

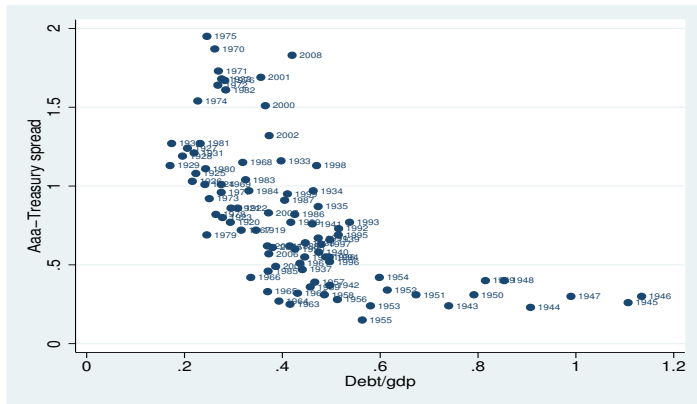
# The Aggregate Demand for Treasury Debt

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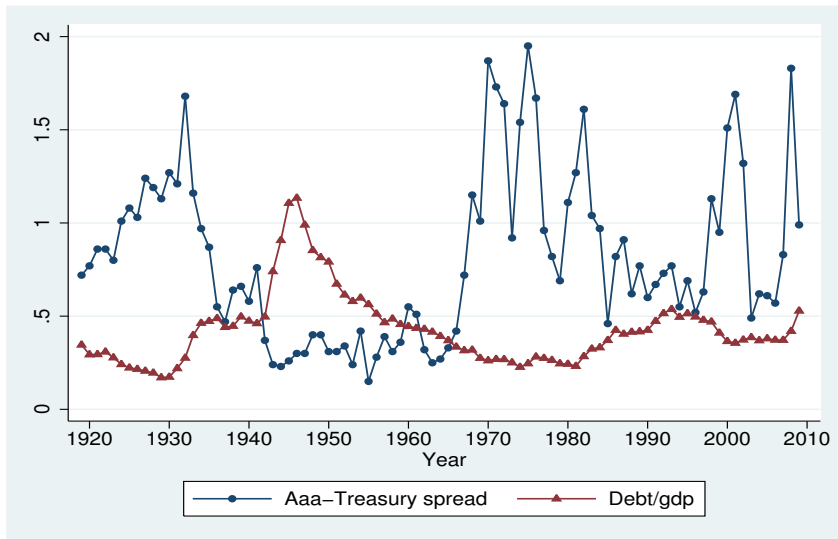
May 2010

Yield spread between Moody's Aaa bond yield and long term Treasury yield, versus Publicly held US Treasury Debt/US GDP. 1919-2008.



- Standard monetary theory: Money is (1) medium of exchange, (2) high liquidity, (3) high safety (store of value).
- Our theory: Treasury bonds offer (2) and (3). The figure is akin to money-demand function, but for government debt.

Time series version of the same relation:



## Related Literature

- Money demand literature
- Ricardian Equivalence: Barro (1974) ...  
We show that government debt is non-Ricardian. Main novelty relative to literature is looking at spreads rather than level of Treasury interest rates.
- Corporate bond pricing/Swap pricing: Collin-Dufresne, Goldstein, and Martin (2001), Longstaff, Mithal, and Neis (2005), Duffie and Singleton (1997), Grinblatt (2001), Liu, Longstaff, and Mandell (2004), Feldhutter and Lando (2005)  
Estimate default component; large residual is referred to as “non-default” component. Indirect inference of a convenience value.
- Supply effects in bond markets: Krishnamurthy (2001), Greenwood, Hanson, and Stein (2009), Greenwood and Vayanos (2010).

# Outline

- 1 Theory and evidence for the existence of a convenience yield on Treasuries
- 2 More theory and evidence: What are the attributes of Treasuries that drive convenience?
- 3 Evidence on money and Treasuries

## Implications

- 1 Fiscal policy and seignorage
- 2 Money and banking
- 3 Global imbalances: Securitization as safe-debt demand, Effect of foreign investors on U.S. interest rates.
- 4 Interpreting movements in T-bill rates and short-term spreads during the crisis.

## 1: The convenience yield on Treasuries

Representative agent who maximizes,

$$E \sum_{t=1}^{\infty} \beta^t u(C_t) \quad (1)$$

where  $C_t$  is the agent's consumption plus "convenience" benefits:

$$C_t = c_t + \nu(\theta_t^A, GDP_t; \xi_t). \quad (2)$$

Convenience assets:

$$\theta_t^A = \theta_t^T + k^P \theta_t^P. \quad (3)$$

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Assume homogeneity in income and holdings. Define:

$$\nu \left( \frac{\theta_t^A}{GDP_t}; \xi_t \right) GDP_t \equiv \nu(\theta_t^A, GDP_t; \xi_t). \quad (4)$$

The one-period yield spread between corporate and Treasury bonds:

$$S_{t,1} \equiv i_t^C - i_t^T = \nu' \left( \frac{\theta_t^T + k^P \theta_t^P}{GDP_t}; \xi_t \right) + \lambda_t D_t. \quad (5)$$

$\lambda_t$  is probability of default in next period, and  $D_t$  is loss-rate given default.

## Pricing FOCs

FOC for Treasury bond holdings.

$$-\frac{P_t^T}{Q_t} u'(C_t) + \beta E_t \left[ \frac{P_{t+1}^T}{Q_{t+1}} u'(C_{t+1}) \right] + \frac{P_t^T}{Q_t} v'(\theta_t^A / GDP_t, \xi_t) u'(C_t) = 0$$

Price level at date  $t$  as  $Q_t$ . Buys zero coupon Treasury bond for a nominal price  $P_t^T$ , real holdings  $\theta_t^A$  rises by  $\frac{P_t^T}{Q_t}$ , which gives convenience,  $\frac{P_t^T}{Q_t} v'(\theta_t^A / GDP_t, \xi_t) u'(C_t)$ .

$$P_t^T = \frac{E_t[M_{t+1} P_{t+1}^T]}{1 - v'(\theta_t^A / GDP_t; \xi_t)} \approx e^{v'(\theta_t^A / GDP_t; \xi_t)} E_t[M_{t+1} P_{t+1}^T]$$

where,

$$M_{t+1} = \beta \frac{u'(C_{t+1})}{u'(C_t)} \frac{Q_t}{Q_{t+1}}$$

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where,

$$M_{t+1} = \beta \frac{u'(C_{t+1})}{u'(C_t)} \frac{Q_t}{Q_{t+1}}$$

Corporate bond (follows Duffie-Singleton (1997) formulation):

$$P_t^C = E_t \left[ M_{t+1} \left( \lambda_t (1 - D_t) P_{t+1}^C + (1 - \lambda_t) P_{t+1}^C \right) \right] \approx e^{-\lambda_t D_t} E_t[M_{t+1} P_{t+1}^C].$$

$\lambda_t$  is probability of default in next period, and  $D_t$  is loss-rate given default.

## Evidence for convenience yield

One-period spread  $S_{t,1} \equiv i_t^C - i_t^T = v' \left( \frac{\theta_t^T + k^P \theta_t^P}{GDP_t}; \xi_t \right) + \lambda_t D_t$  (6)

$\tau$ -period spread  $S_{t,\tau} = \sum_{j=t}^{t+\tau-1} \frac{1}{\tau} E_t[v'(\theta_j^A / GDP_j; \xi_j^L)]$  (7)

$$+ \sum_{j=t}^{t+\tau-1} \frac{1}{\tau} E_t[\lambda_j D_j] - \sum_{j=t}^{t+\tau-1} \frac{1}{\tau} \text{cov}_t(m_{j+1}, \tilde{R}_{j+1})$$

Excess returns  $E_t[M_{t+1} \tilde{R}_{t+1}] = v'(\theta_t^A / GDP_t; \xi_t)$  (8)

## Evidence for convenience yield

$$\text{One-period spread} \quad S_{t,1} \equiv i_t^C - i_t^T = v' \left( \frac{\theta_t^T + k^P \theta_t^P}{GDP_t}; \xi_t \right) + \lambda_t D_t \quad (6)$$

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Tests: Verify that increases in  $\theta_t^T$  cause the spread to fall.

- Requires that  $\theta_t^A = \theta_t^T + k^P \theta_t^P$  increasing in  $\theta_t^T$ . Private sector reaction should not offset more than one-for-one. Extremely unlikely, and we can also check for this.
- Requires that  $\theta_t^T$  does not respond to the spread; i.e. govt reduces debt supply if spread rises (to give negative relation). Reality: if anything govt expands supply if spread rises.
- Caveat: Regression coefficient is net of private-sector response.

- Regressions of the following form:

$$\text{spread}_t = a + b_1 \ln \text{Debt}_t / \text{GDP}_t + b_2 \text{controls}_t + \text{error}_t$$

- Both left and right-hand side persistent. We run OLS, modeling error as AR(1), and adjust down  $t$ -stats
- Why not GLS (first-differences), or Newey-West? Conv yield term is  $E_t[\sum v'(\theta_t^A)]$ , proxied by  $\ln \text{Debt}_t / \text{GDP}_t$ . Measurement error, gets magnified when first-differencing.
- We ran a Monte-Carlo, experimenting with a number of error structures before settling on this.

**Table I**  
**Impact of Treasury Supply on Bond Spreads: Log Specification**

The dependent variables are short and long-term yield spreads between corporate and Treasury bonds, both measured in percentage units. Independent variables are based on the real market value of Treasury debt outstanding, real US GDP, and controls for the default risk and risk premium on corporate bonds. Volatility, EDF, and slope controls are demeaned. Regressions are estimated by ordinary least squares. The standard errors are adjusted assuming errors are AR(1). We use the Box-Jenkins methodology for identifying the error structure.  $\rho$  denotes the first order autocorrelation of the error terms.

Period	Panel A: Aaa-Treasury			Baa-Treasury	Panel C: CP-Bills			CPP2-Bills
	(1)	(2)	(3)	(5)	(6)	(7)	(8)	(9)
	1919-2008	1969-2007	1926-2008	1926-2008	1920-2008	1969-2007	1926-2008	1974-2007
<i>log(Debt / GDP)</i>	-0.744 [-4.32]	-0.910 [-3.35]	-0.797 [-5.06]	-1.304 [-7.54]	-0.728 [-4.37]	-1.006 [-2.21]	-0.550 [-3.52]	-1.919 [-3.86]
<i>EDF - KMV</i>		0.953 [3.57]				0.024 [0.05]		0.086 [0.16]
<i>volatility</i>			1.294 [1.90]	6.364 [6.88]			1.947 [2.33]	
<i>slope</i>		0.045 [1.05]	0.080 [1.86]	0.309 [4.64]		-0.123 [-1.30]	-0.085 [-1.42]	-0.105 [-1.13]
<i>Intercept</i>	0.111 [0.62]	0.052 [0.18]	0.078 [0.49]	0.737 [4.34]	0.095 [0.56]	-0.269 [-0.55]	0.229 [1.49]	-0.813 [-1.58]
<i>R</i> <sup>2</sup>	0.447	0.623	0.568	0.690	0.224	0.211	0.259	0.282
$\rho$	0.572	0.402	0.528	0.012	0.183	-0.023	0.018	0.122
<i>N</i>	90	39	83	83	89	39	83	34

- Column (1) coefficient of  $-0.744$ : One- $\sigma$  change in Debt-to-GDP from mean value of 0.426 to 0.233 increases the convenience yield component of the Aaa-Treasury spread by 0.45% (45 basis points).
- Column (2): One- $\sigma$  increase in EDF  $\rightarrow$  21 basis points.
- Column (3): One- $\sigma$  increase in volatility  $\rightarrow$  10 basis points.
- Column (5): One- $\sigma$  increase in Debt/GDP  $\rightarrow$  79 basis points.

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**Table II**  
**Impact of Treasury Supply on Bond Returns**

The dependent variable is the annual percentage excess return on long term corporate bonds over long term government bonds. Return data are from Ibbotson, beginning in 1926 and ending in 2003. Controls include the annual percentage excess return on junk bonds over Baa bonds (*CreditHedge*), the spread between the 10 year Treasury yield and the 3 month Treasury yield (*Slope*), and the realized returns on long term government bonds over short term bonds (*DurationHedge*). Regressions are estimated by ordinary least squares. The standard errors are adjusted assuming errors are ARMA(1,1).

	(1)	(2)	(3)
<i>log(Debt/GDP)</i>	-0.851 [-1.29]	-1.696 [-2.21]	-1.826 [-1.83]
<i>CreditHedge</i>		0.160 [2.89]	0.121 [2.22]
<i>Slope</i>			0.678 [1.64]
<i>DurationHedge</i>			-0.117 [-2.56]
<i>Intercept</i>	-0.301 [-0.46]	-1.245 [-1.60]	-1.127 [-1.13]
<i>R</i> <sup>2</sup>	0.009	0.100	0.162
<i>N</i>	78	78	78

## 2. What drives the convenience yield on Treasuries?

$v\left(\frac{\theta_t^A}{GDP_t}; \xi_t\right)$  is a reduced form convenience benefit function.

### 1 Liquidity demand:

- ▶ Aiyagari and Gertler (1991), Heaton and Lucas (1996), Vayanos and Vila (1998), Rocheteau (2009)
- ▶  $v(\cdot) > 0$ ,  $v'(\cdot) < 0$ , and  $v'(\cdot) \rightarrow 0$  for large holdings.
- ▶ Comment: These are all two-agent models; so don't take our rep agent formulation literally.

### 2 Short-term safety demand:

- ▶ Limited participation/knowledge explanation (Vissing-Jorgensen 2003)
- ▶ Some investors can only buy safe assets. Drives down safe asset returns.
- ▶ Collateral (Gorton, 2010): Safe collateral pledged in derivatives and settlement.
- ▶ Check-backing (Bansal-Coleman 1996): Households require that banks and money funds hold safe collateral to back checking accounts.
- ▶ Comment: Not high risk aversion in a rep agent model. No link between quantity of safe assets and prices in the rep agent model.

3 Long-term safety demand:

- ▶ Preferred habitat: Modigliani-Sutch (1966), Greenwood and Vayanos (2010)
- ▶ Some investors (e.g. pension funds, insurance companies) demand safe long-term payoffs.

Convenience components on short-term Treasuries:

$$v_{T,short}(\cdot) = v_{liq} \left( \frac{\theta_t^T + k^{liq} \theta_t^{P,liq}}{GDP_t}; \xi_t^{liq} \right) \\ + v_{short-safe} \left( \frac{\theta_t^{T,short} + k^{short-safe} \theta_t^{P,short-safe}}{GDP_t}; \xi_t^{short-safe} \right).$$

Convenience on long-term Treasuries:

$$v_{T,long}(\cdot) = v_{liq} \left( \frac{\theta_t^T + k^{liq} \theta_t^{P,liq}}{GDP_t}; \xi_t^{liq} \right) \\ + v_{long-safe} \left( \frac{\theta_t^{T,long} + k^{long-safe} \theta_t^{P,long-safe}}{GDP_t}; \xi_t^{long-safe} \right).$$

## Short-term spread

We had:

$$S_{t,1} \equiv i_t^C - i_t^T = v'(\theta_t^T + k^P \theta_t^P; \xi_t) + \lambda_t D_t.$$

Expressing in terms of components:

$$\begin{aligned} S_{t,1} &= v'_{liq} \left( \frac{\theta_t^T + k^{liq} \theta_t^{P,liq}}{GDP_t}; \xi_t^{liq} \right) \\ &+ v'_{short-safe} \left( \frac{\theta_t^{T,short} + k^{short-safe} \theta_t^{P,short-safe}}{GDP_t}; \xi_t^{short-safe} \right) \\ &+ \lambda_t D_t. \end{aligned}$$

## Liquidity and Safety Tests

- A pure short-term safety spread (P2 - P1 Commercial Paper):

$$S_{t,1}^{P2-P1} = (k_{P1}^{short-safe} - k_{P2}^{short-safe}) v_{short-safe} \left( \frac{\theta_t^{T, short} + k^{short-safe} \theta_t^{P, short-safe}}{GDP_t}; \xi_t^{short-safe} \right) + \lambda_{t,P2} D_{t,P2} - \lambda_{t,P1} D_{t,P1}.$$

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- A pure long-term safety spread (Baa-Aaa spread):

$$S_{t,\tau}^{Baa-Aaa} = (k_{Aaa}^{long-safe} - k_{Baa}^{long-safe}) \sum_{j=t}^{t+\tau-1} \frac{1}{\tau} E_t \left[ v'_{long-safe} \left( \frac{\theta_j^T, long + k^{long-safe} \theta_j^P, long-safe}{GDP_j}; \xi_j^{long-safe} \right) \right] + \sum_{j=t}^{t+\tau-1} E_t [\lambda_j^{Baa} D_j^{Baa} - \lambda_j^{Aaa} D_j^{Aaa}] - \sum_{j=t}^{t+\tau-1} \frac{1}{\tau} cov_t(m_{j+1}, \bar{R}_{j+1}^{Baa-Aaa}).$$

- Pure liquidity spread (insured bank deposits):

$$S_{t,1}^{FDIC} = i_t^{FDIC} - i_t^T = (1 - k^{liq})v'_{liq} \left( \frac{\theta_t^T + k^{liq} \theta_t^P, liq}{GDP_t}; \xi_t^{liq} \right).$$

Other possibility: on-the-run/off-the-run spread. Works, but short sample.

Table III

## Impact of Treasury Supply on the Price of Safety and the Price of Liquidity

The dependent variable in the first two columns is the spread between Baa rated corporate bonds and Aaa rated bonds. The dependent variable in columns (3) and (4) is the spread between A2/P2 and A1/P1 rated commercial paper. The dependent variable in column (5) is the spread between the interest rate on FDIC insured 6 month CDs and Treasury bills. The dependent variable in column (6) is the spread between the average interest rate paid by banks on time and savings deposits and Treasury bills. Independent variables are as in earlier tables. They also include the market value of Treasury debt with maturity greater than 10 years, and the market value of Treasury debt with maturity less than 1 year. Regressions are estimated by ordinary least squares or instrumented variables, as indicated. The standard errors are adjusted assuming errors are AR(1) or i.i.d. as indicated. We use the Box-Jenkins methodology for identifying the error structure.

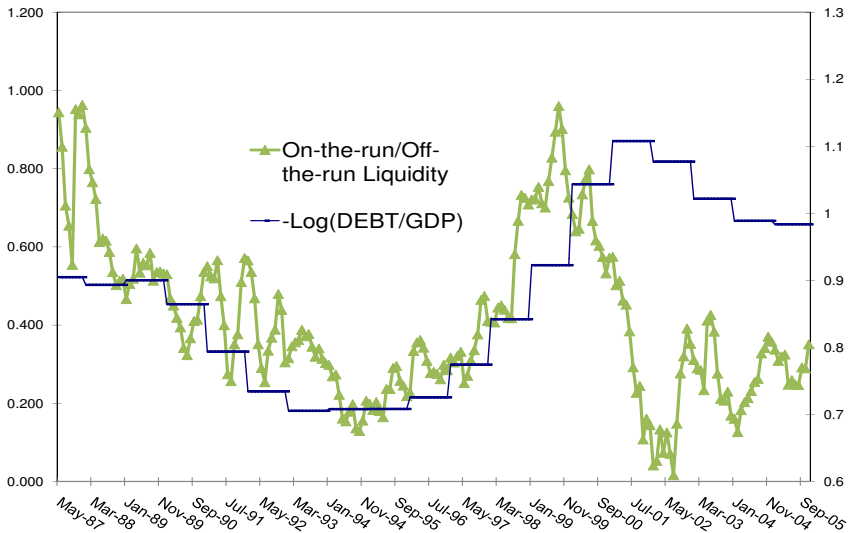
	Panel A: Price of Safety				Panel B: Price of Liquidity	
	Assets with similar liquidity and different safety: $S_{Baa-Aaa}$		Assets with similar safety and different liquidity: $S_{P2-P1}$		$S_{FDIC\ CD-Bills}$	$S_{Deposits-Bills}$
	(1)	(2)	(3)	(4)	(5)	(6)
Period	1926-2008	1926-2008	1974-2007	1974-2007	1984-2008	1934-1965
$\log(Debt / GDP)$	-0.506 [-3.42]		-0.879 [-4.47]		-1.904 [-2.56]	-0.731 [-5.24]
$\log(Debt > 10\text{ year maturity}/GDP)$ , instrumented by $\log(Debt/GDP)$		-0.369 [-2.53]				
$\log(Debt \leq 1\text{ year maturity}/GDP)$ , instrumented by $\log(Debt/GDP)$				-1.755 [-3.18]		
Volatility	5.070 [6.53]	6.401 [6.36]	0.321 [0.38]	-0.327 [-0.28]		
Slope	0.229 [4.15]	0.219 [3.24]	0.014 [0.40]	0.072 [1.42]	0.137 [1.48]	1.054 [17.06]
Constant	0.660 [4.52]	2.622 [4.39]	-0.500 [-2.45]	8.827 [3.33]	-1.500 [-2.30]	-0.031 [-0.35]
N	83	83	34	34	25	31
$R^2$	0.600		0.486		0.271	0.912
Estimation method	OLS	IV	OLS	IV	OLS	OLS
Error term	AR(1)	AR(1)	AR(1)	AR(1)	i.i.d.	i.i.d.

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Source for on/off: Fontaine and Garcia (2007)

### 3. Money and Treasuries

- Convenience yield on money (money demand function) driven by:
  - 1 Medium-of-exchange for goods transactions
  - 2 Liquidity in financial transactions
  - 3 Safety, as in secure store of value
- We have argued that Treasuries share (2) and (3)
- If so, then money should be a substitute asset for Treasuries

# Money as a Substitute

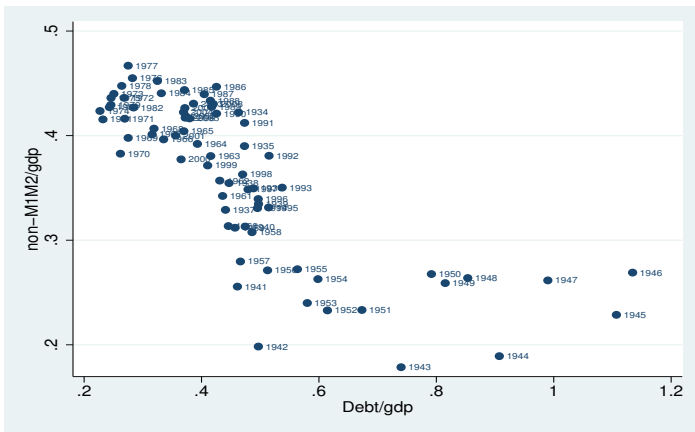
- Money spread:

$$i_t^C - i_t^{\text{money}} = k^{liq} v_{liq}' \left( \frac{\theta_t^T + k^{liq} \theta_t^{P, liq}}{GDP_t}; \xi_t^{liq} \right) + v_{short-safe}' \left( \frac{\theta_t^{T, short} + k^{short-safe} \theta_t^{P, short-safe}}{GDP_t}; \xi_t^{short-safe} \right) + \lambda_t D_t.$$

- If the supply of money (specifically bank deposits) is price elastic, then  $\theta_t^{\text{Money}}$  and  $\theta_t^T$  will be negatively related.

## Money (M2 minus M1) versus Debt/GDP:

- Remove M1 because M1 is primarily about medium-of-exchange, and is also not under direct control of private sector.



**Table V**  
**Response of Money to Treasury Supply, 1934-2008**

Panel A presents reduced form regressions between measures of money and Treasury supply. The money measures include small time and savings deposits (nonM1M2) and small and large time and savings deposits, repos and Eurodollars (nonM1M3). Panel B presents structural instrumental variables estimates of the supply response of the banking system. In the first stage, the spread between Baa bond yields and the interest rate on nonM1M2 is regressed on  $\log(\text{Debt} / \text{GDP})$  and controls. In the second stage, the fitted values of the spreads are regressed on  $\log(\text{non} - \text{M1M2} / \text{GDP})$ , with controls. The regressions in Panel B exclude the Regulation Q period of 1965-1983. Errors are adjusted assuming serial correlation of either AR(2) or AR(1), as indicated. We use the Box-Jenkins methodology to identify the error structure.

	Panel A: Reduced Form			Panel B: Structural Form			
	(1)	(2)	(3)	(4)		(5)	
Dep. Var.	non-M1M2/GDP	non-M1M2/GDP	non-M1M3/GDP	1st Stage of IV $S^{Baa} - \text{nonM1M2}$		2nd Stage of IV $\log(\text{non} - \text{M1M2} / \text{GDP})$	
Period	1926-2008	1959-2005	1959-2005	1935-1965, 1984-2008	1935-1965, 1984-2008	1935-1965, 1984-2008	1935-1965, 1984-2008
<i>Debt / GDP</i>	-0.305 [-5.52]	-0.352 [-4.16]	-0.553 [-3.34]	<i>Log(D / Y)</i>	-1.587 [-2.10]	$S^{Baa} - \text{Dep}$	0.394 [2.29]
<i>Year</i>		0.001 [1.86]	0.007 [5.99]	<i>Volatility</i>	7.942 [2.81]	<i>Volatility</i>	-2.717 [-1.47]
				<i>Slope</i>	0.440 [2.27]	<i>Slope</i>	-0.140 [-1.37]
<i>Intercept</i>	0.502 [18.26]	-1.467 [-1.38]	-12.161 [-5.69]	<i>Intercept</i>	2.279 [3.94]	<i>Intercept</i>	-2.439 [-4.13]
$R^2$	0.601	0.534	0.802				
<i>N</i>	75	47	47	56		56	
Estimation method	OLS	OLS	OLS	OLS		IV	
Standard errors	AR(2)	AR(2)	AR(2)	AR(1)		AR(1)	

## Summary

- Treasury supply  $\uparrow \Rightarrow$  spread between non-convenient and convenient Treasury assets  $\downarrow$ .
  - ▶ True for many spreads, and after default controls.
- Underlying source of convenience: liquidity and safety
  - 1 Treasury supply  $\uparrow \Rightarrow$  spread between illiquid and liquid assets  $\downarrow$ .
  - 2 Treasury supply  $\uparrow \Rightarrow$  spread between more credit-risk and less-credit risk assets  $\downarrow$ .
  - 3 Treasury supply  $\uparrow \Rightarrow$  Supply of money, offering liquidity and safety,  $\downarrow$

Next: Implications

# 1. Quantification and Seignorage

- Suppose we fit:

$$Spread_t = f(\theta_t^T / GDP_t) + b_0 + b_1 controls_t + error_t$$

where we impose that  $f(\infty) \rightarrow 0$ .

- Then convenience yield at supply of  $\theta^T / GDP_t$  is  $f(\theta^T / GDP_t)$
- $\log(\cdot)$  function does not have the asymptote property.

## Table VI

### Impact of Treasury Supply on Bond Spreads:

$$f(\text{Debt}/\text{GDP}) = b_1 \times \max[b_2 - \text{Debt}/\text{GDP}, 0]$$

This table estimates a piecewise linear specification for the relation between Treasury supply and bond spread. The function estimated is  $b_0 + b_1 \times \max[b_2 - \text{Debt}/\text{GDP}, 0]$ . The dependent variables are long-term yield spreads between corporate and Treasury bonds, measured in percentage units. Independent variables are based on the real market value of Treasury debt outstanding, real US GDP, and controls for the default risk and risk premium on corporate bonds. Volatility, and slope controls are demeaned. Regressions are estimated by non-linear least squares. The standard errors are adjusted assuming errors are AR(1). We use the Box-Jenkins methodology for identifying the error structure.

	Panel A: Aaa-Treasury		Panel B: Baa-Treasury	
	(1)	(2)	(3)	(4)
Period	1919-2008	1926-2008	1919-2008	1926-2008
$b_0$	0.319 [ 1.80 ]	0.346 [ 2.51 ]	1.019 [ 1.94 ]	1.199 [ 7.29 ]
$b_1$	2.579 [ 4.02 ]	3.060 [ 5.07 ]	4.310 [ 2.64 ]	4.941 [ 6.75 ]
$b_2$	0.585 [ 6.96 ]	0.549 [ 9.56 ]	0.625 [ 4.22 ]	0.545 [ 12.92 ]
<i>Volatility</i>		1.189 [ 1.90 ]		6.236 [ 7.05 ]
<i>Slope</i>		0.095 [ 2.38 ]		0.330 [ 5.03 ]
$R^2$	0.477	0.612	0.290	0.704
$N$	90	83	90	83

- Average convenience over 1926-2008 sample: 72 basis points
- If we use Baa-Aaa as long-term safety (lower bound): 26 basis points
- If we use Aaa-Treas as liquidity (upper bound): 46 basis points
- Treasury *not* riskless rate in the CAPM framework.

## Seignorage

- Average seignorage on govt debt: 0.25% of GDP
- Money: multiply  $M0$  in 2007 by 4% = 0.24% of GDP

## 2. Bank leverage

Typical corporate finance/banking model:

- Bank with equity capital (net worth) of  $E$ .
- Lenders impose a credit/collateral constraint:  $Debt = \frac{E}{\text{haircut}}$
- Leverage and bank debt determined by haircut.

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This paper:

- There is a well defined safe/liquid debt demand function.

$$convenience - yield = v'(\theta_t^T + k^P \theta_t^P; \xi_t)$$

- Banks supply this debt, which is a part of  $\theta_t^P$  (also includes repos, etc.).
  - ▶ Supply channel: Variation in  $\theta_t^T$ , banks issue more debt ( $\theta_t^P$ )
  - ▶ Demand channel ( $\xi_t$ ): Suppose investors' demand for safe/liquid debt increases. In eqm, banks issue more debt.

### 3. Global imbalances and safe/liquid debt

Caballero-Krishnamurthy (AER 2009): "Global Imbalances and Financial Fragility"

- Most of reserve accumulation over last decade was in "safe/liquid" debt.
- Increase demand for debt drives bank (and shadow bank) issuance of debt and leverage.
  - ▶ This was a factor driving securitization boom.
  - ▶ Factor driving the expansion of repo to many asset classes (Gorton, 2010)
  - ▶ Driver of bank leverage.
  - ▶ Fragility

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  - ▶ Driver of bank leverage.
  - ▶ Fragility

Of course, debt was neither as safe nor as liquid as advertised:

- In crisis, supply of liquid and safe private debt contracts.

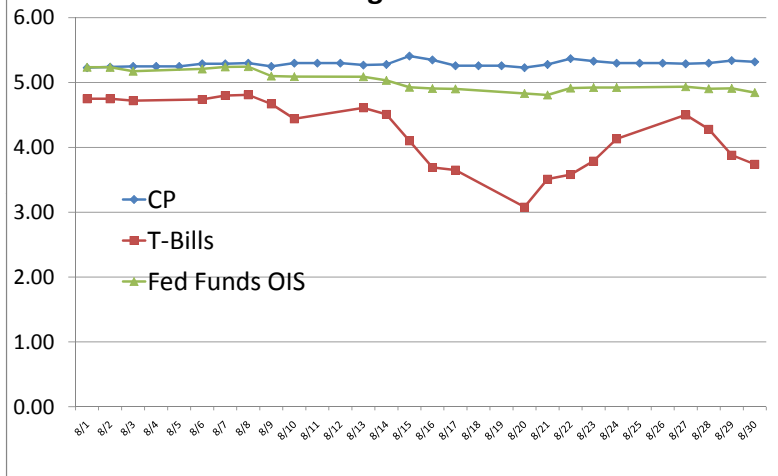
$$\text{convenience} - \text{yield} = v'(\theta_t^T + k^P \theta_t^P; \xi_t)$$

$\theta_t^P \downarrow$  causes spreads to rise

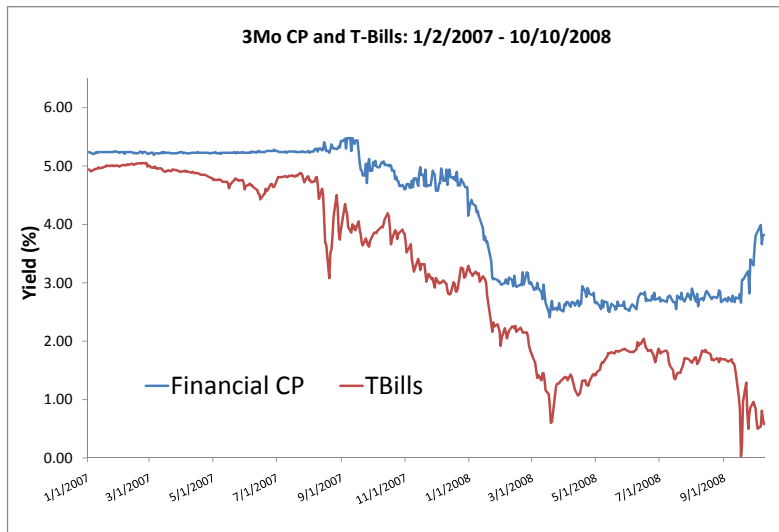
- Plus, flight-to-quality:  $\xi_t \uparrow$  further rise in spreads.

## 2007-2008 Crisis

### August 2007



## 2007-2008 Crisis



New type of open-market operation:

- Buy MBS, pay with Treasuries.
- Liquidity benefits:

$$\text{convenience} - \text{yield} = v'(\theta_t^T + k^P \theta_t^P; \xi_t)$$

Expand  $\theta_t^T$  to offset shock to  $\theta_t^P$  and  $\xi_t$ .

- Variant of standard monetary doctrine: Expand money supply in response to a money demand shock.

# Effect of Foreign Official Holders on interest rates

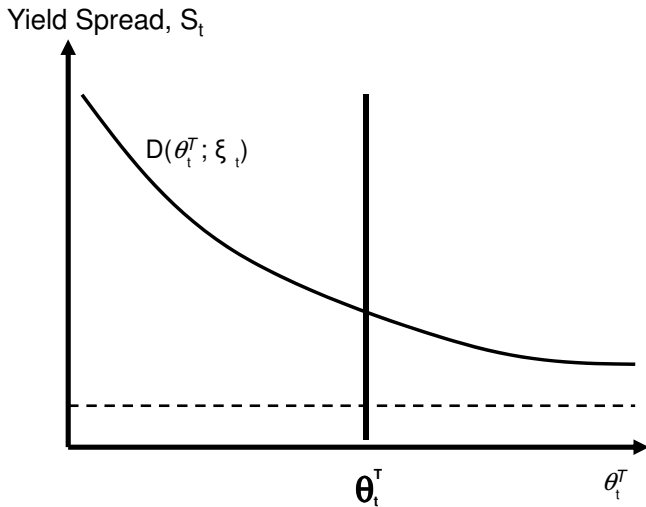
**Table VII**  
**Debt Holdings, by Group**

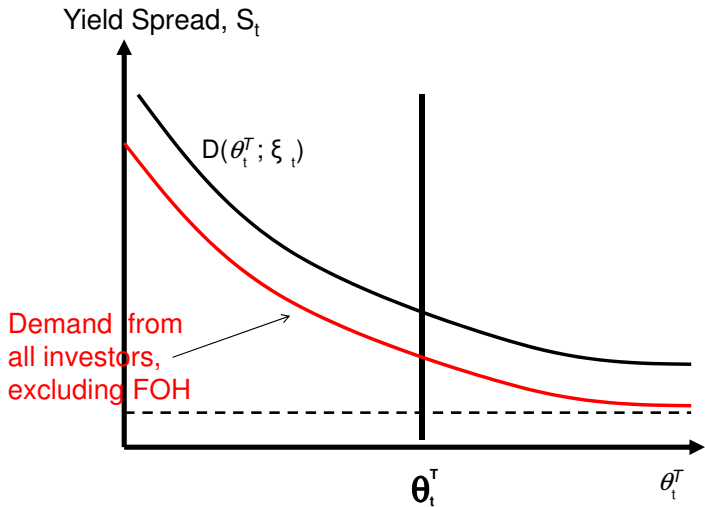
Panel A of this table presents statistics on the fraction of Treasury securities held by various groups. The data are from the Flow of Funds Accounts of the Federal Reserve, and are annual (end of year) from 1945 to 2008. Mutual funds include closed-end funds and exchange traded funds. Panel B presents the bond portfolio composition of each of the groups, broken down into Treasury, Agency, and short and long-term corporate bonds. Holdings of 1% or less are sometimes reported as zero in the Flow of Funds.

Group	Panel A: Who holds Treasury Debt?				
	Mean	Std. Dev.	1945	1975	2008
Federal Reserve Banks	0.138	0.040	0.097	0.199	0.075
Foreign Official Holdings	0.113	0.088	0.010	0.141	0.367
State/Local Governments	0.088	0.042	0.022	0.064	0.076
Banks/Credit Institutions	0.201	0.116	0.416	0.222	0.017
Households and Mutual Funds	0.260	0.051	0.265	0.263	0.169
Foreign Private Sector	0.042	0.049	0.000	0.010	0.140
Fed/ri/State/Local Govt. Ret.	0.035	0.022	0.006	0.006	0.045
Private Pensions	0.028	0.020	0.008	0.029	0.029
Insurance Companies	0.048	0.023	0.093	0.022	0.025

Group	Panel B: Bond Market Portfolio Composition			
	Treasury	Agency	Long-term Corporate	Short-term Corporate
Federal Reserve Banks	0.983	0.017	0.000	0.001
Foreign Official Holdings	0.948	0.052	0.000	0.000
State/Local Governments	0.720	0.217	0.029	0.034
Banks/Credit Institutions	0.526	0.312	0.141	0.020
Households and Mutual Funds	0.563	0.095	0.223	0.118
Foreign Private Sector	0.240	0.084	0.479	0.197
Fed/ri/State/Local Govt. Ret.	0.387	0.108	0.487	0.018
Private Pensions	0.233	0.142	0.583	0.042
Insurance Companies	0.172	0.078	0.726	0.024





Based on estimated demand functions:

- Table VI, (4): Raise long-term rates by 59 basis points
- Table I, (5) (log spec): Long-rates by 41 basis points
- Table I, (9): Short-rates by 60 basis points.

Effect is on spread; levels of rates may or may not change.

## 4. Money demand

Typical framework:

$$i_t^C - i_t^{money} = m \left( \frac{M}{GDP_t}; \xi_t \right)$$

Measured price of money reflects a single attribute, linked to a single aggregate (M1, M2, ...)

- Money reflects: (1) medium-of-exchange attribute; (2) liquidity; (3) safety

$$S_t^M = k^{M,short-safe} v'_{short-safe}(\theta_t^{A,short-safe} / GDP_t; \xi_t^{short-safe}) \\ + k^{M,liq} v'_{liq}(\theta_t^{A,liq} / GDP_t; \xi_t^{liq}) + k^{M,X} v'_X(\theta_t^X / GDP_t, \xi_t^X)$$

- Three aggregates, not one, are important for prices.
- Treasuries should be part of the liquidity and safety aggregates.
- Need to use other bond market spreads,  $P2 - P1$ ,  $CP - Bills$ , etc., to recover three underlying demand functions.
- Stability ...

## Conclusion

- Liquidity and safety are asset-attributes that are demanded by investors.
- There is a broad aggregate of assets that satisfy the demand.
- Treasuries are an important component of the aggregate; also, high-grade corporate bonds and Agency paper
- Historical average: Liquidity value of Treasuries = 46 basis points; Safety value = 26 basis points.
- Treasury seignorage is comparable to money-seignorage
- Results have implications for many first-order issues in finance and macro.