggregate country-level debt data
- Debt holdings exhibit strong domestic-currency bias
- Carry traders are outweighed by investors who prefer domestic assets

Model Advantages

- Continuum economy with heterogeneity in risk aversion and portfolio choice
- Extends Samuelson-Devereux-Sutherland solution method to heterogeneous agents
- Highly tractable with closed-form solutions for individual and aggregate variables

Key Findings

- Aggregate portfolios can have domestic bias even when portfolio returns are low
- Individual positions range from speculative carry trades to safe domestic hedges