

Demand for Collateral, Foreign Holdings of U.S. Treasuries and Taxes on Capital Flows

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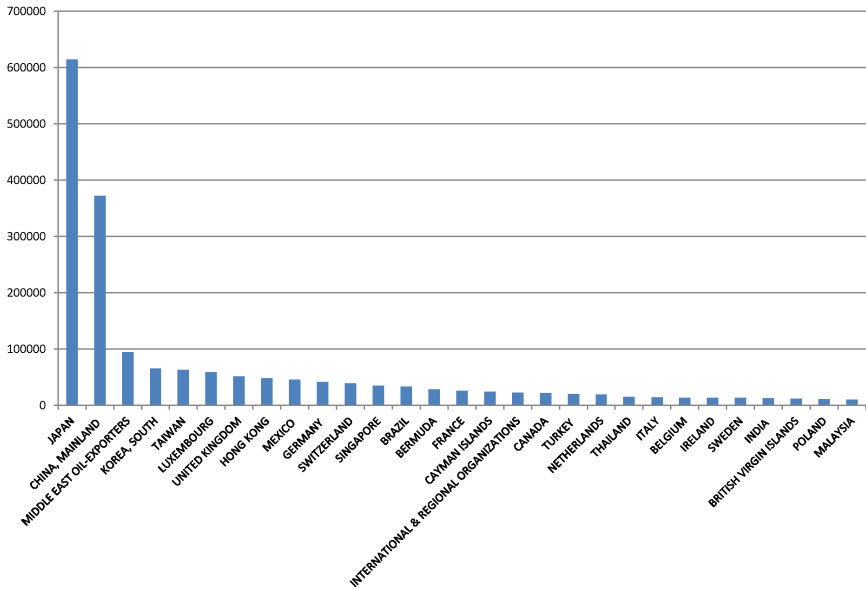
Motivation

- ▶ Foreign holdings of U.S. Treasuries. Two ways to look the data:
 - ▶ The US view
 - ▶ The foreigners view

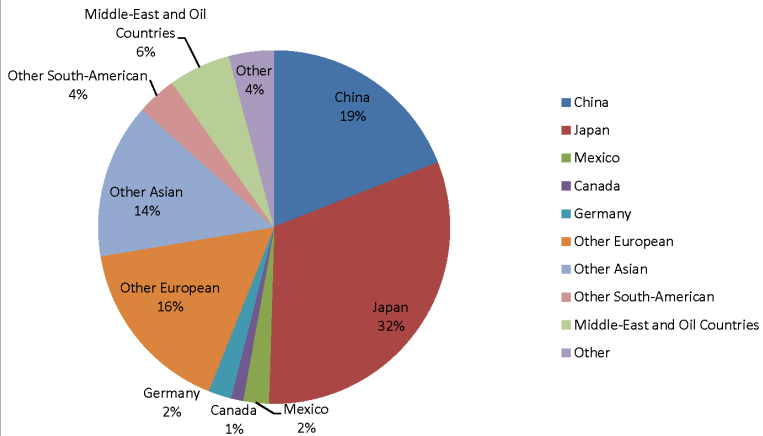
1. From the U.S. view, look absolute holdings:

- ▶ Foreign holdings are large. In 2010:
 - ▶ around 57% of long term (>1 yr) Treasuries
 - ▶ around 17% of long term Agency bonds
 - ▶ Most are "official public holdings", but private holdings are not trivial ($\approx 25\%$)
 - ▶ "Official public holdings" not disclosed at country level

- ▶ Foreign holdings reduced U.S. interest rates.
 - ▶ Did they trigger housing boom?
- ▶ They finance U.S. current account and fiscal deficits
- ▶ A few countries dominate the foreign holdings. From this view, just to care about China and Japan?



2006 holdings of LT Treasuries in millions of U.S. dollars.



Source: TIC's data

2. From the foreigners' view, look relative holdings:

- ▶ Ample heterogeneity in the cross-section of countries.
- ▶ Why so much capital flows from poor countries to the U.S.?
 - ▶ Signal of domestic weaknesses? which ones?
 - ▶ What implications for financial reforms?

Foreign holdings of LT U.S. Treasuries over GDP

	2004-2009			
	Mean	Std. Dev	Min	Max
High Income countries	.04	.06	.004	.24
Middle Income countries	.04	.03	.016	.09
Low Income countries	.05	.03	.011	.12

- ▶ Sample of top 46 countries excluding financial hubs like UK, Switzerland, Cayman Islands...
- ▶ At country level, data are for both private and official holdings

Another measure: Foreign holdings of long term U.S.
Treasuries and Agency securities over (Exports+Imports)

	2004-2009			
	Mean	Std. Dev	Min	Max
High Income countries	.086	.13	.006	.69
Middle Income countries	.08	.1	.005	.49
Low Income countries	.085	.074	.0015	.35

What explains foreign demand for U.S. Treasuries?

1. Theory work:

- ▶ **Portfolio choice:** return differentials and correlations
 - ▶ Home bias: distance and links to U.S.
- ▶ **Financial development:**
 - ▶ Demand for assets that serve as store of value (Caballero et al. 2008)
 - ▶ Demand for insurance (Mendoza et al. 2009)

2. Empirical work:

- ▶ Forbes (2010) regresses foreign holdings of U.S. equity and debt on...
 - ▶ Capital controls, Closeness to the U.S., Corporate Governance, Correlation in returns, Returns differentials
 - ▶ Stock Market Capitalization/GDP, Private Bond Market/GDP (proxies for financial underdevelopment)
- ▶ She concludes **financial underdevelopment** is key
- ▶ But... which type of financial underdevelopment?

Our contribution:

- ▶ If some countries do **not have enough assets** that can serve as **collateral**.
- ▶ If foreigners **need to do repo borrowing (collateralized credit)**
- ▶ then **demand for collateral** drives demand for U.S. assets

Model

- ▶ Agents with periods of high income (e_H) and of low income (e_L)

$$e_H > e_L$$

- ▶ Preferences:

$$\sum_{t=0}^{\infty} \beta^t u(c_t^i)$$

$u(c)$ is strictly increasing, strictly concave

- ▶ Both deterministic and stochastic model give same insights. Also, same insights if borrowing is for investment

Asset Structure

- ▶ k_t denotes foreign asset holding of U.S. assets
- ▶ Return on U.S. asset is R^{US} (assumed constant for now)
- ▶ Domestic borrowing and lending (b_t^i) at the interest rate R_t .
- ▶ Borrowing has to be collateralized by U.S. asset.
- ▶ Example: banks participating in money markets. The collateral is different from models where household or firms borrow.

- ▶ Budget constraint of agent i :

$$c_t^i + \frac{1}{R_{US}} k_{t+1}^i + \frac{1}{R_t} b_{t+1}^i \leq e_t^i + b_t^i + k_t^i$$

- ▶ Collateral Constraint:

$$b_{t+1}^i \geq -m k_{t+1}^i$$

- ▶ $m < 1$: overcollateralization E.g. mortgages
 - ▶ $m > 1$: undercollateralization. E.g. Fractional-reserve banking
- ▶ Domestic agents cannot short sell the foreign asset

$$k_{t+1}^i \geq 0$$

- ▶ Natural borrowing limit holds when $m > 1$

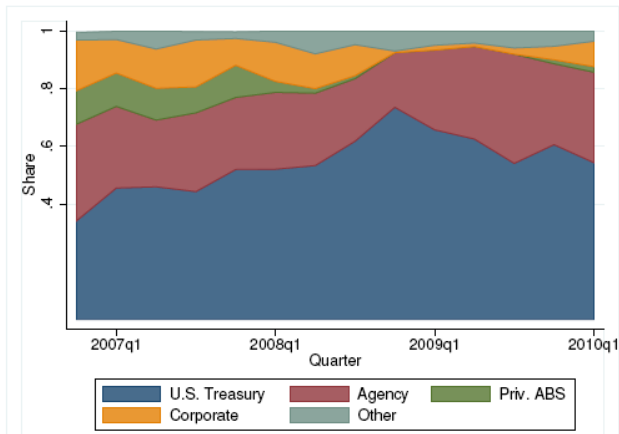
3 Facts justify these assumptions

1. **Repo Markets are huge.** Although economists (and policy-makers) only paid attention to them after recent crisis...
 - ▶ There are no official statistics on the size of the repo markets

- ▶ Some estimates:
 - ▶ Gorton and Metrick (2011): U.S. repo markets in 2007 about the **same size, or larger, than the U.S. banking system** of \$10 trillion.
 - ▶ Hördahl and King (2008): gross amounts outstanding at year-end 2007, \$10 trillion in each of the U.S. and Euro markets, \$1 trillion in the UK.

- ▶ Fitch Ratings (2011): the recent financial crisis **pushed banks towards repo funding** because:
 - ▶ 1) the cost differential between secured and unsecured bank debt widened after 2008;
 - ▶ 2) the inability of weaker banks to access senior unsecured debt markets.
- ▶ Lam and Zhang (2010): in **China**, interbank repo transactions have become the **most important form of interbank borrowing** due to the problem of non-performing uncollateralized interbank loans.

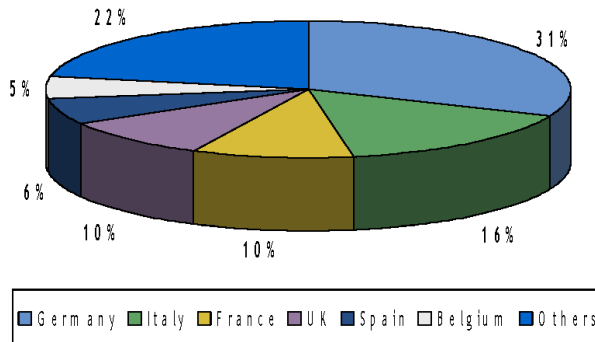
2. U.S. Treasuries are the assets most widely accepted around the world as collateral



U.S. Repo Markets, type of collateral accepted

Euro Repo Markets, country origin of collateral accepted

Country of underlying collateral



Source: ISMA European Repo market survey - June 2003

Euro Repo Markets, currency of the loan

Figure 2.4 – Currency analysis

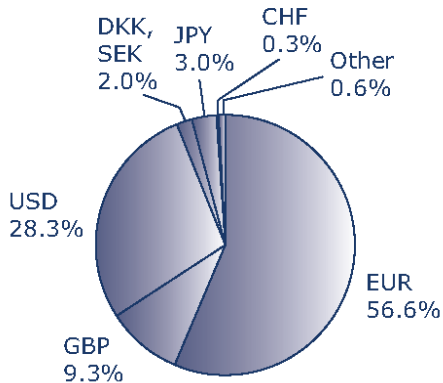


Table 2.7 – Currency comparison in June 2010

3. Cross-border lending is important in many emerging economies

- ▶ BIS (2010): in 2008, total bank lending of foreign banks and their affiliates exceeded...
US\$ 1,500 billion in emerging Asia,
US\$ 900 billion in emerging Europe
US\$ 800 billion in Latin America.

- ▶ Shin (2010): Korean banks have low deposits to loan ratios and borrow in international wholesale funding markets.
 - ▶ We used BIS data to estimate in 2008 foreign lending to the Korean banking sector exceeded 40% of Korean's GDP.
 - ▶ Unfortunately we do not know which fraction of the lending was done via repo markets. But Korean Securities Institutions allow U.S. Treasuries as collateral.

Three types of equilibrium depending on m

- ▶ If $m = 0$, Type 1
- ▶ if $0 < m \leq 1$, Type 2.
 - ▶ **In Type 1 and Type 2 there is no demand for collateral, only demand for storage à la Caballero et al. (2008)**
- ▶ If $m > 1$, Type 3.
 - ▶ **In Type 3 there is only demand for collateral, no demand for store of value.**
- * Also demand for collateral if $m \leq 1$ and stochastic model with high risk aversion and high enough returns for Treasuries

Type 1: No active repo markets

- ▶ If $m = 0$, no borrowing allowed

$$b_{t+1}^i \geq 0$$

- ▶ if no borrowers, no lenders

$$\sum_{i \in \{o, e\}} b_{t+1}^i = 0$$

- ▶ so rich can only invest in the U.S.

$$b_{t+1}^i = 0$$

Type 2: No active repo markets

- ▶ if $0 < m \leq 1$, the model is equivalent to the one with $m = 0$, there is only demand for storage.
- ▶ Intuition: the collateral requirement is too high, if an agent needs to borrow, she will not have enough capital to buy collateral.

Type 3: Active repo markets

- ▶ If $m > 1$: in equilibrium,

$$R_t > R^{US}$$

- ▶ Rich will strictly prefer to lend rather than investing in the foreign asset
- ▶ Poor want to purchase the foreign asset as collateral to borrow.
- ▶ The foreign asset only has collateral value, not storage value.

- ▶ When collateral constraint is binding:
Endogenous spread between borrowing and lending. Not in Curdia and Woodford (2009)

$$\underbrace{\frac{(m-1)}{\frac{m}{R_t} - \frac{1}{R^{US}}}}_{\text{Borrowing rate}} > \underbrace{R_t}_{\text{Lending rate}}$$

Example: Deterministic Economy

- ▶ Two agents odd and even:

$$\{e_t^e\}_{t=0}^{\infty} = (e_H, e_L, e_H, \dots)$$

and

$$\{e_t^o\}_{t=0}^{\infty} = (e_L, e_H, e_L, \dots)$$

- ▶ If $m \leq 1$:

$$R_t = R^{US}$$

- ▶ If $m > 1$:

$$R_t = mR^{US} \frac{2}{\sqrt{1 + 4m(m-1)\beta^2(R^{US})^2 + 1}} \in (R^{US}, mR^{US})$$

given that

$$R^{US} < \frac{1}{\beta}$$

- ▶ As $m \rightarrow \infty$: Domestic markets are complete.
Optimum if full insurance

$$R \rightarrow \frac{1}{\beta}$$

Numerical results 1

Let's assume:

▶ $\beta = 0.95$

▶ $u(c) = \frac{c^{1-\sigma}-1}{1-\sigma}; \sigma = 3$

▶ $R^{US} = \frac{1}{1.1*\beta};$

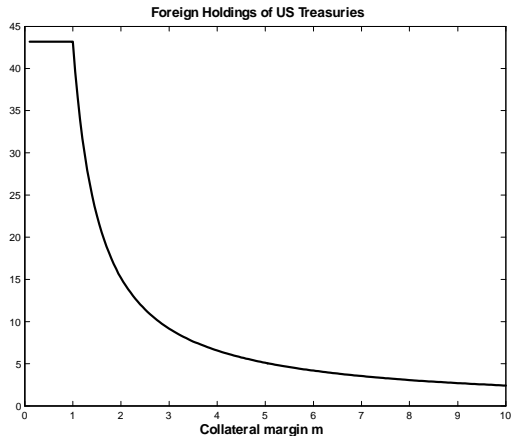
▶ $e_L = 10$

▶ $e_H = 100$

▶ m varies from 0 to 10

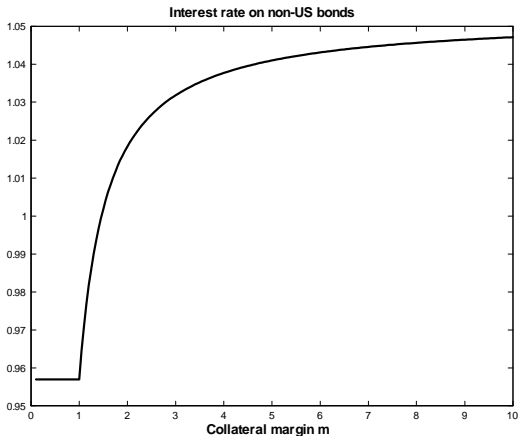
Holdings of US Treasuries

- ▶ Holdings decrease as $m \rightarrow \infty$ because need to post foreign collateral decreases

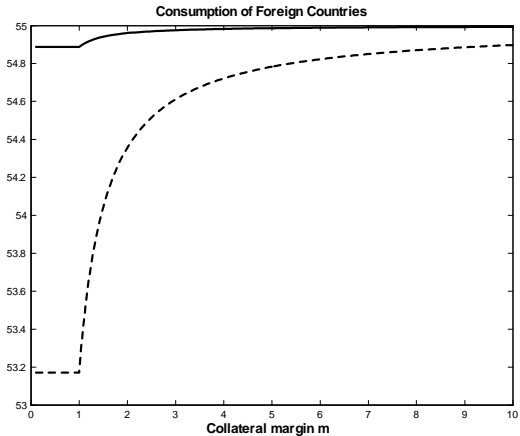


Domestic interest rate

- ▶ Domestic rate increases as borrowers need to buy less foreign collateral



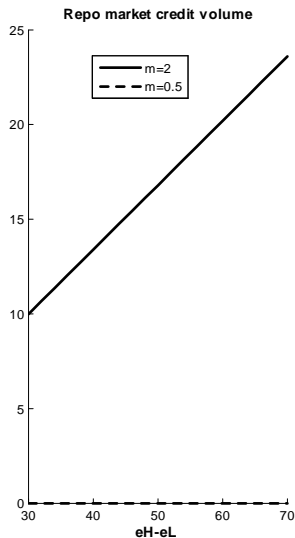
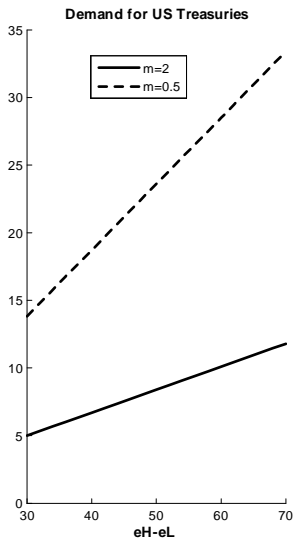
Consumption of Domestic Agents converges to perfect insurance case



Can we disentangle demand for collateral from demand for store of value?

- ▶ Fix $m = 2$ (demand for collateral) or $m = 0.5$ (demand for storage)
- ▶ Assume that desire for borrowing ($e_H - e_H$) varies from 30 to 100

yes we can! Look at foreigners' activity in repo markets



Policy implications

- ▶ Collateral shortages is type of financial underdevelopment
- ▶ It prevents repo borrowing
- ▶ Structural reforms take many years to affect m
 - ▶ Fight corruption, reform legal system etc.
- ▶ Can taxes/subsidies help?
 - ▶ Related to recent academic and policy interest on capital controls

New models supporting capital controls

- ▶ Based on pecuniary externality that our model lacks E.g. Bianchi (2010), Korinek (2011)
 - ▶ Price of collateral (U.S. Treasury) is exogenous in our model
- ▶ But we have inefficiency those models lack
 - ▶ They lack our heterogeneity among foreigners
- ▶ First inefficiency pushes for taxes on borrowings, ours for subsidies

Policy experiment 1

- ▶ Subsidize repo borrowing, financed by lump-sum taxes

$$c_{i,t} + \frac{1}{R_t^{US}} k_{i,t+1} + \frac{1}{R_t} b_{i,t+1} \leq e_{1,t} + b_{i,t} + k_{i,t} - T_{i,t}$$

if $b_{i,t+1} \geq 0$,

$$c_{i,t} + \frac{1}{R_t^{US}} k_{i,t+1} + \frac{1 + \tau}{R_t} b_{i,t+1} \leq e_{1,t} + b_{i,t} + k_{i,t} - T_{i,t}$$

if $b_{i,t+1} < 0$

Subsidize Repo Borrowing

- ▶ Look for equilibria with balanced transfers:

$$\sum_{i=1,2} b_{i,t+1} = 0$$

$$\sum_{i=1,2} \left(T_{i,t} + \frac{\tau}{R_t} b_{i,t+1} \mathbf{1}_{\{b_{i,t} < 0\}} \right) = 0.$$

- ▶ Proposition: Let $\tau^* = \frac{1}{m} \left(\frac{1}{\beta R^{US}} - 1 \right)$, then the foreign economies achieve full risk-sharing.

Policy experiment 2

- ▶ Subsidize the foreign holdings of U.S. Treasuries, financed by lump-sum taxes

$$c_{i,t}^F + \frac{1 - \tau}{R_t^{US}} k_{i,t+1} + \frac{b_{i,t+1}}{R_t} \leq e_{1,t} + b_{i,t} + k_{i,t} - T_{i,t}$$

if $b_{i,t+1} \geq 0$,

$$c_{i,t}^F + \frac{1 - \tau}{R_t^{US}} k_{i,t+1} + \frac{b_{i,t+1}}{R_t} \leq e_{1,t} + b_{i,t} + k_{i,t} - T_{i,t}$$

if $b_{i,t+1} < 0$

Subsidize the foreign holdings of U.S. Treasuries

- ▶ Equilibrium Definition:

$$b_{1,t+1} + b_{2,t+1} = 0$$
$$\sum_i \left(T_{i,t} - \tau \frac{1}{R_t^{US}} k_{i,t+1} \right) = 0.$$

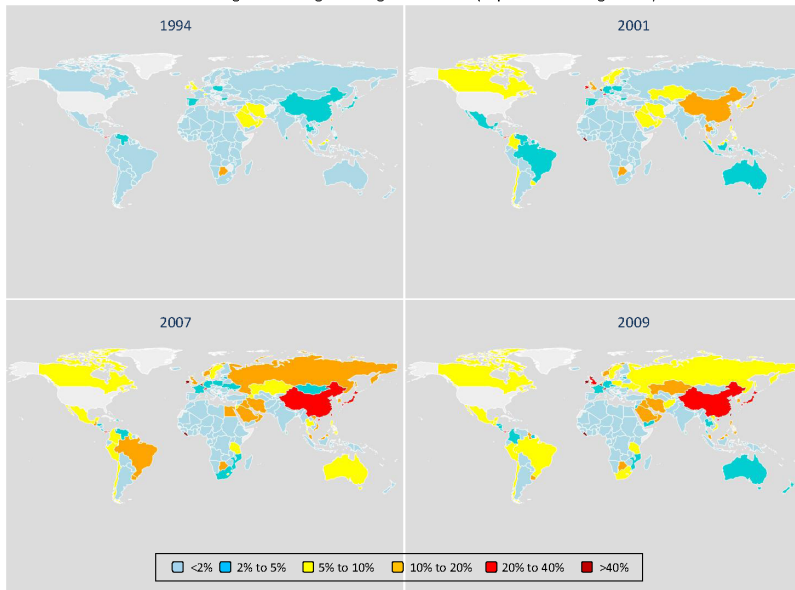
- ▶ Proposition: Let $\tau^* = 1 - \beta R^{US}$, then the economy achieves full risk-sharing.

Conclusion

- ▶ Demand for collateral may drive holdings of U.S. Treasuries
- ▶ Implications for policies on capital controls

Appendix

Figure 6: Foreign Holdings of US Bonds (in percent of foreign GDPs)



Source: Treasury TIC database, WEO, and IMF staff calculations.