The Demand for Money, Near-Money, and Treasury Bonds

Arvind Krishnamurthy[1] Wenhao Li[2]

[1]Stanford Graduate School of Business, SIEPR and NBER

[2]USC Marshall Business School

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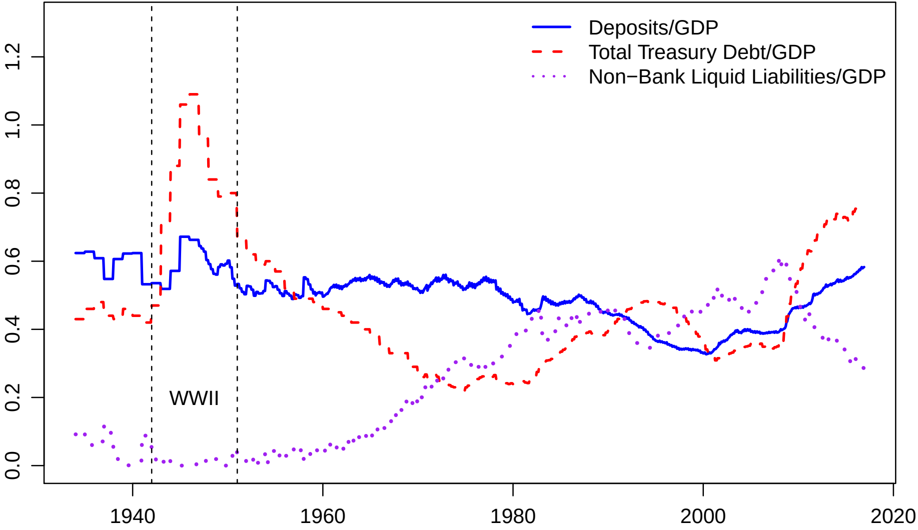
Many assets offer "moneyness"; Which assets, how substitutable?

- Three major types: bank deposits, Treasuries, and non-bank liquid liabilities.



Many assets offer "moneyness"; Which assets, how substitutable?

(1) We estimate, for D_t as commercial bank deposits, and B_t as Treasury bonds:

$$Q_t = \left((1-\lambda_t)(\frac{D_t}{P_t})^{\rho} + \lambda_t(\frac{B_t}{P_t})^{\rho}\right)^{\frac{1}{\rho}}. \tag{1}$$

(2) For D_t^{NB} as non-deposit short-term debt:

$$Q'_t = \left((1-\lambda_t)(\frac{D_t}{P_t})^{\rho} + \lambda_t(\frac{B'_t}{P_t})^{\rho}\right)^{\frac{1}{\rho}}. \tag{2}$$

where,

$$B'_t = \left((1-\mu_t)(\frac{D_t^{NB}}{P_t})^{\eta} + \mu_t(\frac{B_t}{P_t})^{\eta}\right)^{\frac{1}{\eta}}. \tag{3}$$

Why should anyone care?

- Effectiveness of quantitative easing
- Treasury liquidity premium
- Impact of Treasuries on banking and shadow banking. Central bank digital currency.

Model

Non-bank investor with objective:

$$E_0[\sum_{t=1}^{\infty}\beta^t u(C_t, Q_t),] \tag{4}$$

over consumption, C_t, and liquidity aggregate:

$$Q_t = \left((1-\lambda_t)(\frac{D_t}{P_t})^{\rho} + \lambda_t(\frac{B_t}{P_t})^{\rho}\right)^{\frac{1}{\rho}}. \tag{5}$$

Gives FOCs:

$$u_Q{}'(C_t, Q_t)Q_t^{1-\rho}(1-\lambda_t)(\frac{D_t}{P_t})^{\rho-1} = u_C{}'(C_t, Q_t)\frac{i_t - i_t^d}{1+i_t}, \tag{6}$$

$$u_Q{}'(C_t, Q_t)Q_t^{1-\rho}\lambda_t(\frac{B_t}{P_t})^{\rho-1} = u_C{}'(C_t, Q_t)\frac{i_t - i_t^b}{1+i_t}. \tag{7}$$

Divide the FOC of bonds by the FOC of deposits on both sides and rewrite:

$$i_t - i_t^b = \frac{\lambda_t}{1-\lambda_t}(\frac{B_t}{D_t})^{\rho-1}(i_t - i_t^d). \tag{8}$$

Estimation intuition

Define $\ell_t^b = i_t - i_t^b$ and $\ell_t^d = i_t - i_t^d$.

$$\ell_t^b = \frac{\lambda_t}{1-\lambda_t}(\frac{B_t}{D_t})^{\rho-1}\ell_t^d.$$

Take a special case where $\lambda_t = const.$ and $\rho = 1$ (perfect substitutes):

$$\ell_t^b = \frac{\lambda}{1-\lambda}\ell_t^d$$

- *Spreads will move in lockstep: single liquidity factor*
- Regression estimates ρ by asking if the relative spread variation can be explained by B_t/D_t.

Data: $i_t - i_t^b$

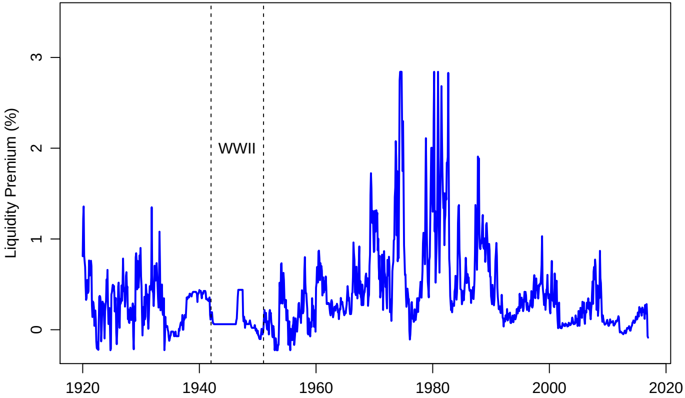


Figure: **Treasury Liquidity Premium**. This figure plots the spread between 3-month general collateral (GC) repo rate and 3-month Treasury bill rate from 1991 to 2016, and 3-month general Banker's Acceptances and 3-month Treasury bill rate from 1920 to 1991.

Data: deposit spread, ℓ_t^d

We measure, using RateWatch data from 1984 to 2018:

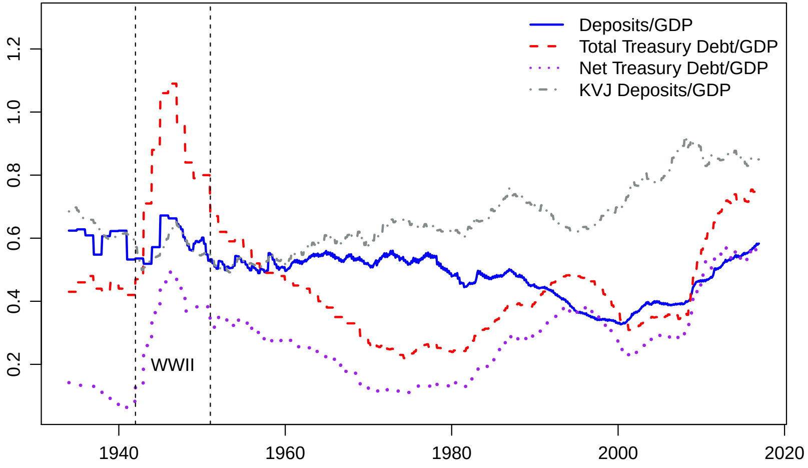
$$\ell_t^d = \frac{D_{\text{checking},t}}{D_t}(i_t - i_{\text{checking},t}) + \frac{D_{\text{saving},t}}{D_t}(i_t - i_{\text{saving},t}) + \frac{D_{\text{small time},t}}{D_t}(i_t - i_{\text{small time},t}) \tag{9}$$

and project on Fed Funds rate:

$$\ell_t^d \approx 0.34 i_t \tag{10}$$

- The projection serves two purposes: (1) instrument to address endogenous response of deposits to ℓ_t^b; (2) avoid the negative deposit spread issue.

Quantity measures: B_t and D_t



- B_t: Net Treasury Debt/GDP = (Total Treasury Debt - Bank Treasury Holdings - Fed Treasury Holding)/GDP.
- D_t: Checking, savings + time deposits (Deposits); broad measure of financial sector debt (KVJ deposits)

Estimation equation

We use VIX (stock market vol) to measure the preference shifter:

$$\frac{\lambda_t}{1-\lambda_t} = \beta_\lambda \cdot \text{VIX}_t \tag{11}$$

and estimate,

$$\ell_t^b = \beta_\lambda \text{VIX}_t (\frac{B_t}{D_t})^{\rho-1} i_t \cdot \exp(\epsilon_t), \tag{12}$$

Two approaches:

- Take logs ... coefficient on *log* $\left(\frac{B_t}{D_t}\right)$ is $\rho - 1$.
- GMM to estimate (β_λ, ρ)

$$E\left[\left(lp_t - \beta_\lambda \cdot \text{VIX}_t (\frac{B_t}{D_t})^{\rho-1} i_t\right) \cdot \begin{pmatrix} i_t \\ \text{VIX}_t \\ B_t/D_t \\ 1 \end{pmatrix}\right] = 0. \tag{13}$$

Log regressions, OLS and IV

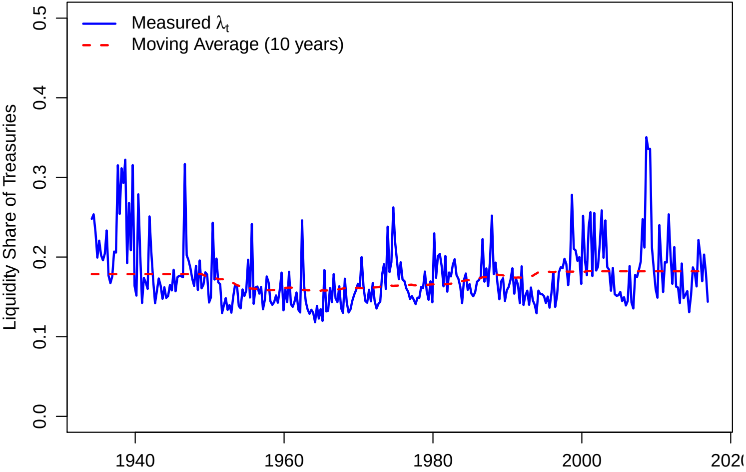
	Dependent variable: log(liquidity premium$_t$)			
	OLS		IV	
	(1)	(2)	(3)	(4)
$\log(\frac{\text{Net Tsy}_t}{\text{Deposits}_t})$	−0.35		−0.87	
	(0.13)		(0.39)	
$\log(\frac{\text{Net Tsy}_t}{\text{KVJ Deposits}_t})$		−0.52		−0.72
		(0.18)		(0.36)
$\log(\text{FFR}_t)$	0.54	0.51	0.46	0.47
	(0.09)	(0.09)	(0.13)	(0.10)
$\log(\text{VIX}_t)$	0.73	0.57	0.59	0.46
	(0.28)	(0.28)	(0.34)	(0.30)
Observations	300	300	300	300
R^2	0.43	0.44	0.36	0.44

Why IV? *NetTsy/Deposits* depends on bank choices, thus endogenous to liquidity premium. We use *TotalTsy/GDP* as instrument. Assumption: fiscal policy does not depend on liquidity premium.

GMM estimates

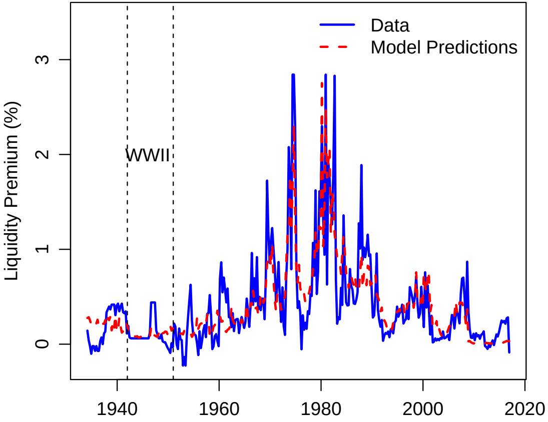
	Measurement of B/D			
	$\frac{\text{Net Tsy}}{\text{Deposits}}$	$\frac{\text{Net Tsy}}{\text{KVJ Deposits}}$	$\frac{\text{Net Tsy}}{\text{Deposits}}$	$\frac{\text{Net Tsy}}{\text{KVJ Deposits}}$
	(1)	(2)	(3)	(4)
ρ	0.685	0.671	0.657	0.625
	(0.102)	(0.212)	(0.189)	(0.214)
β_λ	0.012	0.011	0.012	0.010
	(0.001)	(0.003)	(0.002)	(0.003)
p-value of J-test	0.859	0.871	0.953	0.943
Total Treasury IV?	No	No	Yes	Yes
Variation explained	69.5%	68.9%	69.7%	69.2%
Observations	332	332	332	332

The Liquidity Share of Treasuries (λ_t)

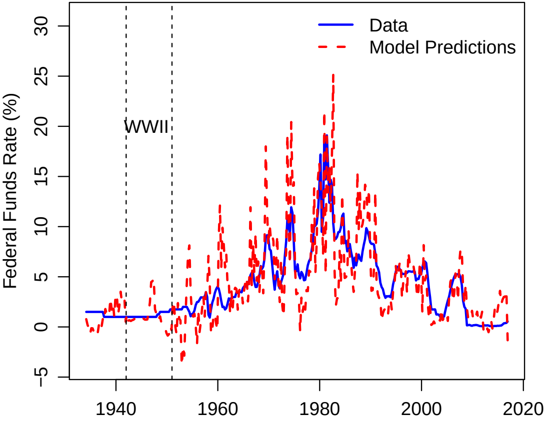


$$Q_t = \left((1-\lambda_t)\left(\frac{D_t}{P_t}\right)^{\rho} + \lambda_t\left(\frac{B_t}{P_t}\right)^{\rho}\right)^{\frac{1}{\rho}}.$$

Model fit



(a) Liquidity Premium



(b) FFR

Expanded model: including “shadow bank” deposits

$$Q'_t = \left((1-\lambda_t)(\frac{D_t}{P_t})^{\rho} + \lambda_t(\frac{B'_t}{P_t})^{\rho} \right)^{\frac{1}{\rho}}. \tag{14}$$

where,

$$B'_t = \left((1-\mu_t) \cdot (D_t^{NB})^{\eta} + \mu_t \cdot B_t^{\eta} \right)^{1/\eta}. \tag{15}$$

One more FOC now:

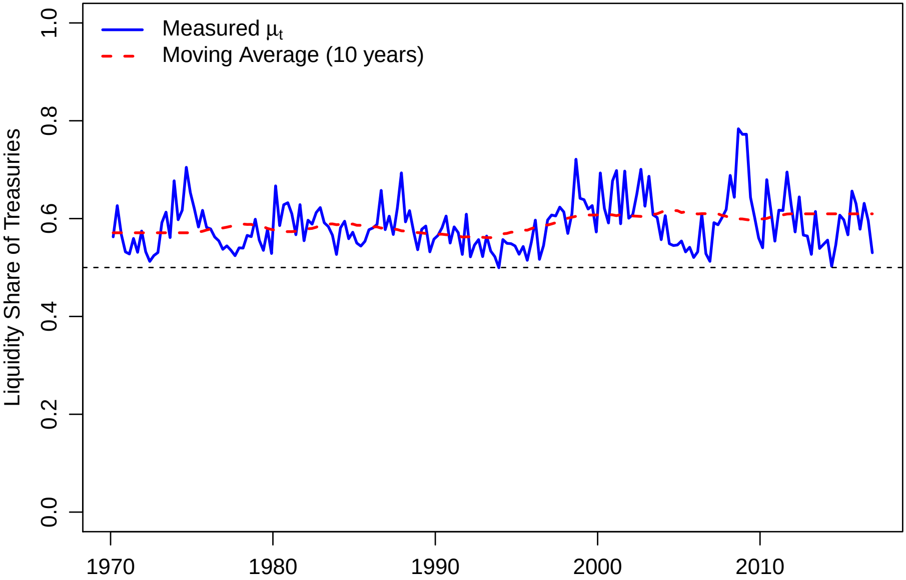
$$\ell_t^{\mathrm{Tsy}} = \frac{\mu_t}{1-\mu_t}(\frac{B_t}{D_t^{NB}})^{\eta-1} \ell_t^{NB}. \tag{16}$$

- Measure D_t^{NB} as KVJ-deposits minus D_t
- Use the non-convenience benchmark rate as P2 rated CP (rather than Fed Funds). Sample starts 1974.
- For NB rate, we use P1 rated CP (or, yield on MMF for a sample starting 1984)
- We estimate $\rho, \eta, \lambda_t, \mu_t$

Full model estimates

	Measurement of non-bank liquidity premium			
	P2CP−P1CP	P2CP−MMF	P2CP−P1CP	P2CP−MMF
	(1)	(2)	(3)	(4)
ρ	0.816	0.900	0.249	0.643
	(0.155)	(0.327)	(0.161)	(0.432)
β_λ	0.024	0.059	0.018	0.060
	(0.003)	(0.002)	(0.002)	(0.002)
η	0.959	0.997	0.855	0.997
	(0.109)	(0.001)	(0.064)	(0.001)
β_μ	0.133	0.029	0.123	0.030
	(0.009)	(0.001)	(0.006)	(0.001)
Total Treasury IVs?	No	No	Yes	Yes
R^2 for ℓ_t^{Tsy}	0.59	0.6	0.62	0.6
R^2 for $\ell_t^{B'}$	0.43	0.43	0.45	0.43
Observations	169	113	169	113

Estimates of Treasuries/Shadow-Bank Deposits Liquidity Provision μ



Applications

- Effectiveness of quantitative easing.
- Addressing the instability of money demand.

Quantitative Easing

- Assume that the liquidity premium stays constant for T periods.
- T-period risk-free rate pricing:

$$E_t[\exp(T \cdot i_{t,T})\frac{M_{t+T}}{M_t}] = 1$$

- T-period Treasury pricing:

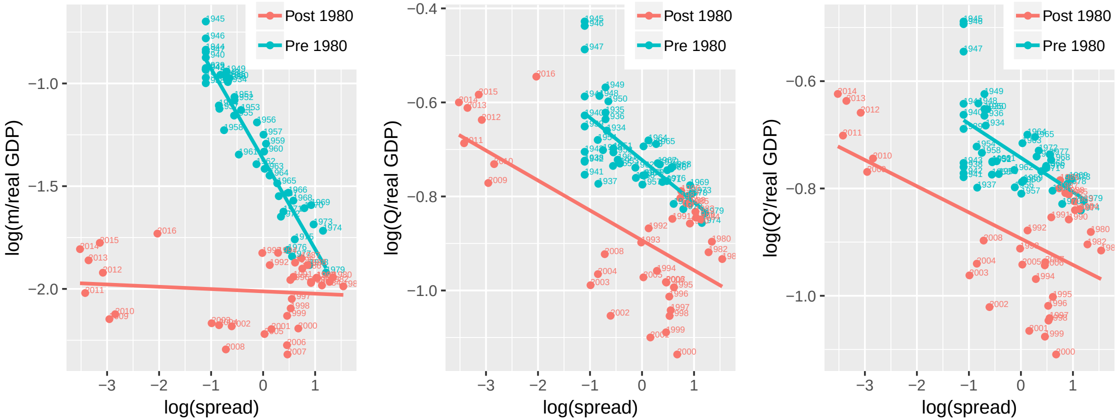
$$E_t[\exp(T \cdot i^b_{t,T})\frac{M_{t+T}}{M_t}\exp(\sum_{\Delta t=0}^{T-1} \ell^b_{t+\Delta t})] = 1$$

- The yield of T-period Treasury bond:

$$i^b_{t,T} = i_{t,T} - \delta i_t \frac{\lambda_t}{1-\lambda_t}(\frac{B_t}{D_t})^{\rho-1}$$

  - $\rho = 1$: no role of quantity beyond i_t.

Money demand stability



(c) $\log(m_t/\text{real GDP}_t)$ (d) $\log(Q_t/\text{real GDP}_t)$ (e) $\log(Q'_t/\text{real GDP}_t)$

Figure: The y-axis is $\log(\text{deposit spread}_t/(1+\text{FFR}_t))$ across all three panels. Data are annual averages, with the years marked on the figure. 1934 to 2018

Summary

- We study the substitution among deposits, Treasuries, and shadow bank deposits.
- $\rho \approx 0.6$: quantity has additional effect on liquidity premium; QE is effective. Different from literature.
- $\eta \approx 1$: Treasuries and shadow bank deposits are highly substitutable.
- Liquidity provision per unit: Deposits $>$ Treasury $\approx$ shadow bank deposits