Gaining and Losing US Government Funding Advantage

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Introduction

- Common argument that US Federal government has enjoyed a **funding advantage**:
  - Can issue debt at a lower yield (higher price) compared to the private sector
  - ...for bonds with same after-tax payout process.

$$\underbrace{\chi_t}_{\text{Funding advantage}} := \underbrace{i_t^p}_{\text{Yield on private debt}} - \underbrace{i_t^b}_{\text{Yield on US public debt}} > 0$$

- And so can issue debt unbacked by surpluses:

$$\substack{\text{Market value}\\\text{of govt. debt}} \approx PDV\left(\substack{\text{future}\\\text{surpluses}} + \substack{\text{future}\\\text{seigniorage}}\right) + \underbrace{\sum_{s=1}^{\infty} \xi_{t+s} \underbrace{\left(q_{t+s}^b B_{t+s}\right)}_{\text{Market value}} \underbrace{\left(1 - \exp(-\chi_{t+s})\right)}_{\text{Convenience "tax"}}}_{PDV(\text{future convenience revenue})}$$

- **Q.** How is funding advantage gained and lost?

This Talk

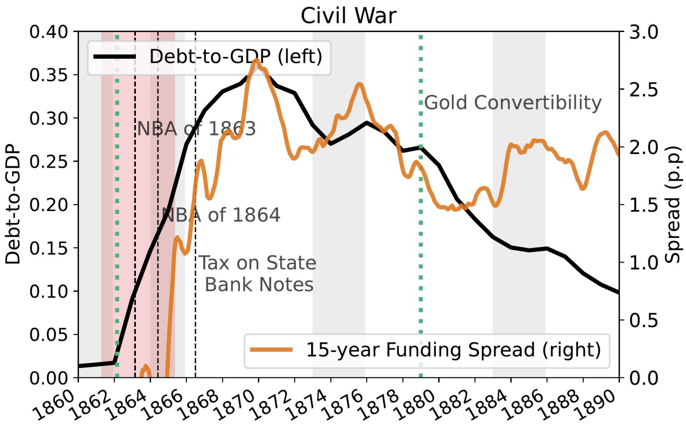
- Tell story of the US federal government's attempts to generate funding advantage. (from Lehner-Payne-Shurtleff-Szőke-25)
  - Using our estimates of term structure of US funding advantage since 1860.
  - "Manipulation" of financial markets to generate treasury demand (e.g. NBE), and
  - "Stabilization" of price volatility to make treasuries "safe assets" (e.g. WWI, WWII).

- Sketch a model of US Treasury demand. (from Payne-Szőke-25a, Payne-Szőke-25b) Outline a government's macroeconomic tradeoffs. Cannot choose all three of:
  - (i) high funding advantage,
  - (ii) healthy financial sector,
  - (iii) fiscal/monetary-driven debt devaluation.

- Comment on theories of financial, fiscal, and monetary dominance.

When has the US gained and lost a funding advantage?

Financing The Civil War (1861-65) Required a New Financial System



15-year funding spread

= yield(15y "AAA" corp. bonds) − yield(15y Treasurys)

- *Early Civil War (1862):* banks stopped buying US Treasurys
- *National Banking Era (1862-1913):* banks could issue notes up to 90% of the min of par and market value of long-term US Treasurys.
- *Goal:* "captive bond market".

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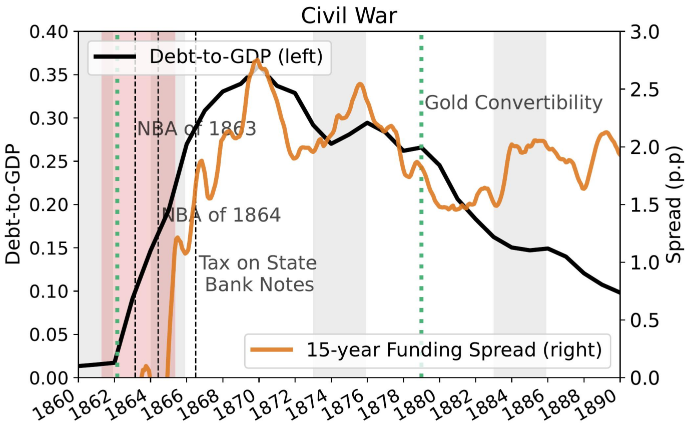

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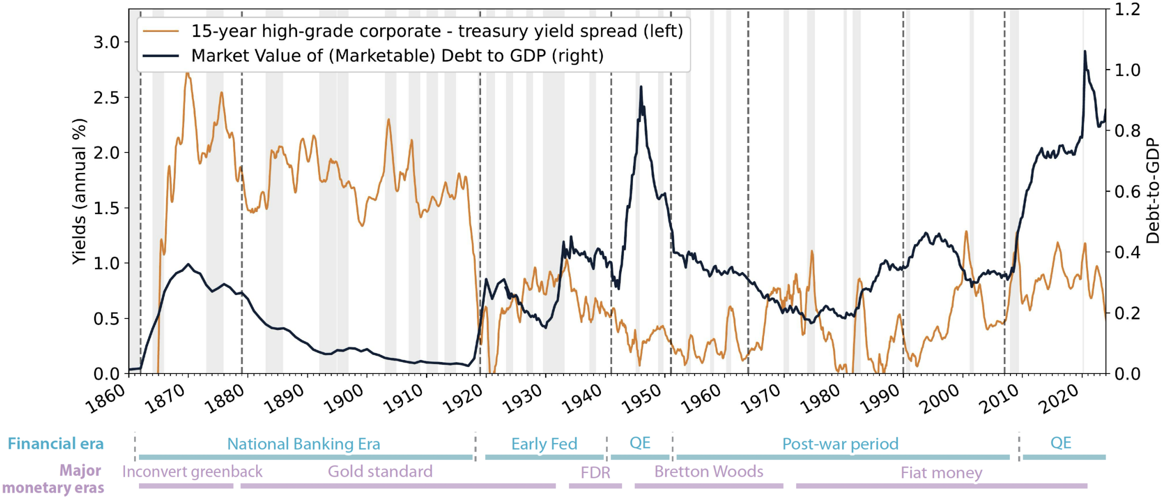
. . . Starting a Complex History of Interventions and Financing Costs



Selected Major Episodes

		Δ Debt/GDP	Funding advantage
1861-1870	Civil War, NBE	+ 35 ppts	$\uparrow$ from -0.5 to 2.0
1917-21	WWI, Fed emergence	+ 30 ppts	$\downarrow$ from 1.7 to 0.0
1942-51	WWII, Yield control	+ 50 ppts	$\sim$ constant at 0.4
2009-2014	GFC, QE	+ 40 ppts	$\uparrow$ from 0.4 to 1.0
1975-85	Inflation volatility	-	$\downarrow$ from 0.4 to 0.0

Losing Funding Advantage Prompted Much Policy Maker Concern

- **World War I (1914-1918)**: McAdoo blamed financing problems on investor concerns about bond price uncertainty [Garbade-12].

  "When the public is assured that the rate will not rise, . . . a flow [of funds] into Government securities . . . may be confidently expected."

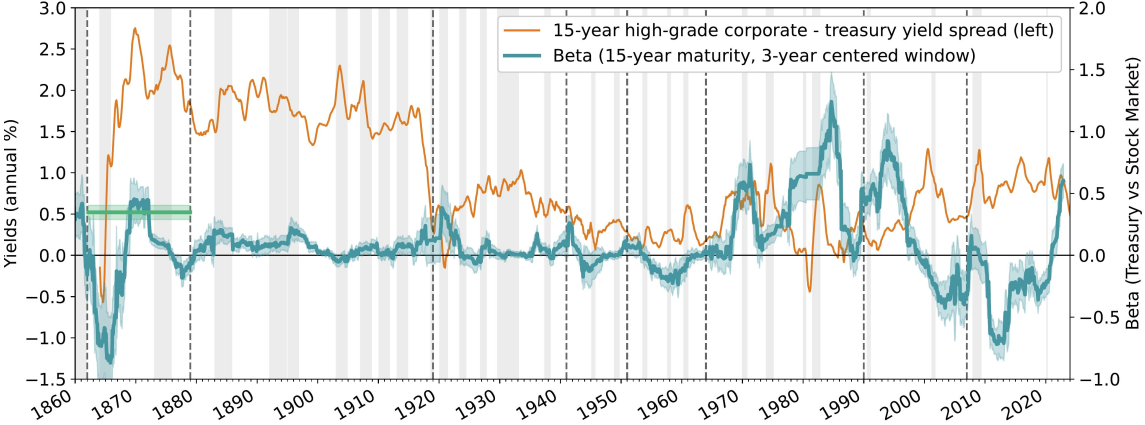
  Emanuel Goldenweiser (Fed Board, R&S)

- **Inflation volatility (1975-1985)**: Financial commentators focused on Treasury return risk and the decrease in bank Treasury holdings.

Funding Advantage And Bond-Stock Betas

β is the correlation between Treasury returns and stock returns.

$\Rightarrow$ Treasurys are a good hedge when $\beta < 0$ and a bad hedge when $\beta > 0$.



Selected Major Episodes Revisited

		Δ Debt/GDP	β	Funding advantage
1861-70	Civil War and NBE	+ 35 ppts		↑ from -0.5 to 2.0
1917-21	WWI/Fed emergence	+ 30 ppts	↑ from 0.0 to 0.4	↓ from 1.7 to 0.0
1942-51	Yield curve control	+ 50 ppts	constant at 0.0	constant at 0.4
2009-14	GFC and QE	+ 40 ppts	↓ from -0.2 to -0.8	↑ from 0.4 to 1.0
1975-85	Inflation volatility	-	↑ from 0.0 to 0.8	↓ from 0.4 to 0.0

Regression analysis: financial regulation + bond-stock betas ⇒ adjusted $R^2 = 0.86$.

What does this long history teach us about Treasury demand?

Myths and Truths About US Treasury Demand

1. **Claim:** Treasurys have a “stable” demand function; increases in debt forecast decreases in funding advantage. (e.g. Krishnamurthy-VJ-12, Krishnamurthy-L-24)
   FALSE. US has typically tried to increase debt supply and demand together.

2. **Claim:** US Gov has and exploits monopoly power in LT bond market (e.g. CKP-24)
   FALSE. Asset pricing suggests many substitutes to US Treasurys.

3. **Claim:** US funding advantage ever since the USD became dominant currency.
   FALSE. US completely lost funding advantage in the 1970s-80s when ↑ return risk.

4. **Claim:** US funding advantage when banks can hedge risk with Treasurys (AL-23)
   TRUE. bond stock-betas strongly predicts US funding advantage.

Implications For Macro-Finance

- Macro-finance models typically include an exogenous funding advantage (e.g. BIU)

$$\text{Funding advantage} = \chi\left(q_t^b B_t/GDP,\ \text{exogenous shocks}\right)$$

- We need a model of endogenous funding advantage shaped by government policy:

$$\text{Funding advantage} = \chi\left(q_t^b B_t/GDP;\ \text{financial regulation},\ \text{fiscal/monetary policy}\right)$$

How does government policy impact
government funding advantage and convenience revenue?

A Model of Government Funding Advantage (From Payne-Szoke-25)

- Discrete time RBC economy with households and banks.
- Financial intermediaries face market frictions that limit risk sharing
  $\Rightarrow$ Assets that can help financial intermediaries hedge risk play a "special role"
  $\Rightarrow$ Trade at lower yields (higher prices) even after adjusting for risk premia.
- The government faces an exogenous surplus process
  ... But can influence treasury demand with restrictions on financial sector portfolios.
- Financial-fiscal polices can make government debt the hedging asset
  ... Or destroy its role as a hedging asset.

Details on Modeling The Government

- Government issues bonds at price q_t^b that repay fraction ω of debt outstanding each t
- Sets policy (G_t, T_t, B_t) subject to budget constraint with $B_{-1} = 0$:

$$(\omega + (1-\omega)q_t^b)B_{t-1} \leq T_t - G_t + q_t^b B_t, \quad \forall t \geq 0.$$

Fiscal rule: for surplus $T_t - G_t = \eta\omega\Big(B_{t-1} - \bar{b}y_t\Big) + y_t\Big(\sigma^z \varepsilon_t^z + \sigma^g \varepsilon_t^g\Big)$
where ϵ^z, ϵ^g are TFP and spending shocks. So, $\sigma^z > 0 \Rightarrow \downarrow$ surplus in recessions.

- Sets restrictions on bank portfolios:

Historical Eras

$$\text{AM} \quad \frac{\varrho}{2} x_{t+1}^d (1-\lambda) d_t \leq \Upsilon(b_{t+1}, k_{t+1}) := \Big(\kappa (q_{t+1}^b b_{t+1})^\alpha + (1-\kappa)(q_{t+1}^k k_{t+1})^\alpha\Big)^{1/\alpha} \quad (1)$$

Regulation: ϱ is overall leverage constraint; $\kappa \in [1/2, 1]$ incentivizes debt holding
... $\kappa = 1/2$ "neutral" regulation; $\kappa = 1$ is "pure" repression; $(\varrho, \kappa) \approx$ Basel "risk-weights"

Two Types of Equilibria

- In recessions banks face distress (cannot repay deposits & meet regulations). Can:
  - Re-balancing their portfolio (↑ government bond holdings) and/or
  - Shrinking the size of their balance sheet (↓ deposits and exit).

- Repression (high κ) + fiscal rule that maintains stable long-term bond prices

  ⇒ Profitable for banks to continue so banks respond by ↑ bond holdings in recession

  ⇒ Government bond prices ↑ in bad times

  ⇒ Government debt becomes "good hedge" and earns funding advantage.

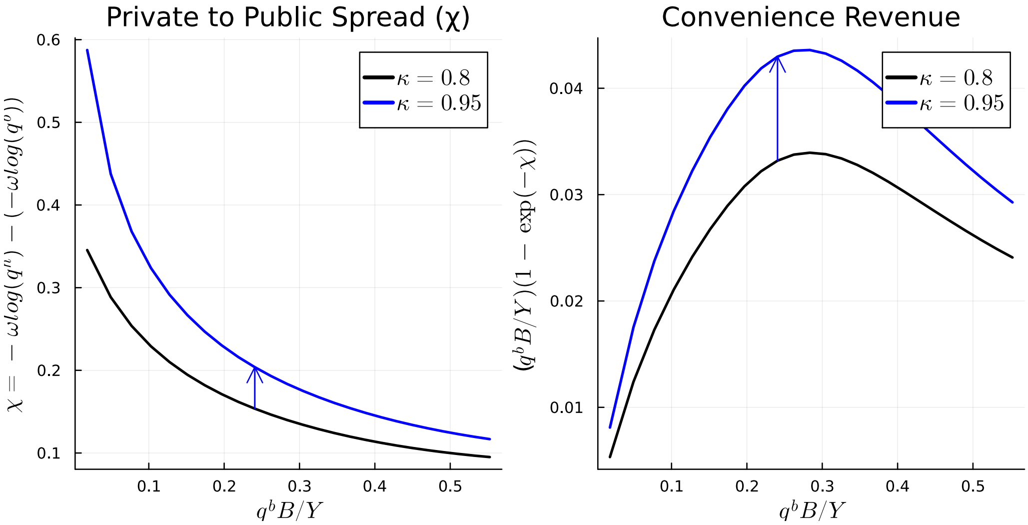
- Repression + fiscal rule that devalues long-term bond prices (e.g. high σ^z)

  ⇒ Banks cannot satisfy regulations without losses so they respond by shrinking

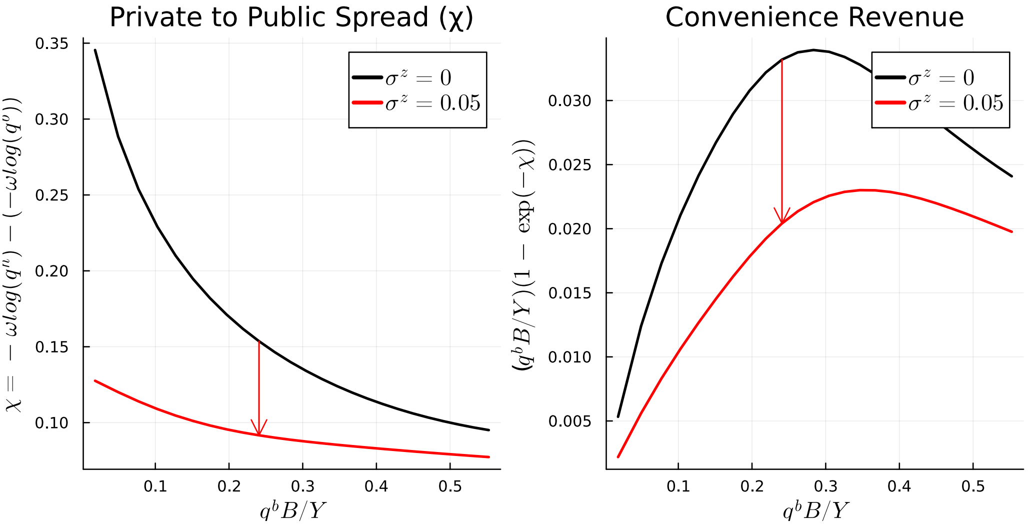
  ⇒ Government bond prices ↓ in bad times

  ⇒ Government debt becomes "bad hedge" and loses funding advantage.

$\uparrow \kappa$ and LT price stability $\Rightarrow \uparrow$ Convenience Revenue Curve



Repression + LT price instability ⇒ ↓ Convenience Revenue Curve



The government can “choose” equilibrium relationships.

What macroeconomic tradeoffs does it face?

Ultimately, the government cannot choose all three of:

1. High funding advantage (high treasury premium),
2. Well-functioning financial sector (profitable and stable), and
3. Fiscal-monetary policy that leads to systematic debt devaluation (e.g. issuance in "bad times", volatile spending shocks, "default", "inflation").

Intuition: If the government forces the financial sector to hold debt, then it cannot inflate away the debt without forcing banks into bankruptcy.

Ultimately, the government cannot choose all three of:

1. High funding advantage (high treasury premium),

2. Well-functioning financial sector (profitable and/or stable), and

3. ~~Fiscal policy that leads to systematic debt devaluation (e.g. "default", "counter-cyclical" issuance, "inflation")~~.

1865-1913: Heavy financial repression and stable bond prices (high κ, low σ^z).

2010-2019: Increase in financial regulation and stable bond prices (high κ, low σ^z)

Ultimately, the government cannot choose all three of:

1. ~~High funding advantage (high treasury premium)~~,
2. Well-functioning financial sector (profitable and/or stable), and
3. Fiscal policy that leads to systematic debt devaluation (e.g. issuance in "bad times", volatile spending shocks, "default", "inflation").

1970s-80s: Debt devaluation and stable financial sector but bank substitution away from Treasurys and no funding advantage.

Broader Macroeconomic Results

1. Repression crowds out investment (as in other models)
   ... but can help bank liquidity provision because:
   - Creates a safe asset which helps the financial sector manage risk and provide services,
   - But links bank balances to government balance sheet

2. Welfare results depend on whether the investment or liquidity provision is more constrained (and how the government uses spending).

3. Counterfactual: rerunning WWI and WWII with financial repression to increase funding advantage is not necessarily welfare increasing.

How does this connect to monetary-fiscal modeling?

Financial Dominance

- We have many theories and models of monetary-fiscal interactions
  (Keynes (1924), Friedman (1948), Hansen(1949), Tobin (1969), Sargent and Wallace (1981), Wallace (1981), Aiyagari and Gertler (1985), Leeper (1989, 1991), Sims (1994), Woodford (1995), Cochrane (2011))
  - Much debate about whether and how to model liquidity premia.
  - Interaction is monetary dominance (active monetary policy/passive fiscal policy), or
  - ... fiscal dominance (passive monetary policy/active fiscal policy).
- But very few papers consider frictions in the financial sector
  ... even though government debt has typically been held by financial intermediaries.
- Our trilemma can be thought of as a model of financial dominance:
  - If the government wants to lower financing costs,
  - Then it has to organize monetary-fiscal policy to ensure banks stay active buyers.

Conclusion

- Government can use financial regulation to make treasuries the safe-asset,
- But this requires running "fiscal" policy that supports long-term debt prices,
- We should focus less on ST debt quantities and more focus on LT debt return risk.

Thank You!

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Model Overview (From Payne-Szoke-25)

- Discrete time, infinite horizon RBC economy
- Financial intermediaries face market frictions that limit risk sharing
  $\Rightarrow$ Assets that can help financial intermediaries hedge risk play a "special role"
  $\Rightarrow$ Trade at lower yields (higher prices) even after adjusting for risk premia.
- The government faces an exogenous surplus process
  ... But can influence treasury demand with restrictions on financial sector portfolios.
- Financial-fiscal polices can make government debt the hedging asset
  ... Or destroy its role as a hedging asset.

Environment: Households and Banks

- Discrete time, infinite horizon RBC economy & AM & PM markets each period.
- Family of households who need "liquid" deposits to consume in the AM market.
  - Households separate across islands in AM (isolated to their island) and recombine in PM.
  - In the AM, on each island, households value AM consumption with prob. λ
  - The probability $\lambda \in \{\lambda_H, \lambda_L\}$ is random across islands.
- On each island, banks offer deposits, which exposes them to withdrawal shock risk:
  - PM: banks issue deposits, raise equity, and purchase assets.
  - AM: deposits can be withdrawn for $x^d_{t+1} \leq 1$ good in the AM or in the following PM
  - Friction: banks cannot raise equity (or short sell) in AM market to cover withdrawals
  - Friction: banks can default on deposits and incur deadweight cost $\Psi(1 - x^d_{t+1}(\lambda))d_t$.

Banks want an asset to "hedge" withdrawal risk.

Environment: Production Technology and Bank Asset Markets

- PM: Primary bank market with assets exposed to aggregate TFP risk $\mathbf{z} = (\breve{z}_{t+1}, z_{t+1})$
  - *Short asset* (m_t), transforms one good to $\breve{z}_{t+1}$ goods next AM
  - *Capital* (k_t), produces $z_{t+1}k_t$ goods next PM; $z_{t+1} > \breve{z}_{t+1}$ and $k_{t+1} = (1-\delta)k_t + \Phi(i_t)$
  - *Government Bond* (b_t), for price q_t^b, repays fraction ω of debt outstanding each PM

- AM: Secondary bank market for bonds (at $\breve{q}_{t+1}^b$) and capital (at $\breve{q}_{t+1}^k$)
  - Must trade bonds & capital with other banks to manage island λ withdrawal shocks

There is no exogenously safe asset for banks to hedge risk.

Environment: Government

- Sets policy (G_t, T_t, B_t) subject to budget constraint with $B_{-1} = 0$:

$$(\omega + (1-\omega)q_t^b)B_{t-1} \leq T_t - G_t + q_t^b B_t, \quad \forall t \geq 0$$

Exogenous fiscal rule: $T_t - G_t$ determined outside the model (political process).
$T_t - G_t = \eta\omega\Big(B_{t-1} - \bar{b}y_t\Big) + y_t\Big(\sigma^z\varepsilon_t^z + \sigma^g\varepsilon_t^g\Big)$ where $\sigma^z > 0 \Rightarrow \downarrow$ surplus in bad state.

- Sets restrictions on bank portfolios:

Historical Eras

$$\text{AM} \quad \frac{\varrho}{2}x_{t+1}^d(1-\lambda)d_t \leq \Upsilon(\breve{b}_{t+1}, \breve{k}_{t+1}) := \Big(\kappa(\breve{q}_{t+1}^b\breve{b}_{t+1})^\alpha + (1-\kappa)(\breve{q}_{t+1}^k\breve{k}_{t+1})^\alpha\Big)^{1/\alpha} \quad (2)$$

Regulation: ϱ is overall leverage constraint; $\kappa \in [1/2, 1]$ incentivizes debt holding
$\ldots \kappa = 1/2$ "neutral" regulation; $\kappa = 1$ is "pure" repression; $(\varrho, \kappa) \approx$ Basel "risk-weights"

Analogous Environments

- Costly default on deposits → Costly bank equity raising
- Portfolio restrictions → Central bank that offers different haircuts when bonds and capital are used as collateral at the discount window.
- Bank → Pension or insurance fund with equity raising constraints.

Bank Problem

Taking prices and household SDF $\xi_{t,t+1}$ as given, the bank maximizes its value:

$$\max_{m,k,b,d,\breve{x}^d,\breve{b},\breve{k},x^e} \quad \mathbb{E}_t\Big[\xi_{t,t+1}\sum_{\lambda_{t+1}} \underbrace{x^e_{t+1}}_{\text{Dividends}} \; dF(\lambda_{t+1})\Big] + q^d_t d_t - m_t - k_t - q^b_t b_t$$

subject to a morning budget constraint on withdrawals:

$$\underbrace{\lambda_{t+1}\breve{x}^d_{t+1}d_t}_{\text{Withdrawals}} \leq \underbrace{\breve{z}_{t+1}m_t + \breve{q}^b_{t+1}(b_t - \breve{b}_{t+1}) + \breve{q}^k_{t+1}(k_t - \breve{k}_{t+1})}_{\text{Short asset + sale of long term assets}} - \Psi(\breve{x}^d_{t+1}), \quad (AM)$$

and the afternoon profit constraint and other constraints:

$$x^e_{t+1} + (1-\lambda_{t+1})d_t \leq \big(z_{t+1} + (1-\Delta)q^k_{t+1}\big)\breve{k}_{t+1} + \big(\omega + (1-\omega)q^b_{t+1}\big)\breve{b}_{t+1}, \quad (PM)$$

& Short selling constraints & Regulatory constraint (2).

Competitive General Equilibrium

Aggregate states $= \mathbf{s} := (\mathbf{z}, k, b)$.

Given a fiscal rule for $T - G$, regulation (ϱ, κ), and a budget-feasible government policy for B, a competitive equilibrium is a set of price functions $\{q^d, q^e, q^b, \breve{q}^k, \breve{q}^b\}$ and policy functions $\{d^h, e^h, \breve{c}, c\}$ and $\{m, k, b, d, \breve{x}^d, \breve{k}, \breve{b}, x^e\}$ s.t.

1. Households and banks optimize.

2. Markets clear: (leaving aggregate state dependence implicit)

$$d^h = d, \qquad e^h = 1, \qquad b = B, \qquad G + m + k = zk - (1 - \bar{\lambda})c,$$

$$\sum_\lambda \breve{b}(\lambda, \cdot)\pi_\lambda = B, \qquad \sum_\lambda \breve{k}(\lambda, \cdot)\pi_\lambda = k, \qquad \sum \lambda \breve{c}(\lambda, \cdot)\pi_\lambda = \breve{z}m - \Psi(\breve{x}^d)d$$

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AM "Interbank" Market: No Regulation

- Interbank market frictions lead to "fire-sale"/"goods-in-market" pricing in the AM:

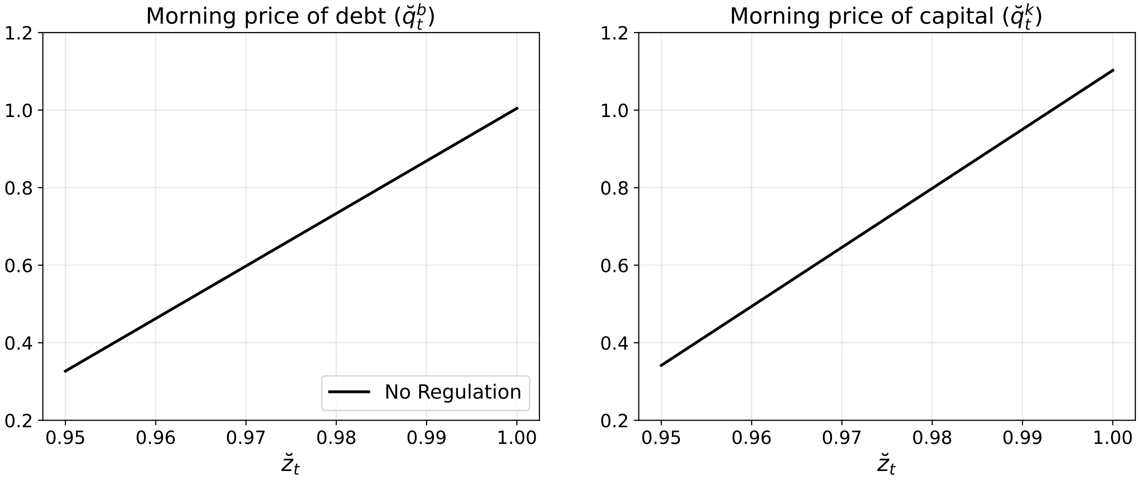
$$\breve{q}^b \leq \underbrace{\omega + (1-\omega)q^b =: x^b}_{\text{Afternoon bond value}}, \qquad \breve{q}^k \leq \underbrace{z + (1-\delta)q^k =: x^k}_{\text{Afternoon capital value}}$$

- Returns on bonds and capital equalize:

$$\frac{\breve{q}^b}{\breve{q}^k} = \frac{x^b}{x^k}$$

- Bad state: fire-sale worse $\Rightarrow$ greater bank difficulty satisfying withdrawals.

AM: No Regulation: “Fire-Sale” Pricing in AM Market



Neither asset hedges risk in the morning market.

AM "Interbank" Market: Repression (High κ) + Fiscal Rule Fixes q^b

- Interbank market frictions lead to "fire-sale" pricing in the AM:

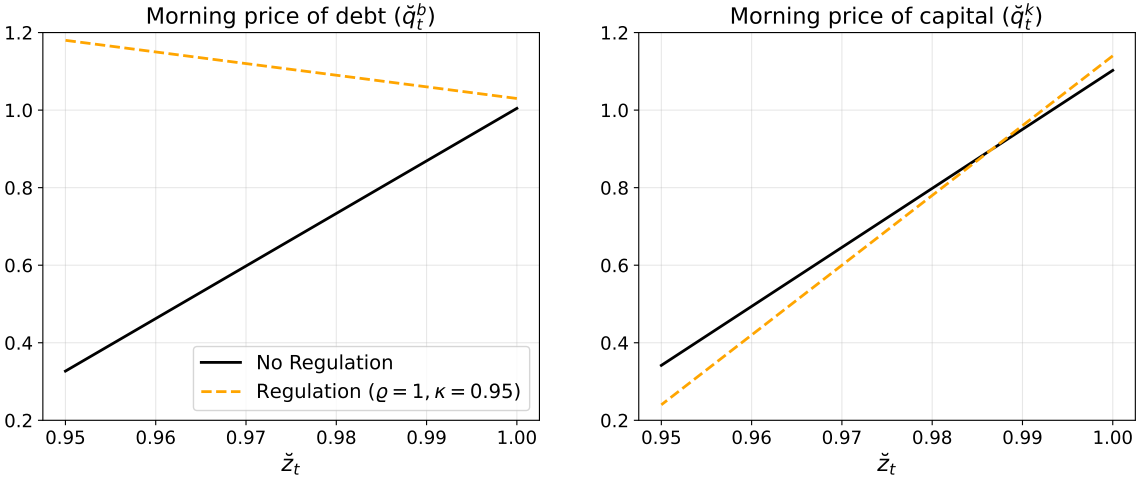
$$\breve{q}^b \leq \underbrace{\omega + (1-\omega)q^b =: x^b}_{\text{Afternoon bond value}}, \qquad \breve{q}^k \leq \underbrace{z + (1-\delta)q^k =: x^k}_{\text{Afternoon capital value}}$$

- AM relative price determined by interaction between bank decisions and govt policy:

$$\frac{\breve{q}^b}{\breve{q}^k} = \frac{x^b}{x^k}\left(\frac{1 - \frac{\breve{\mu}^r}{\breve{\mu}^e}\left(\frac{1-\kappa}{\varrho}\right)\breve{k}^{\alpha-1}}{1 - \frac{\breve{\mu}^r}{\breve{\mu}^e}\frac{\kappa}{\varrho}\breve{b}^{\alpha-1}}\right), \qquad \breve{\mu}^r, \breve{\mu}^e \text{ are LM on reg \& equity penalty}$$

  - Bad state: fire-sale worse $\Rightarrow \uparrow$ bank difficulty satisfying withdrawals & regulation.
  - In the AM banks can: (i) rebalance ($\uparrow$ bond holdings) or (ii) shrink ($\downarrow$ deposits and exit).
  - If future q^b stable, then continuing profitable & banks rebalance by $\uparrow$ AM bond holdings. ("captive demand" for government debt in bad times)

AM: Repression Makes Government Debt Hedge Aggregate Risk



Government debt gains special role as a hedging asset for the banking sector.

AM "Interbank" Market: Regulation + Fiscal Rule Devalues $q^b(z_L)$

- Interbank market frictions lead to "fire-sale" pricing in the AM:

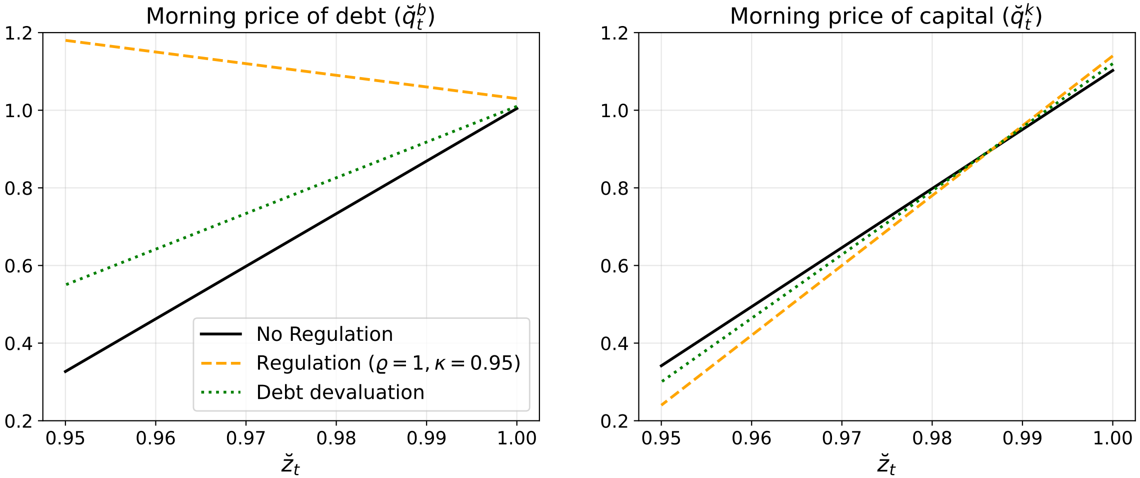
$$\breve{q}^b \leq \underbrace{\omega + (1-\omega)q^b =: x^b}_{\text{Afternoon bond value}}, \qquad \breve{q}^k \leq \underbrace{z + (1-\delta)q^k =: x^k}_{\text{Afternoon capital value}}$$

- AM relative price determined by interaction between bank decisions and govt policy:

$$\frac{\breve{q}^b}{\breve{q}^k} = \frac{x^b}{x^k}\left(\frac{1 - \frac{\breve{\mu}^r(\sigma^z)}{\breve{\mu}^e(\sigma^z)}\left(\frac{1-\kappa}{\varrho}\right)\breve{k}^{\alpha-1}}{1 - \frac{\breve{\mu}^r(\sigma^z)}{\breve{\mu}^e(\sigma^z)}\frac{\kappa}{\varrho}\breve{b}^{\alpha-1}}\right), \quad \breve{\mu}^r, \breve{\mu}^e \text{ are LM on reg \& no-equity}$$

  - Bad state: fire-sale worse ⇒ ↑ bank difficulty satisfying withdrawals & regulation.
  - In the AM bank can: (i) rebalance (↑ bond holdings) or (ii) shrink (↓ deposits and exit).
  - Repression + devaluation of govt debt in PM (high σ^z) ⇒ banks shrink in the AM
    ... because holding govt debt to satisfy regulation is too costly.

AM: Repression + Bond Devaluation Removes Hedge



Government loses special role as a hedging asset for the banking sector.

PM: Treasury Premium from Captive Demand in Bad Times

- PM market: the government debt price satisfies ($\xi(\mathbf{s}')$ is family SDF):

$$q^b(\mathbf{s}) = \mathbb{E}\Big[\xi(\mathbf{s}')\underbrace{\breve{M}^e(\mathbf{s}';\kappa,x^b)}_{\text{Bank wedge}}\underbrace{\breve{q}^b(\mathbf{s}';\kappa,\sigma^z)}_{\text{AM price}} \mid \mathbf{s}\Big], \qquad \breve{M}^e(\mathbf{s}') := \sum_{\lambda'} \underbrace{\breve{\mu}^e(\lambda',\mathbf{s}';\kappa,\sigma^z)}_{\text{LM on no-equity in AM}} \pi_{\lambda'}$$

- Compare to price of zero net supply ω-bond issued by private sector without regulatory privilege: $q^h(\mathbf{s}) = \mathbb{E}[\xi(\mathbf{s}')\breve{M}(\mathbf{s}')\breve{q}^h(\mathbf{s}')|\mathbf{s}]$.

- Special role for govt debt in AM (e.g. $\kappa > 0.5$) creates demand in PM:

$$\begin{pmatrix} \text{Hedging role:} \\ \breve{q}^b(s'_L) > \breve{q}^b(s'_H) \end{pmatrix} \Rightarrow \text{ Banks} \uparrow b(\mathbf{s}) \Rightarrow \begin{pmatrix} \text{Treasury premium:} \\ \uparrow (q^b(\mathbf{s}) - q^h(\mathbf{s})) \end{pmatrix}$$

So the funding advantage spread is:

$$\chi(\mathbf{s}) = -\omega \log(q^h(\mathbf{s})) - (-\omega \log(q^b(\mathbf{s}))) > 0$$

PM: Our Funding Advantage is Highly Policy Variant, unlike BIU, BIA

- Our model: spread to the household SDF:

$$\omega \log(q^b) - \omega \log\left(\mathbb{E}[\xi(\mathbf{s}')]\right)$$

$$= \underbrace{\omega \log\left(\mathbb{E}\left[\xi(\mathbf{s}')\breve{M}^e(\mathbf{s}';\kappa,\sigma^z)\breve{q}^b(\mathbf{s}';\kappa,\sigma^z) \mid \mathbf{s}\right]\right) - \omega \log\left(\mathbb{E}[\xi(\mathbf{s}')\breve{M}(\mathbf{s}')\breve{q}^h(\mathbf{s}')|\mathbf{s}]\right)}_{\text{Funding advantage from special role of govt debt} = \chi(\mathbf{s};\kappa,\sigma^z)}$$

$$+ \underbrace{\omega \log\left(\mathbb{E}[\xi(\mathbf{s}')\breve{M}(\mathbf{s}')\breve{q}^h(\mathbf{s}')|\mathbf{s}]\right) - \omega \log\left(\mathbb{E}[\xi(\mathbf{s}')]\right)}_{\text{Risk premium}}$$

- Bond-in-Utility (BIU) function $\nu(q^b B/y)y$ with $\omega = 1$: spread to the household SDF:

$$\omega \log(q^b) - \omega \log\left(\mathbb{E}[\xi(\mathbf{s}')]\right)$$

$$= \underbrace{\left(1 - \nu'(q^b B/y)/\mu^c\right)^{-1}}_{\text{Funding advantage} = \chi(q^b B/y)} + \underbrace{\omega \log\left(\mathbb{E}[\xi(\mathbf{s}')q^h(\mathbf{s}')|\mathbf{s}]\right) - \omega \log\left(\mathbb{E}[\xi(\mathbf{s}')]\right)}_{\text{Risk premium}}$$

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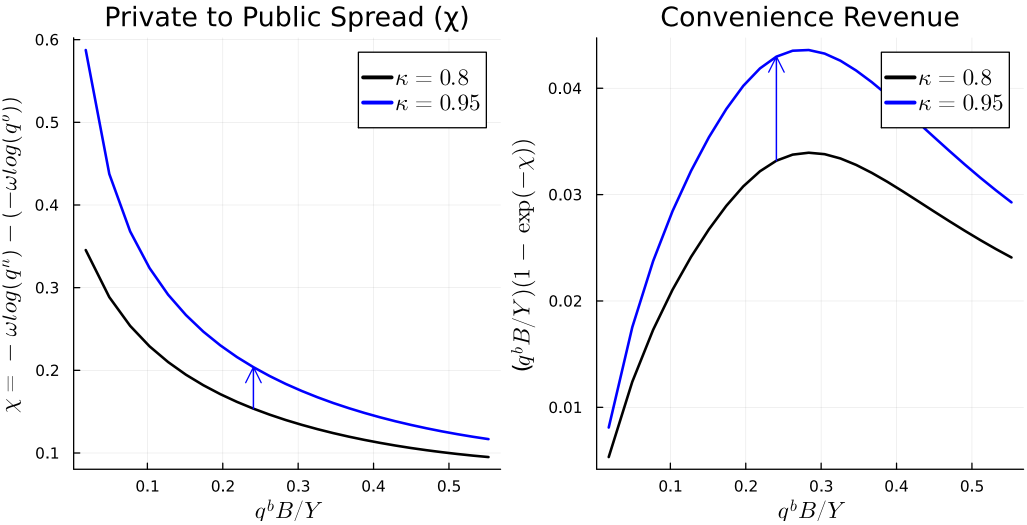
How does government policy impact
government funding advantage and convenience revenue?

Lifetime Government Budget Constraint

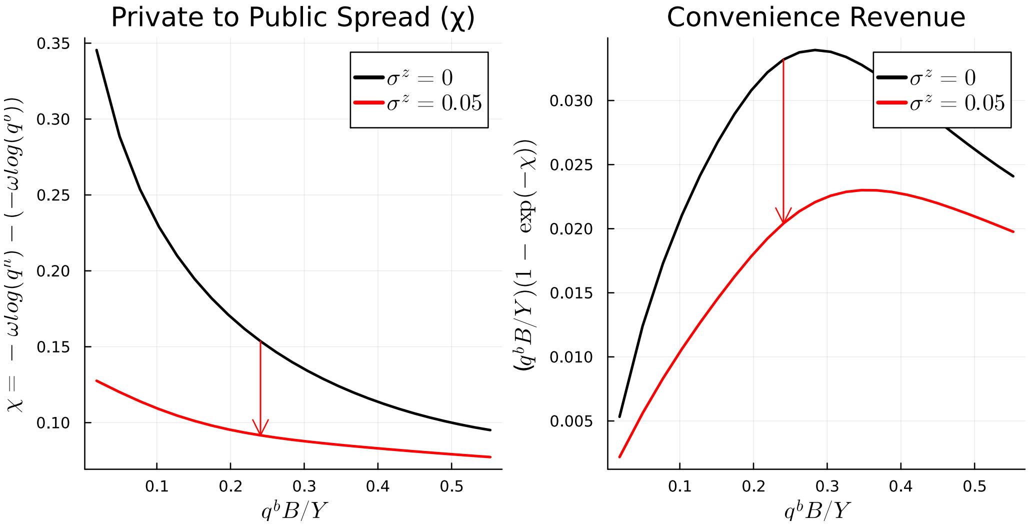
$$\left(\omega + (1-\omega)q_t^b\right)b_{t-1} = \underbrace{\mathbb{E}_t\left[\sum_{s=0}^{\infty}\xi_{t,t+s}\left(\tau_{t+s} - g_{t+s}\right)\right]}_{\text{(Present value of surpluses)}} +$$

$$+ \underbrace{\left(1 - \exp\left(\frac{-\chi_t}{\omega}\right)\right)q_t^b b_t + \mathbb{E}_t\left[\sum_{s=1}^{\infty}\xi_{t,t+s}\left(1 - \exp\left(\frac{-\chi_{t+s}}{\omega}\right)\right)q_{t+s}^b\left(b_{t+s} - (1-\omega)b_{t+s-1}\right)\right]}_{\text{(Convenience revenue)}}$$

↑ κ: "Increases" The Convenience Revenue Curve



$\uparrow \sigma^z$: "Decreases" The Convenience Revenue Curve



Comment: BIU/BIA Lead to Different Policy Connections

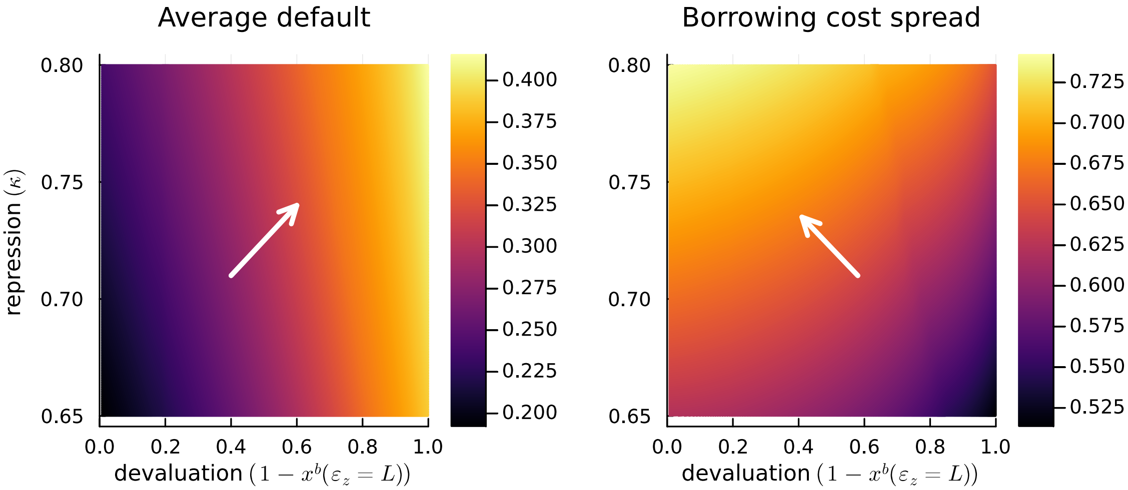
	Our Model	BIU / BIA / Standard Bewley Model
Less supply ($\downarrow q_t^b B_t$)	$\uparrow \chi$	$\uparrow \chi$
More treasury return risk ($\uparrow \sigma_t^z$)	$\downarrow \chi$	No change in χ, $\uparrow \chi$

- Unlike our model, in Bond-in-Utility (BIU) and Bond-in-Advance (BIA):
  - "Specialness" of government debt is exogenous and
  - ... its marginal usefulness increases as market value of government debt decreases
  - So, as the government devalues its debt it becomes more "useful".
    (the agents "like" to fund the government even more).

Government can "choose" equilibrium relationships.

What macroeconomic tradeoffs does it face?

Varying Repression and Fiscal Exposure Have Complicated Tradeoffs



Ultimately, the government cannot choose all three of:

1. High funding advantage (high treasury premium),

$$\uparrow \chi = -\log\left(q^h\right) - \left(-\log\left(\mathbb{E}_{\mathbf{s}}\left[\xi(\mathbf{s}') \underbrace{\breve{M}^e(\mathbf{s}'; \kappa, x^b)}_{\text{Bank Friction Wedge}} \underbrace{\breve{q}^b(\mathbf{s}'; \kappa, x^b)}_{\text{AM price}}\right]\right)\right)$$

2. Well-functioning financial sector (profitable and stable), and

$$\uparrow q^e(\mathbf{s}) = \mathbb{E}\left[\xi(\mathbf{s}') \sum_{\lambda'} x^e(\lambda', \mathbf{s}'; \kappa, x^b)\pi_{\lambda'} \mid \mathbf{s}\right], \qquad \breve{x}^d(\lambda', \mathbf{s}'; \kappa, x^b) = 0$$

3. Fiscal policy that leads to systematic debt devaluation $\uparrow \mathrm{Cov}(x^b, z)$ (e.g. issuance in "bad times", volatile spending shocks, "default", "inflation").

Ultimately, the government cannot choose all three of:

1. High funding advantage (high treasury premium),
2. Well-functioning financial sector (profitable and/or stable), and
3. ~~Fiscal policy that leads to systematic debt devaluation (e.g. "default", "counter-cyclical" issuance, "inflation")~~.

1865-1913: Heavy financial repression but stable bond prices (high κ, low σ^z).

2010-2019: Tight financial regulation but stable bond prices (high κ, low σ^z)

Ultimately, the government cannot choose all three of:

1. ~~High funding advantage (high treasury premium)~~,
2. Well-functioning financial sector (profitable and/or stable), and
3. Fiscal policy that leads to systematic debt devaluation
   (e.g. issuance in "bad times", volatile spending shocks, "default", "inflation").

1970s-80s: Debt devaluation and stable financial sector but no funding advantage.

Broader Macroeconomic Results

1. Repression crowds out investment (as in other models)

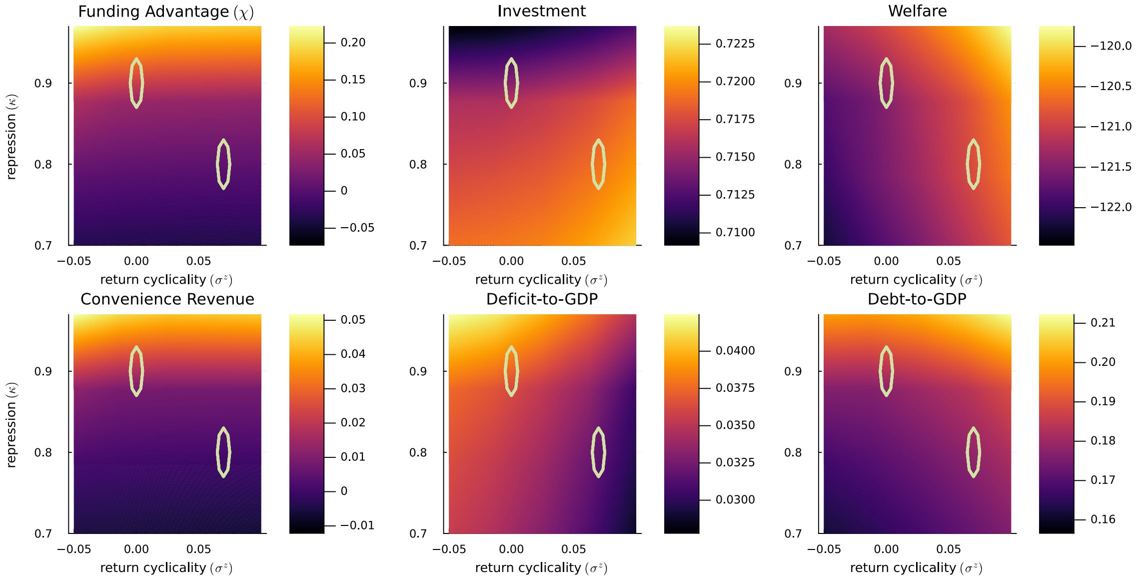
   ... but can help bank liquidity provision because:

   - Creates a safe asset which helps the financial sector manage risk and provide services,
   - But links bank balances to government balance sheet

2. Welfare results depend on whether the investment or liquidity provision is more constrained (and how the government uses spending).

3. Counterfactual: rerunning WWI and WWII with financial repression to increase funding advantage is not necessarily welfare increasing.

Ergodic Welfare Comparisons



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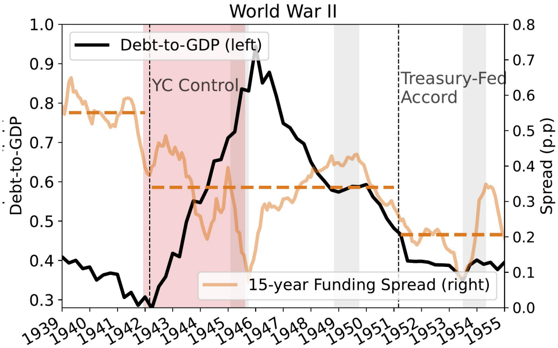
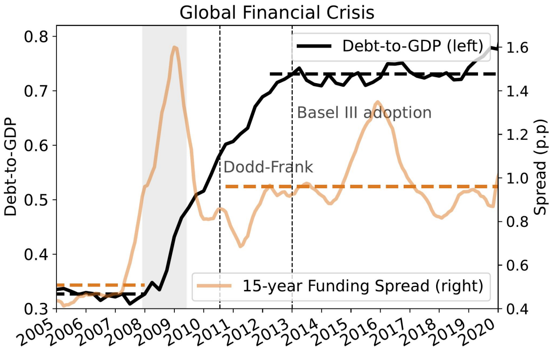
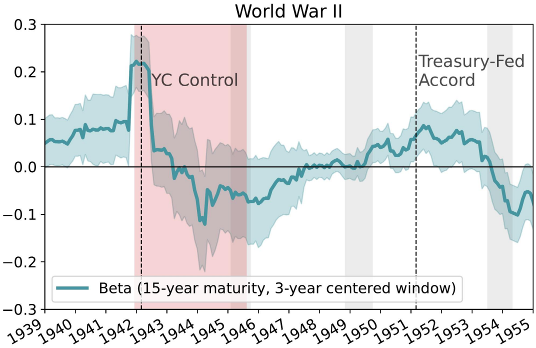
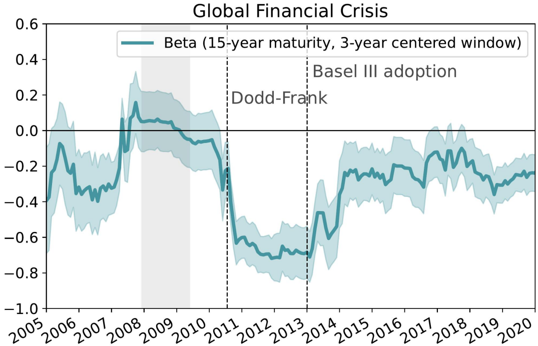
Two More Major Debt Expansions: Funding Spreads





Two More Major Debt Expansions: Bond-Stock Betas

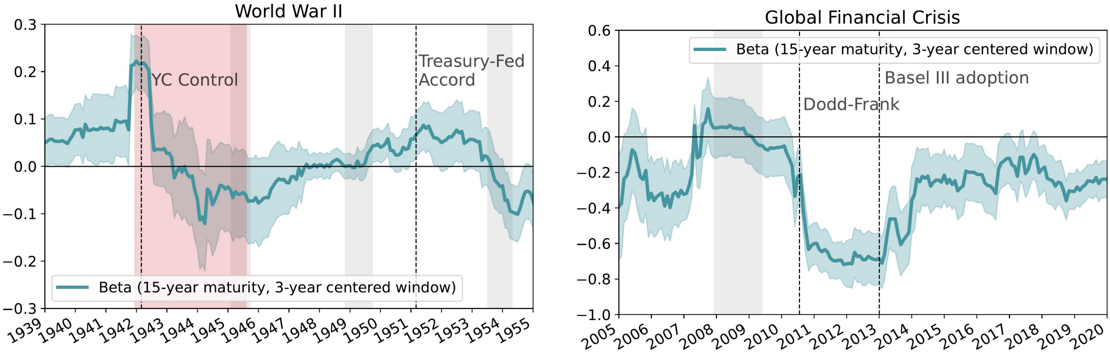




- 1970-80s: bond-stock beta becomes ≈ 1 and funding advantage went to zero.
- Regression analysis: financial regulation + bond-stock betas ⇒ adjusted $R^2 = 0.86$.

1970s-1980s Full Time Series

Two More Major Debt Expansions: Bond-Stock Betas



- 1970-80s: bond-stock beta becomes ≈ 1 and funding advantage went to zero.
- Regression analysis: financial regulation + bond-stock betas ⇒ adjusted $R^2 = 0.86$.

1970s-1980s | Full Time Series

↑ Bond Riskiness Corresponds to Loss of Funding Advantage

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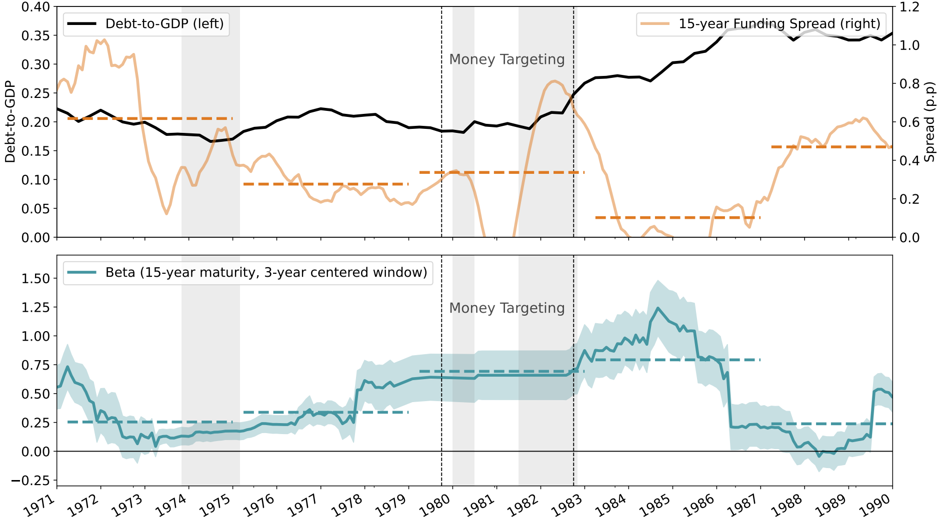

Funding Advantage And Debt-to-GDP

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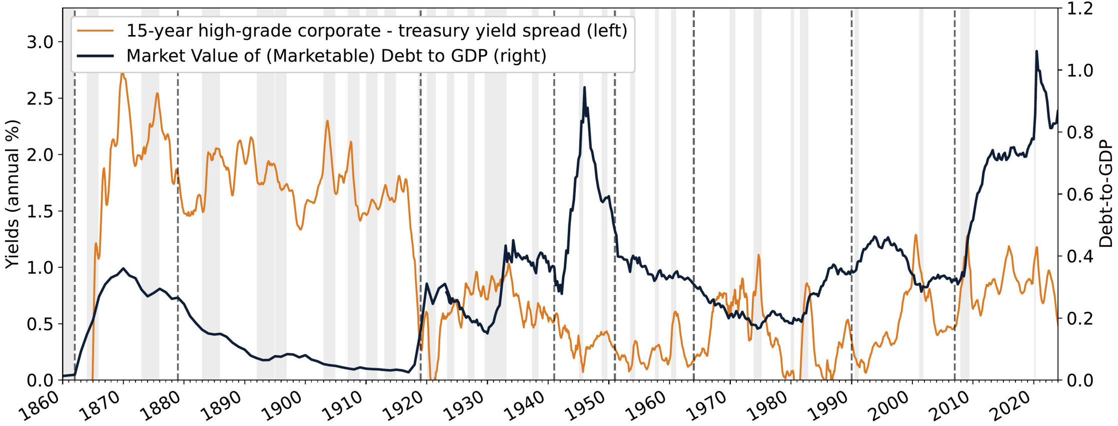

Funding Advantage And Bond-Stock Betas

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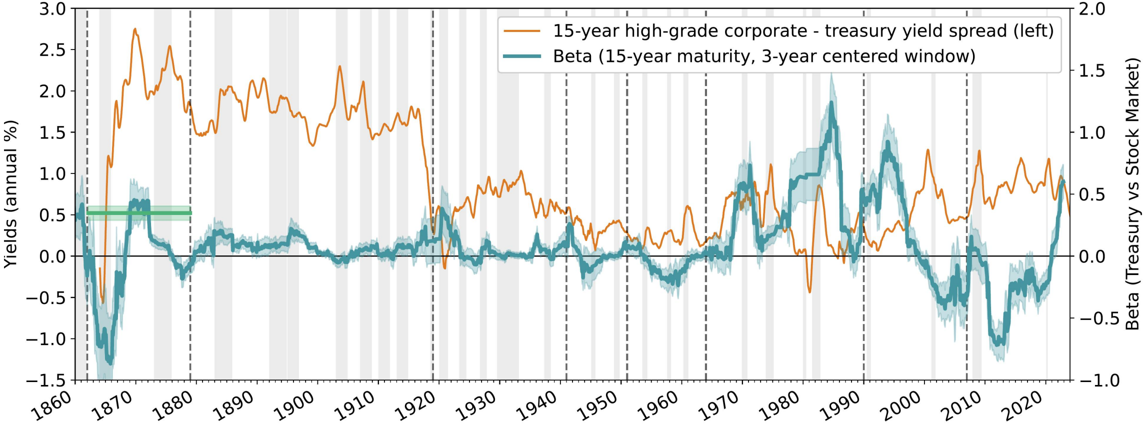

Papers With Bond-in-Utility (and Exogenous Funding Advantage)

Krishnamurthy and Vissing-Jorgensen (2012), Nagel (2016), Krishnamurthy-Li (2023), Kokre-Lenel (2024), Cieslak-Li-Pflueger (2024), Mian-Straub-Sufi (2024), Choi-Kirplani-Perez (2024), Jiang-Lustig-Van-Nieuwerburgh-Zhang (2024,25),

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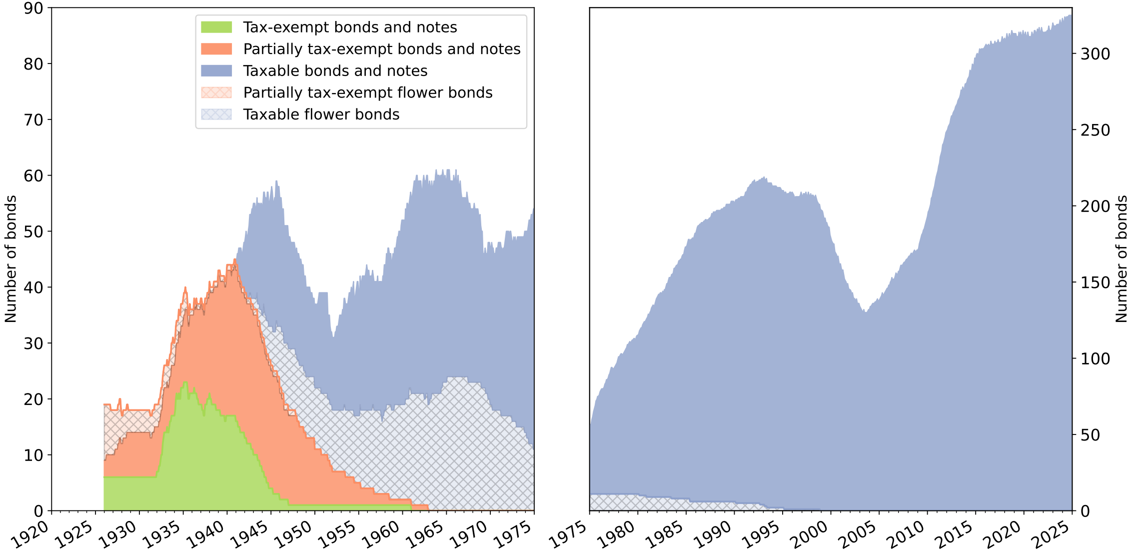
Number of Outstanding Marketable Bonds and Notes



Summary of Regulatory Eras

	Regulation Parameters	Discussion
1791-1862	$\varrho \approx 0$, $\kappa = 0.5$	*Pre-Civil War:* bank regulation at the state level, regulation not tightly enforced.
1862-1913	$\varrho = 0.9$, $\kappa = 1$ for $q^b \leq 1$	*National Banking Era:* has tight repression on the banking sector, which could only use government debt to back money creation.
1913-2007	$\varrho > 0$, κ varying and more implicit	*FED and New Deal Regulation:* implicit advantages for government debt through the FED discount window and the Bretton Woods reserve requirements (from 1944-1971).
2008-2024	$\varrho =$ leverage ratio, $\kappa =$ risk weight on US debt	*Basel III and Dodd-Frank Act:* asset requirements based on their risk weights.

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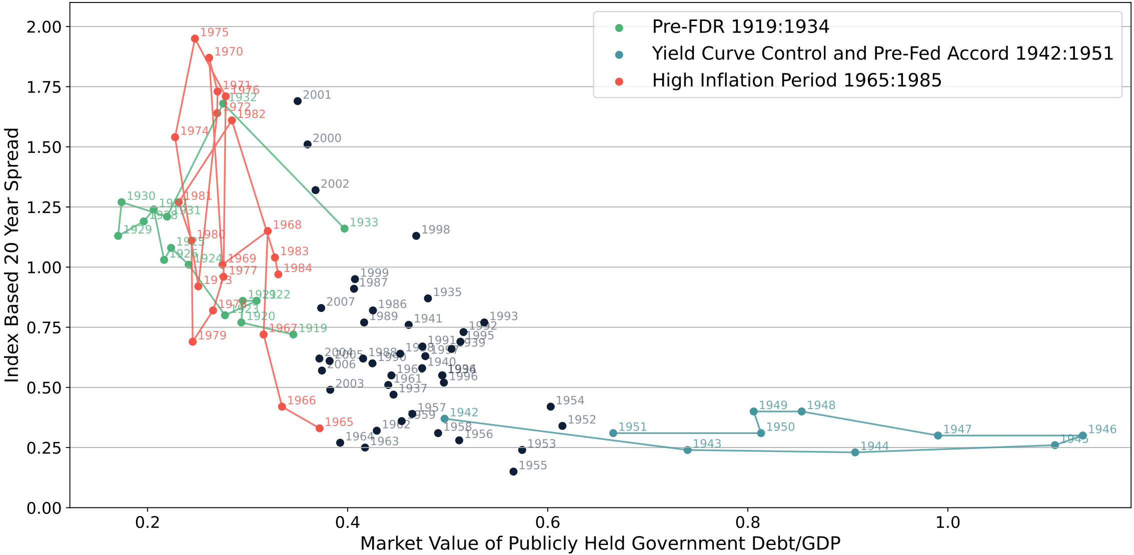
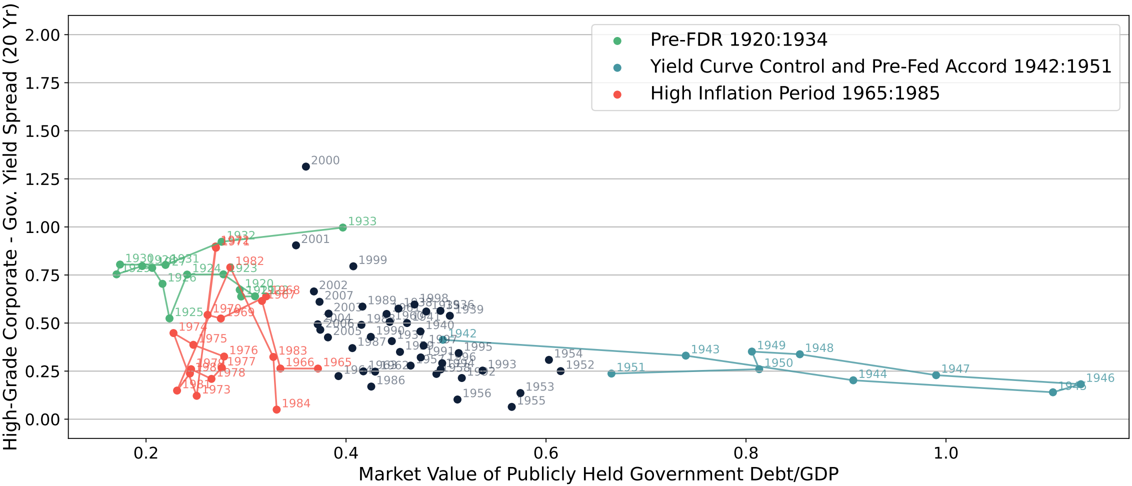
Funding Advantage vs Debt-to-GDP: KVJ



Funding Advantage vs Debt-to-GDP: Our Data



Regressions

	Dependent variable: Convenience Yield (20-Year)			
	(1)	(2)	(3)	(4)
log(Debt/GDP)[All]		-0.143		-0.211***
		(0.105)		(0.073)
Beta (36M)			-0.178**	-0.238***
			(0.082)	(0.082)
Volatility		1.902***	1.906***	1.725***
		(0.493)	(0.340)	(0.336)
Slope		-0.012	-0.028	-0.003
		(0.037)	(0.024)	(0.025)
Pre-1920 Dummy	1.271***	1.848***	1.127***	1.720***
	(0.065)	(0.254)	(0.131)	(0.398)
Post-2010 Dummy	0.448***	1.138***	0.791***	1.571***
	(0.115)	(0.373)	(0.302)	(0.514)
log(Debt/GDP) × Pre-1920 Dummy		0.225*		0.308**
		(0.120)		(0.122)
log(Debt/GDP) × Post-2010 Dummy		0.350		1.667
		(0.938)		(1.104)
Volatility × Pre-1920 Dummy		-1.722***	-0.473	-0.430
		(0.634)	(0.614)	(0.615)
Volatility × Post-2010 Dummy		-2.587***	-1.914	-3.127*
		(0.920)	(1.421)	(1.737)
Slope × Pre-1920 Dummy		0.109**	0.068	0.012
		(0.043)	(0.047)	(0.056)
Slope × Post-2010 Dummy		0.000	0.003	0.062
		(0.125)	(0.093)	(0.111)
Beta × Pre-1920 Dummy			0.732	0.222
			(0.713)	(0.904)
Beta × Post-2010 Dummy			0.176	0.170
			(0.296)	(0.292)
Constant	0.473***	0.008	0.218***	-0.014
	(0.040)	(0.147)	(0.059)	(0.098)
Significance:	$^{*}p < 0.1$	$^{**}p < 0.05$	$^{***}p < 0.01$	
Period:	1860-2025	1860-2025	1880-2025	1880-2025

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Measuring Funding Advantage ...since 1860

- **Funding Advantage**: US gov borrows at lower interest rates than the private sector

  ...even for bonds with identical cash flows and credit risk

  ⇒ US government can issue debt not fully backed by future surpluses

Yield spread between j-period "plain vanilla", like-for-like bonds:

$$\underbrace{\chi_t^{(j)}}_{\text{Funding advantage}} := \underbrace{\widetilde{y}_t^{(j)}}_{\text{Highest-grade private debt}} - \underbrace{y_t^{(j)}}_{\text{US Treasury debt}} > 0$$

- **Data challenge:** observed bonds are heterogeneous (tax advantages, options, etc.)
- **This paper:** first *term structure* of tax- and option-adjusted Aaa-Treasury spreads
  - χ_t has been mismeasured and exaggerated during key episodes of 20th century
  - Build asset pricing model for χ_t: explained by usual bond price risk factors

Literature

Historical Bond Samples

New Data:

- **New Corporate Bond Data:** prices & features for highest-grade bonds (1860-)
  - Pre-1974: CFC, NYT, Moody's Barron's; Post-1974: Lehman Warga, & Merrill Lynch
- **Treasury Bond Data:** prices & features for all treasuries (1790-)
  - Combines Hall-Payne-Sargent-Szőke data (1790-1940) with CRSP (1926-2024)

Key contribution:

- Identify institutional details that matter for historical bond pricing
- Find relevant bond characteristics and orgnize bonds accordingly

Historical Samples Exhibit Substantial Bond Heterogeneity

Tax Advantages

- **Tax Exemptions** (1917-1941): from federal income taxes on government bonds
- Capital Gains Tax Advantage on low coupon bonds

Tax Exemptions | Bonds Trading Below Par

Embedded Options

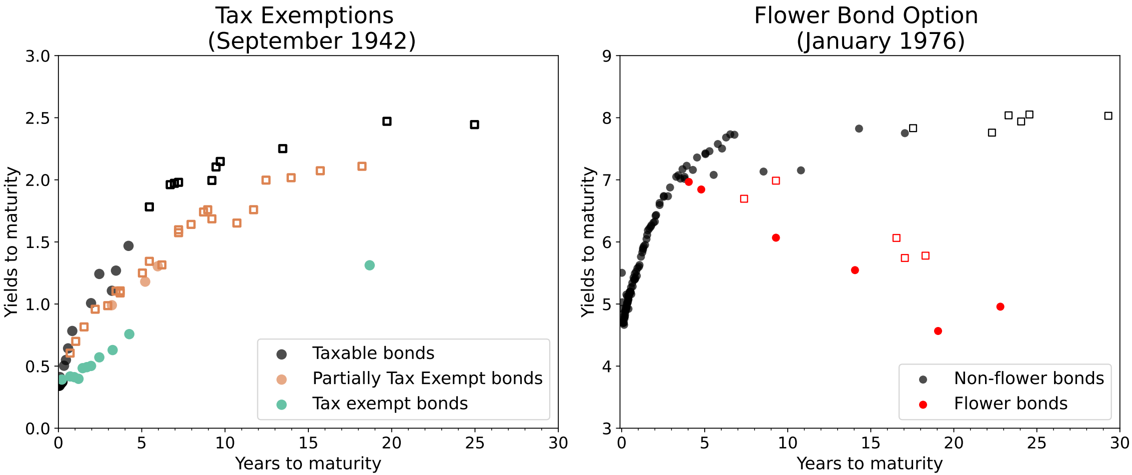
- Call options, Exchange privilege

Composition of callable bonds

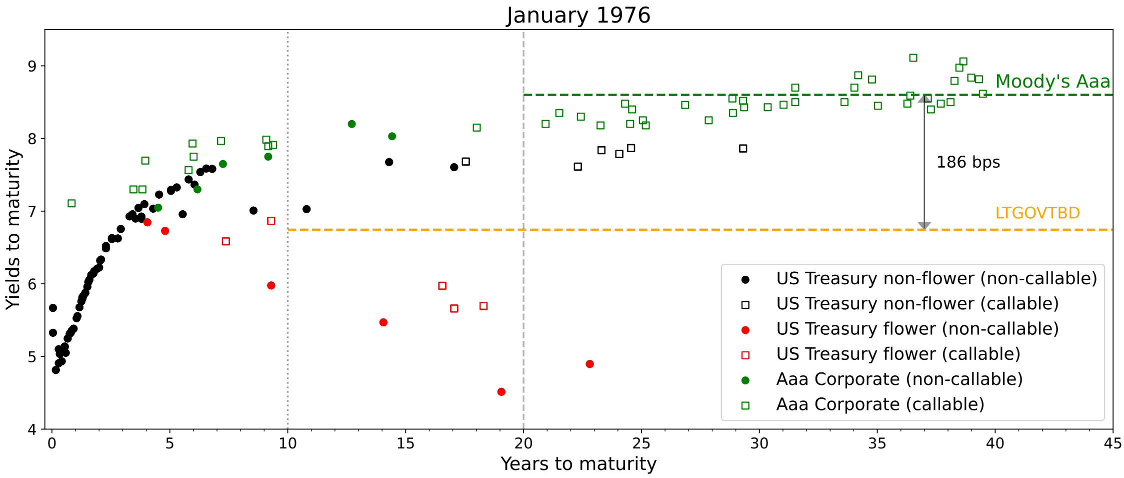
- **Flower Bonds** (1917-1971): Could be redeemed at par to pay the bondholder's federal estate taxes upon their death
  - Tax provision is valuable when market prices are below par ($\approx$ inflation put):

$$\uparrow \text{Inflation} \quad \Rightarrow \quad \uparrow \text{Interest rates} \quad \Rightarrow \quad \downarrow (\text{Price} - \text{Par}) \quad \Rightarrow \quad \uparrow \text{Put Moneyness}$$

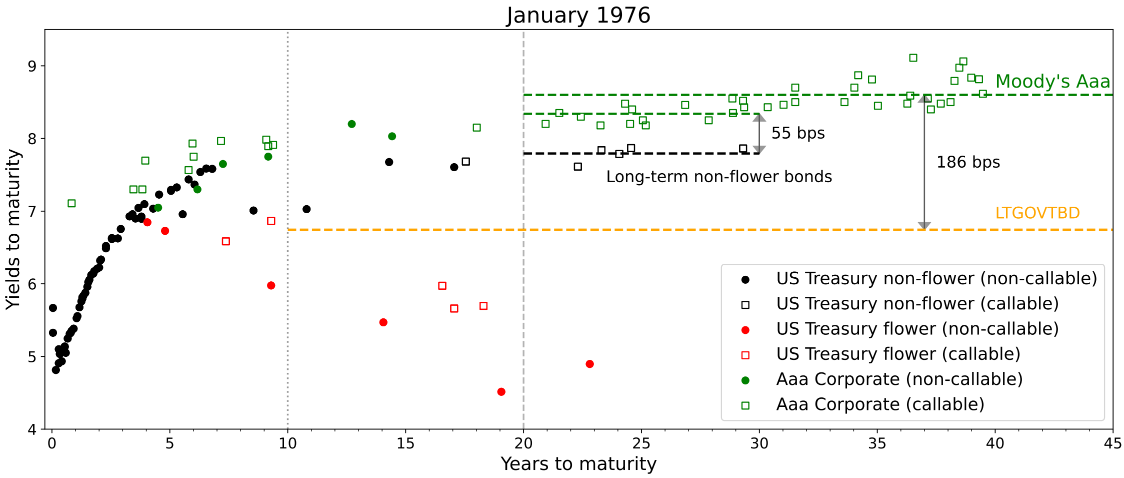
Price Effect of Taxation and Flower Bonds



Commonly Used Measure of Long-Maturity Funding Advantage



“Inflation Put” in Government Bonds ⇒ Mismeasured Spread



How can we make progress?

Yield Curve Estimation With Plain Vanilla Bonds

Law of one price: common discount function, $\mathsf{q}_t := \{q_t^{(j)}\}_{j\geq 1}$, to price all bonds

$$p_{i,t} = \sum_{j=1}^{\infty} q_t^{(j)} c_i^{(j)} + \underbrace{\varepsilon_{i,t}}_{\text{price error}}$$

Identification: simultaneously observe bonds with different maturities and coupons

Yield Curve Estimation With Bond Heterogeneity

Law of one price: common discount function, $\mathsf{q}_t := \{q_t^{(j)}\}_{j\geq 1}$, to price all bonds

$$p_{i,t} = \sum_{j=1}^{\infty} q_t^{(j)} \underbrace{z_i^{(j)}(\eta_t, p_{i,t})}_{\text{tax advantages}} c_i^{(j)} + \underbrace{v_i(\theta_t, p_{i,t})}_{\text{option value}} + \underbrace{\varepsilon_{i,t}}_{\text{price error}}$$

... time-varying wedges $(z_{t,i}, v_{t,i})$ with theory-consistent forms:

$$z_i^{(j)}(\eta_t, p_{i,t}) := f\Big(\text{determinants of tax advantage}\Big)$$

$$= \exp\left(\eta_{t,0}\mathbb{1}\left\{\begin{matrix}\text{Partial}\\ \text{tax}\\ \text{exempt}\end{matrix}\right\} + \eta_{t,1}\mathbb{1}\left\{\begin{matrix}\text{Fully}\\ \text{tax}\\ \text{exempt}\end{matrix}\right\} + \eta_{t,2}\sum_{s=0}^{j}\max\left\{\overline{y}_{t,i} - cp_i/\widehat{E}_t[p_{t+s,i}],\ 0\right\}\right)$$

Tax Exemptions | Low Coupons | Flower | Kernel Ridge | Price Errors

Yield Curve Estimation With Bond Heterogeneity

Law of one price: common discount function, $\mathsf{q}_t := \{q_t^{(j)}\}_{j\geq 1}$, to price all bonds

$$p_{i,t} = \sum_{j=1}^{\infty} q_t^{(j)} \underbrace{z_i^{(j)}(\theta_t, p_{i,t})}_{\text{tax advantages}} c_i^{(j)} + \underbrace{v_i(\theta_t, p_{i,t})}_{\text{option value}} + \underbrace{\varepsilon_{i,t}}_{\text{price error}}$$

...time-varying wedges $(z_{t,i}, v_{t,i})$ with theory-consistent forms:

$$\begin{aligned} v_i^f(\theta_t, p_{i,t}) &:= f\Big(\text{moneyness, exercise period, interest rate volatility}\Big) \\ &= \exp\Big(\theta_{t,0} + \theta_{t,1}\max\{\overline{y}_{i,t} - \overline{y}_{i,t}^p, 0\}\Big) M_{i,t}^{\theta_{t,2}} \end{aligned}$$

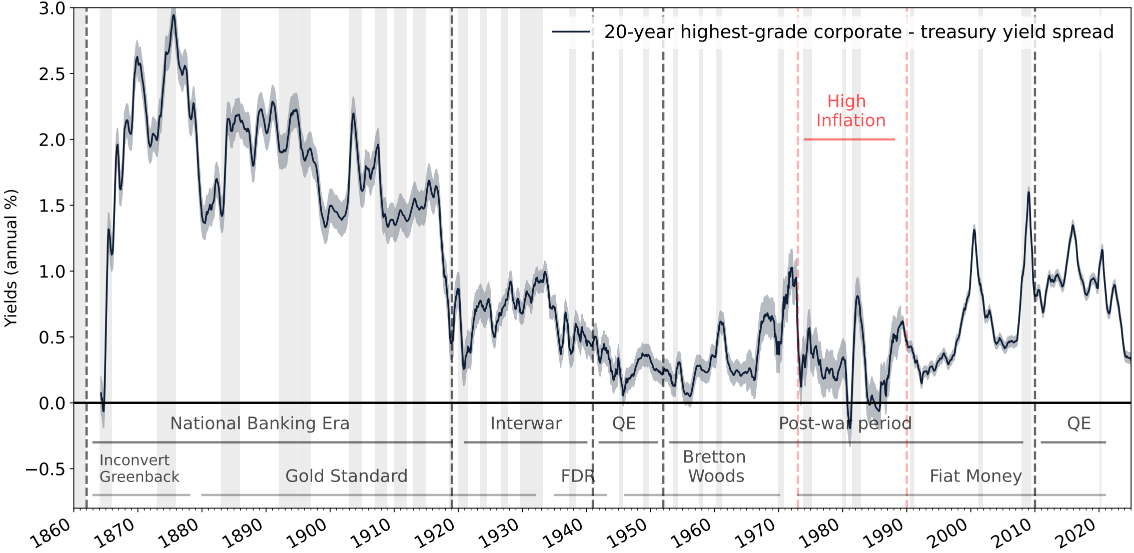
Identification: observe bonds with/without options + with/without tax advantages

- estimate $(\mathsf{q}_t, \eta_t, \theta_t)$ via non-parametric Kernel Ridge (Filipovic, Pelger, and Ye (2025))

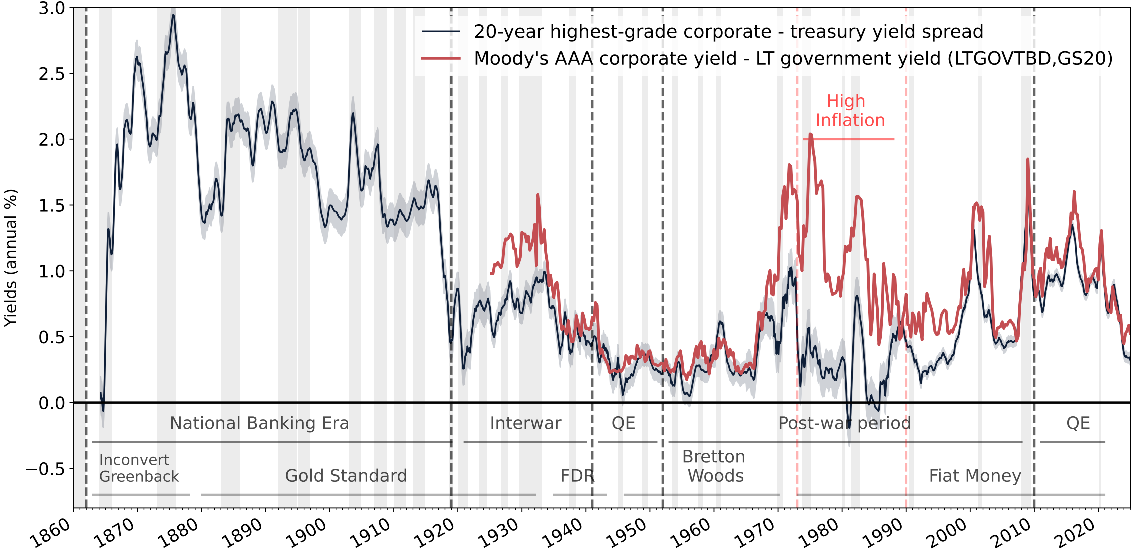
Tax Exemptions | Low Coupons | Flower | Kernel Ridge | Price Errors

What do we find?

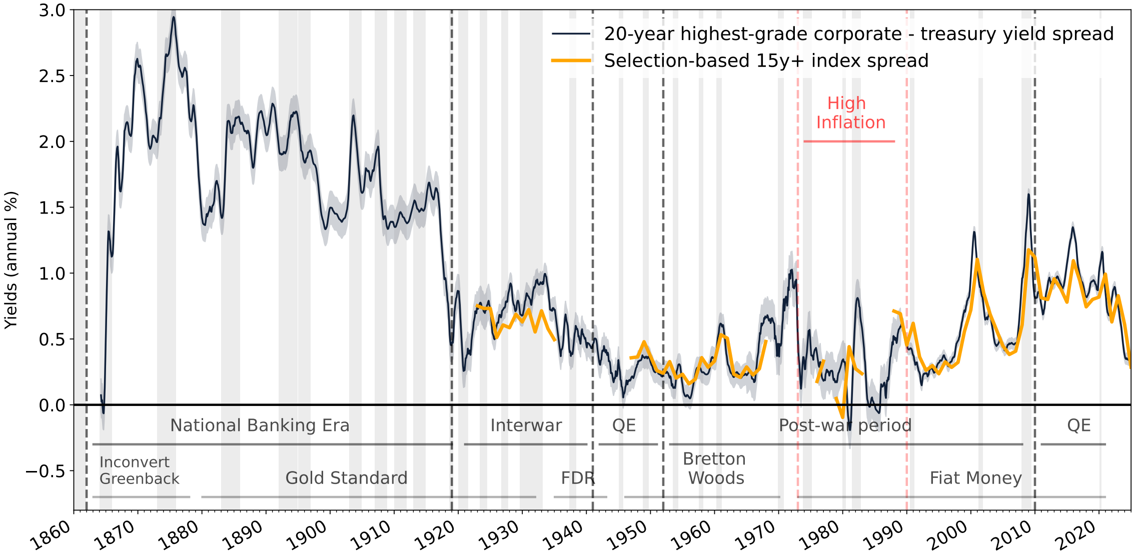
US Funding Advantage 1860-2024



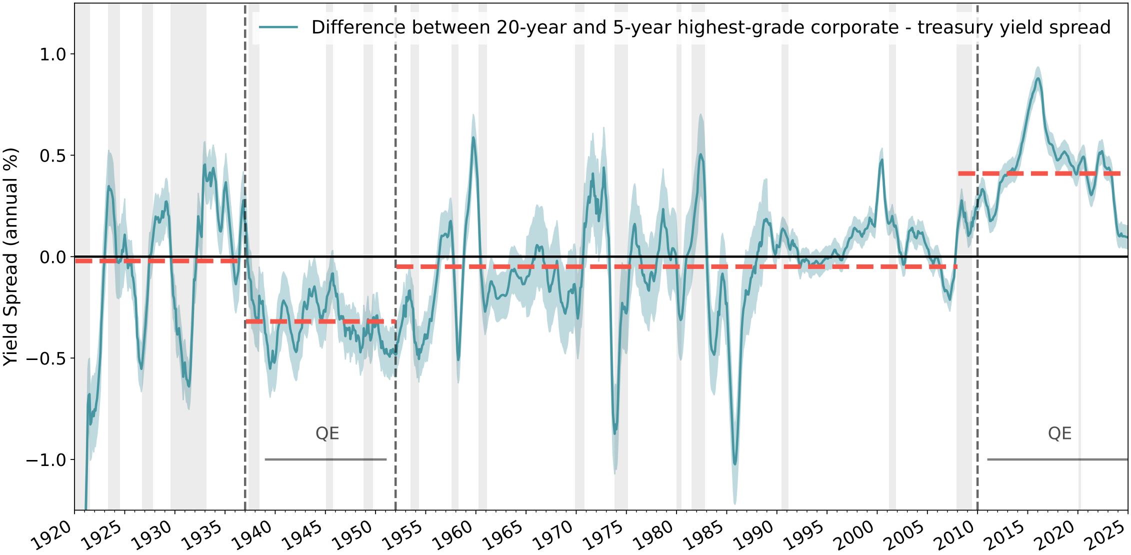
Commonly Used Measure Overestimates US Funding Advantage...



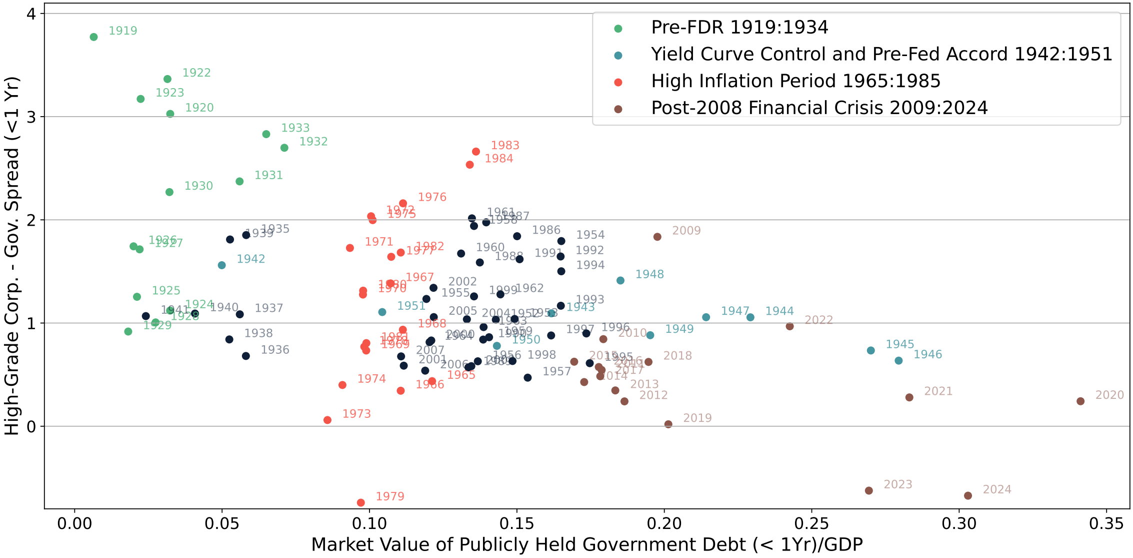
. . . Because It Includes Options and Tax Advantages



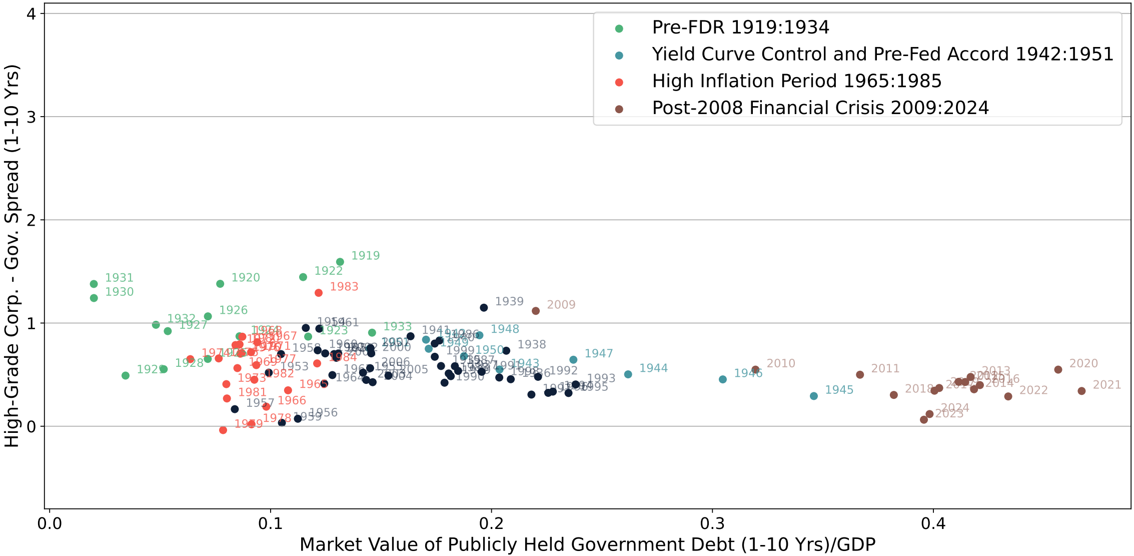
Term Structure Opens Up During QE Episodes



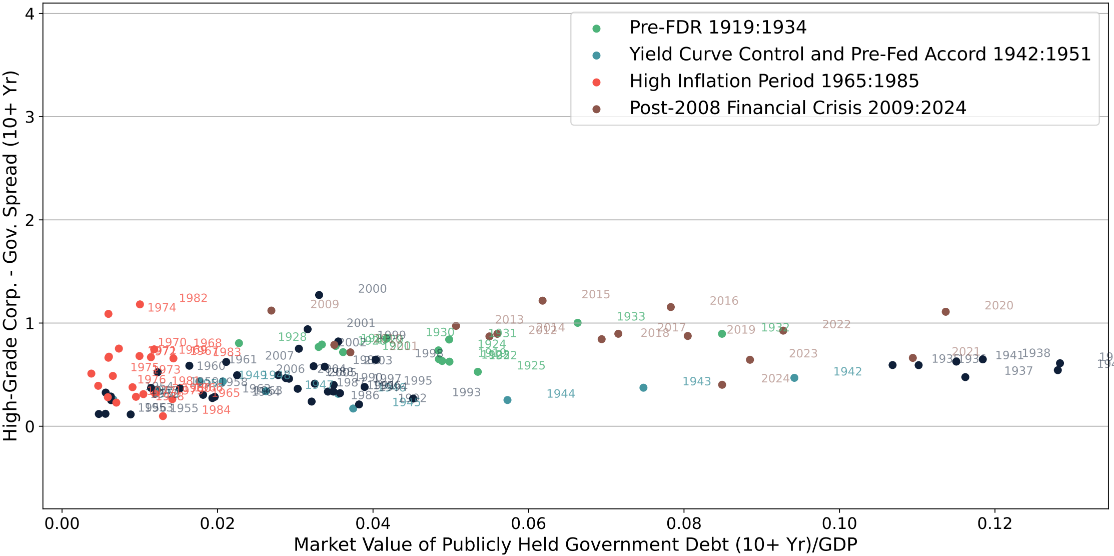
Comovement with Debt-to-GDP



Comovement with Debt-to-GDP ... Only at the Short End



Comovement with Debt-to-GDP . . . Only at the Short End



What Accounts For Changes in $\chi_t^{(j)}$?

Asset Pricing Model For The Funding Spread

- Let $\xi_{t,t+1}$ be the pricing kernel for corporate bonds satisfying the dynamic recursion:

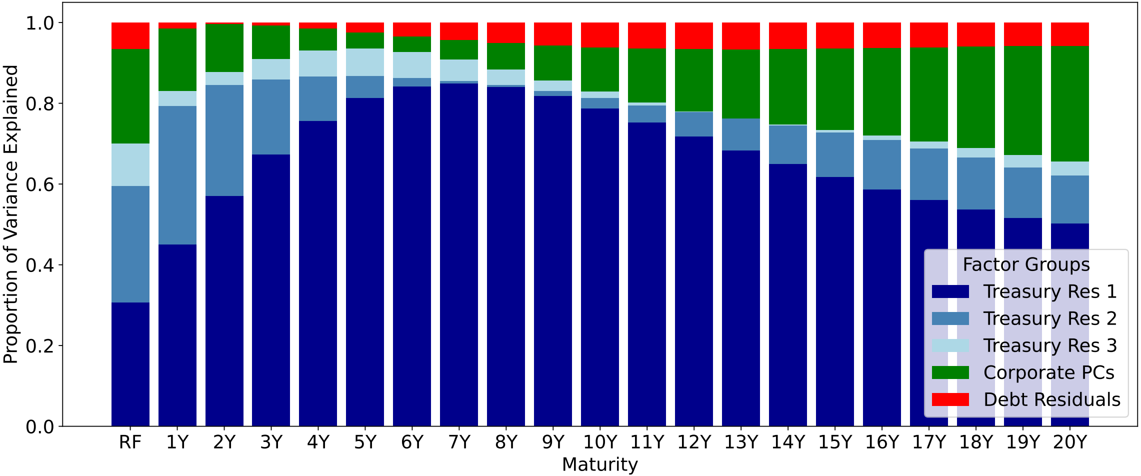
$$\tilde{q}_t^{(j)} = \mathbb{E}_t \left[\xi_{t,t+1} \tilde{q}_{t+1}^{(j-1)} \right], \quad j \geq 1, \quad \tilde{q}_t^{(0)} = 1$$

- Let $\Omega_{t,t+1}^{(j-1)}$ be the non-pecuniary component required to price j-maturity treasuries:

$$q_t^{(j)} = \mathbb{E}_t \left[\xi_{t,t+1} \Omega_{t,t+1}^{(j-1)} q_{t+1}^{(j-1)} \right], \quad j \geq 1, \quad q_t^{(0)} = 1$$

- Exponential Affine Model of $\xi_{t,t+1}$ and $\Omega_{t,t+1}^{(j)}$ with a state space $X_t := [\widetilde{x}_t, b_t, x_t]$:
  - $\widetilde{x}_t$ = Principal components spanning the corporate yield curves,
  - b_t = Principal components of the Treasury's *promised cash-flow matrix* relative to GDP
  - x_t = Residualised principal components of the Treasury yield curves

Treasury Risk Factors Explain a Lot of The Variance in The Spread



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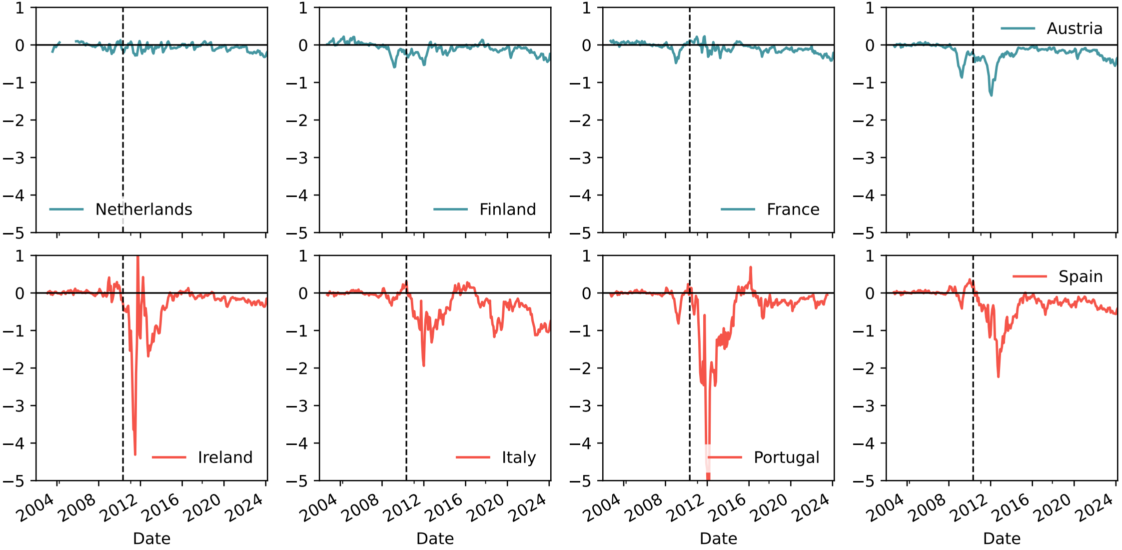
Eurozone Evidence

- The historical US data provides a comparison across very different regulatory eras.
- However, it is difficult to isolate changes in the role of government debt from changes in the risk on government debt.
- For the modern period, we can use data from credit default swaps (CDS) to approximate risk-adjusted convenience yields.
- We follow Jiang et al. (2020) and do this for European countries during the Eurozone crisis (2009-15).
- This allows us to study a second important prediction of our model: increases in the likelihood of government default erode the risk-adjusted convenience yield.

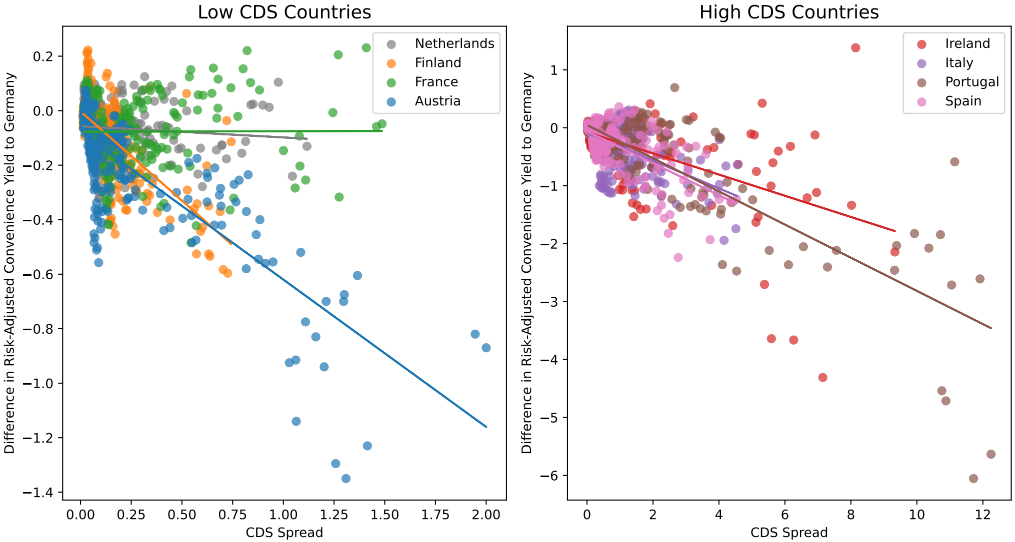
Context on European Regulatory Restrictions

- Before 2005, the ECB decided collateral terms using a private discretionary rating system.
- In 2005, the ECB moved to a market based criteria that linked the collateral value to a combination of the credit ratings from different agencies.
- However, the ECB announced a waver for Greek debt (April 2010) and subsequently other countries (Ireland, Portgual, Spain, Italy).
- This meant that all Eurozone debt maintained its special regulatory role.

Difference in Risk Adjusted Convenience Yields to Germany



High CDS Spread Predicts Low Risk Adjusted Convenience Yield



Lesson:

Fiscal distress predicts low risk-adjusted convenience yields (relative to Germany) during Eurozone crisis.

- *Inconsistent* with models in which the convenience yield comes from a collateral benefit but is unrelated to fiscal policy.
- *Consistent* with our model where real devaluation "shifts" government debt demand down.